

## Assessment of Learning Outcomes in Engineering (ALOE) Final Report, 01 September 2009

### 1. Origin

The focus on Output Standards around the year 2000 and the launch of the UKSPEC in 2004 led to the realisation that measuring learning outcomes objectively could be particularly challenging. The Assessment in Learning Outcomes (ALOE) Working Group (WG) was thus formed with the aim:

“To support the engineering community in developing more appropriate ways of assessing learning outcomes.”

### 2. Membership and process

The Working Group was formed with representatives from:  
The Engineering Professors' Council (EPC)  
The Engineering Council UK (ECUK)  
The Higher Education Academy Engineering Subject Centre (ESC) and  
The QUESTE Project.

Twelve meetings of the Working Group were held between March 2006 and March 2009. A group website was established – [www.aloe.ac.uk](http://www.aloe.ac.uk) .

### 3. Context

The following issues were recognised by members of the group as topical and thus influenced the way the group worked and the activities pursued:

- a. The launch of ECUK UK-SPEC made the study timely and highlighted a need for university programmes to be able to provide evidence of the attainment of learning outcomes for accreditation.
- b. It was thought to be unrealistic to attempt to produce a *single* assessment model. It was thus agreed to address the generic issues of assessment.
- c. Over-assessment of students was recognised as a growing concern leading to excessive student and staff load.
- d. Appropriate and timely feedback was critical to learning, but recent student surveys showed that this was often lacking.
- e. There currently appeared to be an inadequate focus on programme outcomes in favour of module-level outcomes.
- f. It was anticipated that Case Studies would provide the most appropriate learning vehicles.
- g. Dissemination would be via workshops, addressing the needs of various stakeholders.
- h. Programme Leaders in particular complained of being unable to influence holistic course design.

### 4. Activities

The working group:

- a. Established a website to both hold relevant material and to provide links to other useful sites.
- b. Reviewed the ESC Guide to Assessment in Engineering (2005).

- c. Studied other disciplines, particularly Dentistry, Medicine and Veterinary Medicine, to see what lessons could be learned.
- d. Actively engaged with the engineering professional bodies.
- e. Explored the Euro dimension via engagement with the QUESTE project.
- f. Produced definitions of the Key Terms widely being employed in assessment.
- g. Produced a PowerPoint Presentation summarising the work of the group.
- h. Contributed to the Engineering Subject Centre 'Engage' Project.
- i. Acted as the Advisory Group for the JISC-funded 'EASIMAP' Project.

## **5. Planned activities**

The group initially planned a series of meetings to gather the views from the identified key stakeholders. These were followed by national workshops for programme leaders. On reflection from these initial meetings the group recognized the significance of the influence of a university's own quality assurance system on departmental change and moved to a local programme of support.

It was planned that the activities of the group should culminate in a European Conference which would aim to present case studies and encourage the sharing of good practice in assessing the achievement of learning outcomes in engineering.

## **6. Conference Outcomes**

Over 50 delegates attended from across Europe with keynote presentations given by Liz McDowell, Assessment for Learning Centre for Excellence in Teaching and Learning, Northumbria University, Mona Dahms UCPBL, Aalborg University, Richard Wynne, IMechE and J L Horner, Loughborough University.

The delegates had predominately academic backgrounds and this was reflected in the feedback comments received.

On reflection, the driver for those from outside the UK to attend was the need to develop qualification frameworks under Bologna in which 'Learning Outcomes' need to be articulated. The feedback was very rich and thoughtful and many of those attending concurred with the group members view that the articulation of Learning Outcomes is still a learning curve for many. Those attending were hoping to achieve "a clearer perspective on learning outcomes", gain an "understanding of current issues regarding learning outcomes" and "to learn from other people's experiences of course development".

Several delegates were motivated to attend by upcoming validations and were looking for "practical" information or examples of how others had embedded or implemented learning outcomes into programmes, and "mapping UK-SPEC to course outcomes". Some were looking for "new ideas" or "answers on how to assess LO's" and many planned to feedback to colleagues in their own institutions. A number of delegates spoke of organising their own events in the Spring of 2009 and there may be opportunities for members of the ALOE WG to be involved with these although no invitations have been received to date.

The presentations and discussions helped to reassure many that "everyone else struggles too" and that many issues were "widespread" including "the lack of

independent learning capacity of students". Others were inspired by the "examples of good practice" and, in the light of these, felt that they were "probably doing a much better job than we thought we were".

At the end of the conference delegates were asked to reflect on which question(s) remained. These included: "General assessment of LO's", "How many LO's per unit/module are necessary?" and "Linking assessment to feedback in a formative and efficient way". Curriculum design issues were also raised: "Exactly who should be responsible for formulating the LOs?"

Concerns from the UK delegates were raised from their personal experiences of the accreditation process, about the "expectations" of Professional Engineering Institutions being too content driven in engineering programmes. Issues regarding academic levels and confusion between understanding and competence were also raised. The need for additional staff development surfaced with one delegate asking "How are academics best inducted/trained in the application of UK-SPEC learning outcomes in their work?"

Some delegates had specific queries, for example regarding learning outcomes and Enquiry Based Learning (EBL) and whether you "end up with different learning outcomes for different students". The question of "threshold levels" was raised with the suggestion being made that defining and meeting such levels could lead to a lowering of the overall programme standards. It could also fail to motivate and inspire the most able students. Identifying the "most appropriate assessment strategy" was also discussed together with the use of portfolios and whether approaches such as these are limited by "class size?"

## **7. Revision of the Guide to Assessment in Engineering**

In June 2005 the Engineering Subject Centre published a guide to The Assessment of Learning Outcomes. Originally used to support a series of workshops for Programme Leaders, this resource has been well received over the last 4 years and considers programme design and constructive alignment to support the assessment of learning outcomes. In June 2008 a revised version was published to reflect the publication of the revised QAA Benchmark Statement for Engineering<sup>1</sup>, and the publication of the National Qualifications Framework level descriptors<sup>2</sup> for England.

The National Student Survey has also raised a number of issues concerning assessment including engineering student dissatisfaction with feedback. The ALOE WG have suggested a new format for the Guide, restructuring it into three sections:

- Part 1) based on the current guide,
- Part 2) focussing on holistic approaches to curriculum design, and
- Part 3) looking at assessment practices.

## **8. Conclusions and Reflections**

The Working Group concluded that:

- a. The engineering discipline seems to have embraced the use of learning outcomes more readily than other subject areas.

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<sup>1</sup> <http://www.qaa.ac.uk/academicinfrastructure/benchmark/statements/Engineering06.pdf>

<sup>2</sup> [http://www.qca.org.uk/libraryAssets/media/qca\\_05\\_2242\\_level\\_descriptors.pdf](http://www.qca.org.uk/libraryAssets/media/qca_05_2242_level_descriptors.pdf)

- b. Developing assessment tools is still seen as a 'learning curve' by many engineering staff in HE. "It's reassuring to find that everyone else struggles too" was a telling observation made many times by different stakeholders throughout the course of the study.
- c. There is confusion over the meaning of a number of key terms used in this field. The list of definitions established by the group was well received when used in the workshops.
- d. Over-assessment remains a concern for both staff and students. Do *all* modules *really* have to be assessed? 'Mark-free areas' could encourage more innovation among both students and staff.
- e. There needs to be a return to the use of Blooms Taxonomy as assessment methods designed for lower level tasks are not well suited to higher levels of understanding.
- f. The most appropriate route to achieving a learning outcome may differ widely between students and a range of opportunities which allow all students to demonstrate evidence of attainment should be explored.
- g. There continues to be excessive focus on assessing the outcome of individual modules rather than the overall programme outcomes. This unsatisfactory situation demonstrates the lack of influence of many Programme Leaders on university-imposed systems.
- h. The tendency to reduce formative and increase summative assessment in engineering HE as teaching loads increase means that appropriate and timely feedback to students is not occurring. This has been confirmed in the recent National Union of Students survey.
- i. Group working has demonstrable benefits, and methods now exist to realistically assess the contribution of individual students. Discussion at the conference indicated that 'self-selection' can help avoid the 'passenger' problem.
- j. Excessively rigid university regulations can be an impediment to the development of creative assessment regimes.
- k. There remains a perception that some Professional Engineering Institutions in the UK are too 'content driven' when reviewing programmes for accreditation. This perception – whether true or not - can stifle innovation in assessment.
- l. There are lessons that can be learned from other disciplines such as medicine in terms of focusing on assessing strictly *only* that which is required as a learning outcome.
- m. The Engineering Subject Centre Guide to Assessment remains a key source of information.

The Working Group also reflected that:

- n. The general disappointment that students are not "independent learners" is not confined to the UK. It appears to be of equal concern within Europe and Scandinavia.

## 9. Recommendations

The Working Group recommends that:

- a. The definition of key terms used in the Assessment of Learning Outcomes written by the group should be widely distributed.
- b. Assessment needs to be monitored across all programmes to ensure that *over* assessment is not taking place to the detriment of both students and staff.
- c. The use of Blooms Taxonomy should be encouraged to help match the nature of the assessment to the level of understanding.

- d. More work needs to be carried out to explore the 'scalability' of a number of approaches to learning and assessment.
- e. Programme Leaders need to be empowered to override the demands of Module Leaders if assessment at programme level is to be established.
- f. A proper balance should be struck between formative and summative assessment with the former remaining an important learning vehicle.
- g. Group working among students needs to be encouraged and the resulting assessment challenges not used to deter creative ideas.
- h. Programme Regulations need to be reviewed on a regular basis to avoid restricting the development of innovative approaches to assessment.
- i. Professional Engineering Institutions need to dispel the idea that accreditation is 'content driven' thus avoiding stifling innovation in assessment.
- j. The developments in other disciplines such as medicine should be monitored with regard to assessing only that which needs to be assessed.
- k. The Engineering Subject Centre Guide to Assessment should be further revised in the light of this study.

## **Appendices**

- 1. Workshop topics and dates.
- 2. Conference details.
- 3. Key stakeholder groups.
- 4. 'Engage' Project summary.
- 5. 'EASIMAP' Project summary.
- 6. Definition of key terms.
- 7. AaeE Conference paper
- 8. Group PowerPoint Presentation.

FJM/LW 03/08/09

## **Appendix 1 - Workshop topics and dates.**

### **Thursday 26 October 2006 - Assessment of Learning Outcomes – Lessons learnt**

Programme included sessions on: Sharing Experiences, Defining learning outcomes and Sharing experiences of Accreditation

### **Assessment of Learning Outcomes – Towards Level descriptors for Engineering workshop, Monday 25 June 2007**

Attended by members of the group, engineering academics and one Professional Engineering Institution staff member.

Sessions included: defining key terms used in programme documentation and design, NICATS level descriptors and generic vs engineering level descriptors. Copies of the following reference guides were made available:

*Higher Education in Wales Credit Specification & Guidance*, available from:  
[http://www.elwa.ac.uk/doc\\_bin/Credit%20Framework/credit\\_specification\\_guidance\\_100604.pdf](http://www.elwa.ac.uk/doc_bin/Credit%20Framework/credit_specification_guidance_100604.pdf)

*National Qualifications Framework – Level Descriptors*, available from:  
[http://www.qca.org.uk/libraryAssets/media/qca\\_05\\_2242\\_level\\_descriptors.pdf](http://www.qca.org.uk/libraryAssets/media/qca_05_2242_level_descriptors.pdf)

*Academic Infrastructure*, available from:  
<http://www.qaa.ac.uk/academicinfrastructure/FHEQ/EWNI/default.asp>

### **Comments and Outcomes**

Attendees felt that evaluators of programmes currently looked for a hierarchy of level of study throughout a programme. Level descriptors would be useful for agreeing level of final year of study and particularly useful at MSc level.

Engineering version – attendees raised the question, is there a need for yet another set? It was felt that NICATS or equivalent were sufficient as reference documents. It was suggested that a guidance document outlining progression from level 4 and how to reference level descriptors would be valuable.

It was suggested that training and advice on the assessment of learning outcomes and using level descriptors may be needed by industry representatives on accreditation panels.

It was felt that it would be useful for the group to produce a glossary of terms (based on the terms presented in the group exercise) to aid shared understandings during accreditation visits.

### **Workshop for Programme Leaders**

CEEBL, The University of Manchester  
Thursday 13 September 2007

Programme included sessions on: getting the language right, Design for assessment using the UK-SPEC, the key influences on programme design (including managing change) and the EASIMAP tool.

The day included valuable discussions for those present although lower than expected numbers attended. The discussions led to a better understanding of levels and confidence in the explanations for the future.

**IMechE Degree Accreditation Workshop, 3 October 2007**

A very well received event with excellent engagement with the delegates (who were all members of the IMechE accreditation panels).

**EAB Accreditors training day 13 September 2008**

**The assessment of learning outcomes in engineering International Conference 2008,**

27 November 2008

**ICE Further Learning Day 16 December 2008**

**Engineering Subject Centre Workshops for departments**

*Supporting departmental and programme teams with level descriptors and learning outcomes.*

NEWI, 19 May 2006

Sheffield University, 24 January 2007

Northumbria University, November 2007

Nottingham University, December 2008

## Appendix 2

### The Assessment of Learning Outcomes in Engineering International Conference 2008

#### Programme

10.00 – 10.30	<b>Registration and Coffee</b>	
10.30 – 10.45	<b>Welcome and Introduction</b> <i>Richard Shearman, ECUK</i>	
10.45- 11.15	<b>Making learning outcomes work for learning</b> <i>Liz McDowell, Director, Centre for Excellence in Assessment for learning (CETL AfL), Northumbria University</i> Specifying learning outcomes and accurately measuring student performance against them does not in itself promote good learning. However, learning outcomes can be made to work for learning. Some suggestions on how to do this will be drawn from the research and development programme of the CETL Assessment for Learning.	
11.15 - 12.30	<b>The Assessment of Learning Outcomes in Engineering perspectives</b> An International perspective - Mona Dahms, Aalborg University Professional Institution perspective – Richard Wynne, IMechE A programme leader perspective – Jane Horner, Loughborough University	
12.30 – 13.00	<b>Panel session,</b> <b>Chair Professor Fred Maillardet, EPC</b>	
13.00 – 14.00	<b>Lunch</b>	
14.00 – 15.00	<b>Parallel sessions with Case studies presentations and discussions</b>  <b>Assessment</b> <b>Chaired by Roger Penlington, AfL CETL</b> Assessment of Engineering UK-SPEC Transferable Skills Learning Outcomes on a BEng Engineering Distance Learning Degree <i>Keith McGraw, The Open University</i> Promoting student learning: the use of portfolios in the assessment of learning outcomes <i>Lloyd Scott, Dublin Institute of Technology</i>	<b>Curriculum Design and delivery</b> <b>Chaired by Ivan Moore, CPLA, Sheffield Hallam University</b> Team approaches to curriculum design and delivery <i>Anthony Rossiter, University of Sheffield</i> Mapping and assessing learning outcomes online: EASIMAP <i>John Dickens, the Engineering Subject Centre</i>
15.00 – 15.15	<b>Afternoon tea</b>	
15.15 – 15.45	<b>Plenary Session, chaired by Professor John Dickens the Engineering Subject Centre</b> Summary from parallel sessions and overview of the day.	

### Appendix 3: Key stakeholder groups.

Category	Within the university	Outside the university
Management and leadership	Deans, Heads of Schools, Heads of Departments Programme leaders, Course leaders.	SSCs, EPC, EC
Education Development	Learning and Teaching Co-ordinators (faculty or school), Educational or staff developers	Engineering Subject Centre, Engineering Subject Centre Associates
Education	Teaching staff	External examiners
Quality	Uni QA officers, chairs of local quality committees, standing panels etc.	QAA staff QAA-appointed validation panels, working groups etc.
Accreditors and (output) validators	Accreditation team leaders, programme leaders, course leaders	Prof bodies, Accreditation Teams, SSCs
Recipients	Students	Employers

#### Note:

- 1 some constituents may appear in more than one category
- 2 students are not target stake-holders, but represent a body of stake-holders from whom views and perspectives may be sought. They may also help with delivery
- 3 employers are recipients in that they are the 'beneficiaries' of the programmes. They may also help with interpretation and standards.

## Appendix 4 - 'Engage' Project summary

### Executive Summary

In recent years the UK government has been providing funding through the Higher Education Funding Council for England (HEFCE) to drive forward employer engagement processes between Higher Education (HE) and business. This has followed from the Leitch Review in 2006 that proposed a radical vision for 40% of UK adults attaining a university-level qualification by 2020. The reasons for this have been to promote economic growth and maximise productivity, so that the UK can be increasingly globally-competitive at a time when, at a national level, there will be fewer 18-year olds to populate both HE and industry. The government would like to see a proportion of HE being funded by demand-led mechanisms and wants greater numbers of more employable graduates being produced, particularly within key areas such as science, technology, engineering and mathematics (the STEM disciplines). To satisfy this need, many of these future graduates will have to come from the existing workforce and the process would increase their higher-level skills. Industry in the UK already spends a great deal on training its workforce and HE could work towards capturing a proportion of that market.

The employer engagement agenda has particular significance for engineering as a recent report has indicated that UK industry expects an increasing shortage of high-quality engineers over the next decade. If HE cannot address this shortage, then industry may have to attract talent from overseas. Currently, the engineering HE community does not have the capacity, or incentives, to deliver courses linked to employer needs, nor does it fully appreciate learning gained in the workplace.

The Engineering Subject Centre is one of 24 discipline-specific Centres established by the Higher Education Academy (HEA) to support teaching and learning. The Centre had already set up a network to support collaborative work between HE, Sector Skills Councils (SSCs), Professional Engineering Institutions and other stakeholders and thus was well placed, along with the Subject Centres for Materials and Physical Sciences, to run a one-year employer engagement project funded by the HEA. The purpose of the funding was to enable the building of longer term strategic relationships with SSCs and to support HE institutions' response to identified workforce development needs by developing discipline-specific practice. The 'Engage' project, *Facilitating Dialogue between Employers and Engineering, Physical Sciences and Materials Academics in Higher Education*, started in February 2007 and culminated in a one-day conference in January 2008. This was attended by over 80 delegates and the key findings from the day are reported here, along with links to speaker biographies, presentations, videos and reported discussions.

The project process involved an initial facilitated partnership meeting that identified key priorities and defined the remit for four working groups:

1. Work-based learning;
2. Levers and enablers;
3. Management of change;
4. Building partnerships.

The working groups had a nine-month timeframe to set their own directions, define their own goals, expand their membership as necessary, and deliver useful outputs. This report describes the activities of these four working groups and highlights the range of valuable resources developed, including case studies, university contact lists, a 'mind-mapped' journey of an employee through a WBL programme and an acronym buster. A second facilitated partners' meeting drew the outcomes from these working groups together and derived a series of observations and conclusions.

Overall, the Engage project has made a successful start in bringing together key partners to address the skills agenda in engineering and physical sciences. Opportunities are needed for partners in this agenda to continue to meet so that shared understanding can be translated into positive action.

Full Report available from <http://www.engsc.ac.uk/downloads/engage-report-final.pdf>

## Appendix 5 EASIMAP Project Summary

### 1. Project description

The primary aim of this project was to define, design, develop and pilot an online electronic tool (EASIMAP) that would:

- Enable academics to map programme/module/assignment intended learning outcomes to the QAA Benchmark Statement for Engineering based on the UK-SPEC
- Provide programme designers/leaders with an assessment matrix to demonstrate coverage of intended learning outcomes across a programme for internal review, external accreditation, institutional quality assurance etc.
- Capture, record, evidence, and demonstrate the assessment/achievement of learning outcomes at programme/module/assignment level
- Enable students to record and evidence the attainment of learning outcomes and assessment feedback within their PDP/e-Portfolio records, to aid the processes of evidencing competence, reflecting upon progress and planning personal and academic development

An online tool has been designed and developed which facilitates the mapping process outlined above and which could be used to capture, record and evidence the assessment and achievement of learning outcomes. The tool has been piloted with a small number of institutions, with the feedback received leading to further enhancements of the tool which are currently being undertaken. However, for a variety of reasons, the piloting was not as thorough as proposed and consequently the opportunity of testing transfer of real data to students' PDP/e-Portfolio records was not fully explored.

On reflection, it is clear that the main rationale for our piloting partners to become engaged in the project was to assess the suitability of the tool in mapping learning outcomes. As a result their focus tended to be on the process of mapping learning outcomes. Furthermore, the scale of the project being undertaken was such that the stated aims/objectives were more compatible with a longer-term project. The exchange of experiences and ideas undertaken as part of the design process to create a flowchart demonstrating the linkages between the UK-SPEC, the programme, modules and assessment has been of great assistance in helping the project's management team and Advisory Group to clarify many of the issues involved. This has been and will continue to be of great benefit in enabling those involved in the project to offer clear and informed advice on designing programmes of study in line with the UK-SPEC and in demonstrating the linkages in question.

The EASIMAP Tool (<http://easimap.lboro.ac.uk>) is available online with further information available through the Engineering Subject Centre website. Since the launch of the tool at the ALOE conference in November 2008 an additional 8 institutions have requested usernames and passwords to access the tool and the Engineering Subject Centre is in the process of commissioning a video demonstration of the tool's key features to help new users.

Some of the academics who have tested/piloted the tool have identified a number of key potential benefits arising from the work of the project. These include the potential to:

- Provide greater alignment in terms of the planning, design, management, delivery, monitoring and evaluation of degree programmes (within the Engineering disciplines initially but potentially beyond)
- Foster more effective and informed communication, discussion, and dialogue about the design, delivery and assessment of learning outcomes both within departments/schools/faculties and between departments/schools/faculties (This was highlighted in a comment from one of the academics piloting EASIMAP who enthused how a tool of this nature would significantly enhance dialogue and co-ordination of the design and delivery of programmes with colleagues at the University's overseas campuses in China and Malaysia)
- Enable assessment criteria to more closely reflect the intended learning outcomes and to identify the over and under-assessment of learning outcomes
- Bring greater transparency and explicitness to programme quality assurance and accreditation processes
- Provide more timely, structured and constructive assessment feedback to students to enhance their reflection upon and planning of academic and personal development

Opportunities to fully realise such benefits have not yet materialised given the limited scope, time and budget available to the project team. To realise these benefits in full will require further work and the Engineering Subject Centre will continue to seek opportunities to bid for additional funding to facilitate this.

### **Key messages**

There have been a number of key lessons that have emerged from this project:

- The first is the difficulty in trying to address such a range of complex processes (mapping learning outcomes, capturing assessment data and feedback, transferring data to students' e-portfolios etc.) within a single monolithic tool. On reflection, it is clear that developing smaller more bespoke tools (one addressing mapping of learning outcomes, another capturing assessment data and feedback etc.), or developing each function of the tool at separate stages, would have been both easier to achieve and more effective to promote
- Secondly, this complexity is further extended by the diversity of practice that we found. For instance, each programme leader that we spoke to had a different method/template for mapping learning outcomes across a programme and expected that the EASIMAP Tool would accommodate their existing practice. Developing tools that can accommodate such diversity must be a key consideration. (This lesson was presented in relation to the difficulty of developing a tool for all seasons. There is also the more general message that, despite major advances in relation to frameworks, practice is still astonishingly varied)
- Thirdly, we experienced some difficulty in recruiting suitable academic staff prepared to pilot the EASIMAP Tool over an extended period of time, despite the financial support offered to cover part of the costs involved. Some of those that did engage participated in a rather sporadic fashion testing the tool only immediately prior to submission of interim/final reports. On recognising the difficulty that this presented, we recruited at a late stage in the project a further piloting institution and conducted piloting under a more interventionist approach where we spent a whole day with the two academics involved and generated some excellent feedback. On reflection, it is clear that adopting a more proactive, interventionist approach generates far more useful feedback/data than relying on academics to independently find the time around their busy schedules

- Finally, it is clear from our experiences that a keen appreciation of the scale of a project must be had from the outset. The short time on offer to put together at the outset a project proposal did not give us enough time to discuss in detail with those who would provide the technical input to identify clearly what could/would be achievable within the time-frame and budget available.

## Appendix 6: Definition of key terms

### DEFINITIONS of TERMS:

Working document, last updated January 2009

<b>Term:</b>	<b>Definitions</b>
<b>Benchmark statements:</b>	These are a series of discipline specific statements which outline expectations about standards of degrees. They describe the knowledge, understanding, skills and attributes that a graduate on a given degree programme is expected to have demonstrated during the course of the programme. (For Engineering disciplines the benchmark statement reflects the learning outcomes of the UK SPEC.)
<b>Programme specifications:</b>	These set out the aims and objectives of a programme and the means by which they will be achieved. They usually include: a description of the programme; intended learning outcomes; content and structure of the curriculum and teaching and assessment methods.
<b>Programme outcomes:</b>	These are statements of the skills, aptitudes, knowledge and understanding that a student will be able to demonstrate at the end of a programme of study.
<b>Graduate outcomes:</b>	These describe the knowledge, understanding, skills and attributes that a student would be expected to demonstrate on graduation from the undergraduate programme. These may include both discipline and non-discipline related elements.
<b>Intellectual skills:</b>	These are cognitive abilities that involve the application, analysis and synthesis of knowledge and understanding to solve problems, work with ideas, present an argument or make recommendations.
<b>Generic skills:</b>	These are skills which can be transferred and applied across the discipline spectrum. They include (amongst others) communication, applying number, team working and working with others and applying information technology.
<b>Practical skills:</b>	These are the skills required for the practical application of engineering involving appropriate equipment or tools (e.g. measuring properties or testing components) or to design and manufacture a product (e.g. by producing drawings, operating machinery, applying computerised packages etc.)
<b>Levels:</b>	These refer to different stages within a given programme of study. They usually represent a progression in the breadth and complexity of the knowledge base and the degree of independence and intellectual capacity that the student demonstrates in working with the knowledge base.
<b>Level</b>	These are statements which express the level at which a module is

<b>descriptors:</b>	operating and a student is working . They can identify the hierarchy of abilities associated with the intellectual growth and skills students are expected to demonstrate at a given stage of a programme of study.
<b>Modules:</b>	These are discrete units of study (usually focused on a particular theme or topic), each with their own learning outcomes, mode of assessment and credits. Modules form the constituent parts of an overall programme of study.
<b>Learning outcomes:</b>	These are statements of what a learner (student) is expected to know, understand and/or be able to do at the end of a period of learning (e.g. programme, module or discrete activity).
<b>Criteria:</b>	Pre-defined elements of performance used to describe, measure, judge or assess the overall performance. Learning outcomes can be broken down into pre-defined, discrete elements of judgement which are then used to describe, measure judge or assess attainment of the learning outcome.
<b>Threshold:</b>	This is a minimum acceptable performance standard which a student must demonstrate to evidence attainment of a criterion of a learning outcome (the pass/fail point). Standards refer to quality measurements set against internal and external reference points. They may apply to honours classifications, grades or marks used to distinguish between the quality of performance of students in a cohort.
<b>Standards:</b>	These set out the criteria upon which a programme/module is measured for the purpose of ensuring that quality is measured/maintained against internal and external reference points (e.g. university regulations, QAA Benchmark Statements etc).

## Appendix 7 – AaeE paper

### Assessment of Learning Outcomes – Supporting change and the move from input to output standards.

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**Abstract:** *This paper will describe how the Engineering Subject Centre has worked with the Engineering Council UK to support the introduction of an outcomes based model for professional accreditation of engineering degree programmes in the UK. The paper considers how the Engineering Subject Centre with its role as an independent national learning and teaching organisation has brought together a network of key stakeholders to highlight issues and develop appropriate support for changes to programme design, exploring how this model could be adopted to achieve transformative change in other contexts.*

## Introduction

The Higher Education Academy, funded by the four higher education funding councils in the UK and institutional subscriptions, was established in 2004. The Academy's mission is to help institutions, discipline groups and all staff across the UK to provide the best possible learning experience for their students. The Engineering Subject Centre is one of 24 Subject Centres which make up the subject network of the Higher Education Academy. Based in the Faculty of Engineering at Loughborough University, it draws upon the expertise of engineering academics and educationalists from across the higher education sector, and works closely with the leading engineering professional bodies. As the national centre for all engineering academics in the UK, the Engineering Subject Centre delivers subject-based support to promote quality learning and teaching. It achieves this by stimulating the sharing of good practice and innovation, thereby helping engineering academics to contribute to the best possible learning experience for their students.

Through this close involvement with UK based networks and organisations the Centre has been able to offer support in wider curriculum issues such as accreditation of degree programmes, enhancement of the student learning experience and providing representation for the engineering academic community. Collaboration has included working with the Engineering Council UK<sup>3</sup> (ECUK) on the radical review of the standards for registration of Engineers and technicians with the Engineering Subject Centre gathering and collating the academic input to the

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<sup>3</sup> The Engineering Council UK (ECUK) mission is to set and maintain realistic and internationally recognised standards of professional competence and ethics for engineers, technologists and technicians, and to license competent institutions to promote and uphold the standards. Higher education programmes can apply for accreditation from the Qualifications Department of one of the professional body members.

consultation and facilitating dialogue with the Quality Assurance Agency (QAA)<sup>4</sup>, on the revision of the subject benchmark statement for engineering to reflect the changes made.

In the last decade the quality assurance and standards documentation and processes which affect engineering education in the UK have gone through a number of changes. In 2001 the Board of ECUK agreed that the time was right for a substantial review of the whole basis and standards for registration as a professional engineer or technician. The Subject Centre was asked by ECUK to canvass views of engineering academics in Higher Education Institutions as part of the review. Forms were sent to all Heads of Department, and the review was advertised via the Subject Centres electronic mailing lists. Over 120 individual replies were received with approximately 70 Universities represented (around 90 universities offer engineering programmes in the UK) and resulted in the UK Standard for Professional Engineering Competence (UK-SPEC) being drafted in 2003. The more significant change being from a standard based on inputs to one based on graduate outcomes.

The new UK SPEC for the accreditation of higher education programmes was published in May 2004 and following its publication the Engineering Subject Centre, EPC and ECUK approached the QAA to open a dialogue regarding the alignment of the UK SPEC and the QAA Engineering Benchmark Statement. (Previously engineering departments were reviewed by the ECUK against their professional standards and separately by the QAA against their independently developed engineering benchmark statements). On publication of a revised benchmark statement in 2006 the QAA noted that “the approach to the revision of the subject benchmark statement has acknowledged and recognised the evolutionary nature of the output standards for engineering”. QAA 2006

### **Information gathering and facilitating understanding**

The introduction of the UK-SPEC and accreditation of engineering degree programmes based on output standards has raised several issues, in particular how to identify evidence that learning outcomes are being met and at what level. Concerns were raised over the competence of academic departments and accreditation panels to judge the attainment of learning outcomes.

In May 2005 the Engineering Subject Centre, the EPC and ECUK met to establish how those present could further support the engineering community in working with the assessment of learning outcomes. It was agreed that a working group, The Assessment of Learning Outcomes in Engineering (ALOE), would be established to support the engineering community in developing more appropriate ways of assessing learning outcomes and facilitating the sharing of experiences between programme leaders and accreditation teams. Group objectives included producing guidance, exemplars of good practice and the hosting of workshops for the different stakeholders to encourage the exchange and development of ideas.

The group worked on identifying the key stakeholders in the programme design and accreditation process and the various members of the engineering education community whom the group represented. Stakeholders were identified both inside and outside of a university who had a management and leadership, educational development or quality role. In October 2006 the group hosted a workshop to consider the lessons learnt from recent accreditation visits. The event was aimed at those involved in accreditation and provided an opportunity to consult with colleagues

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<sup>4</sup> The Quality Assurance Agency for Higher Education (QAA) was established in 1997 to provide an integrated quality assurance service for UK higher education. The QAA is an independent body funded by subscriptions from universities and colleges of higher education and through contracts with the UK higher education funding bodies.

on the demonstration of learning outcomes and gain feedback and share lessons learnt through recent accreditation visits on identifying evidence. It was also intended that the workshop should provide essential feedback and information which could be used in the design of further support activities for both Institution staff and programme leaders. The interactive sessions were based around a number of key questions; What are learning outcomes? Where is the evidence of the attainment of learning outcomes found? and what resource and support do you and your colleagues need?

The workshop was attended by programme leaders, some of whom were also members of an accreditation team, as well as staff from the professional institutions and members of the working group. The final sessions of the programme facilitated a *Where next?* discussion. A number of suggestions and recommendations were made which identified the need for guidance regarding evidencing attainment including on the use of level descriptors, establishing threshold levels and levels of attainment. Curriculum design issues were discussed including relationships between general learning outcomes and those at programme and module level. The majority of engineering programmes because they existed prior to the learning outcomes approach being adopted, comprised a collection of modules from which programme level outcomes have been derived, a bottom-up approach. There were a limited number of instances where new programmes have started by defining programme level outcomes with the curriculum designed to deliver these outcomes, the top down approach.

At the next meeting of the group a plan of activities was drafted which included further opportunities to gather the views from the stakeholders identified and establishing a programme of support activities for programme leaders and members of accreditation teams. The Engineering Subject Centre has no regulatory or quality assurance role in UK HE, it is a support centre and this allowed us to lead on workshops and produce resources to offer guidance to engineering academics. The UK SPEC allows universities to develop programmes which utilise the strengths of the individual faculties and therefore ECUK felt it was important to be able to offer guidance and exemplars of how the standard could inform curriculum design rather than prescribe details.

### **Supporting change and network building**

The group's approach to their work mirrors what Roche (2003) in "*being an agent of change*" identifies as a framework for inquiry and key to informative change:

Inquiry 1: Stakeholder analysis stage 1 – Who are the people?

Inquiry 2: Stakeholder analysis – what are stakeholder values, aspirations and needs and what is the fit between expectations and the current situation?

Inquiry 3: What do people interpret as the development issues requiring attention and what is their vision for the future?

Inquiry 4: Where is the leverage for change?

Inquiry 5: What has been learnt for programme design and/or change direction from the exploration?

The organisations which make up the working group themselves represent those who have key roles to play in the process, namely programme leaders and Heads of Department (through the EPC) and the professional bodies (through ECUK). The Subject Centre's strong knowledge brokerage role supports the dissemination of the findings and resources beyond the members. The group has organised opportunities to develop its understanding of the stakeholders values and needs and is now

developing an appropriate programme of activities to support changes need to curriculum design and assessment.

Key findings from initial stakeholder workshops included identifying a need to improve understandings of level descriptors and establishing threshold levels of attainment to ensure consistency of assessment across programmes. Hounsell (1994) discusses the much needed shift in universities from a managing change process which focuses on “*winning the consent of all staff*” to “*assisting them in deploying knowledge and skills needed to make that policy a reality*”. The opportunity to attend 2 day workshops were offered to programme leaders aimed at developing curriculum design to support the assessment of learning outcomes. One day workshops were also offered on writing and using level descriptors. In the case presented here the leverage for change within engineering departments is the desire to gain accreditation for degree programmes. However accreditation visits happen on average, every 5 years and this affects how strong the leverage for change may be within a particular department each year. Also as mentioned previously the UK SPEC allows the development of unique programmes at each university and each university develops its own quality assurance regulations to which engineering academics must respond. Although national workshops were popular when UKSPEC was first launched as more people became familiar with the documentation the approach to support has also had to change. More recently workshops have been developed with faculty or department learning and teaching teams to target specific elements of programme design which they are looking to develop. With this more targeted approach the group is able to respond to what is interpreted as a development issue and to facilitate learning amongst the target stakeholder group. It was also apparent that there was a need to support accreditation teams as well as academics in universities. Having ECUK as members of the working group created the opportunity for the Subject Centre to contribute to training sessions offered to members of accreditation teams by the professional institutions. This provided the opportunity to help to improve understandings amongst all members of the panel including those outside programme development teams.

Ford et al (1996) identify four key stages in the process of managing change; Direction, Organisation, Process and Infrastructure. In the case highlighted in this paper the working group was key in establishing direction (following the stakeholder analysis) and organisation (assessing the relationships which need to be maintained). The Subject Centre played a key role in providing the infrastructure to support the processes which needed to be in place (such as workshops and guidelines) and to support the working group itself.

A call for case studies aims to capture good practice in the assessment of individuals in groups, assessing creativity in design and the assessment of sustainable design. Through the ECUK and members of the working group who serve on accreditation panels examples of how UK – SPEC is informing curriculum design are being identified. The group continues to support changes and practices in curriculum design and the assessment of learning outcomes and will showcase the developments in the UK through the ALOE International Conference November 2008.

### **In Summary**

Through actively networking with key national organisations and professional bodies it has been possible to have an impact on the procedures and processes related to engineering programme review. There is now a single unified standard for engineering honours degree programmes and following a review of the institutional audit process in the UK. Engineering is the first subject area where the QAA has adopted the professional standards for the discipline and this approach has

subsequently been adopted in other subject areas. As well as reducing the evidence burden placed on academic departments, these reviews have highlighted the need and provided the motivators for engagement with a programme of activities developed to support the implementation of the new standards. Hounsell (1994), for example, highlights that *“Using staff development programmes to address organizational needs of this kind is therefore a tool in the management of change which universities will find increasingly hard to do without”*. In this case the Engineering Subject Centre has been the vehicle through which to raise awareness and improve understandings of good practice in programme design and assessment which will in turn enhance the learning experience of engineering students in the UK.

The opportunity to have these discussions we would not consider is unique to the UK. The professional accreditation process has provided a key lever for programme teams to prioritise the change agenda and an organisation like the Subject Centre has been able to supply the infrastructure needed to meet the staff development requirements of both the academic programme and accreditation teams. The provision of professional development activities which provide an overview of programme design methods will also help those involved be better able to respond to change drivers in the future.

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## **Appendix 8 – Group PowerPoint Presentation**

Available to download from [www.aloe.ac.uk](http://www.aloe.ac.uk)