Accreditation of Higher Education Programmes Edition 4 – Evolution or Revolution?

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Introduction

This paper discusses the significant changes that have been made to Accreditation of Higher Education Programmes (AHEP) following the review that concluded in 2020. AHEP is the handbook for academic accreditation of degree programmes by Professional Engineering Institutions (PEIs) licensed by the Engineering Council to carry out this activity and was adopted by QAA as the Engineering Subject Benchmark from 2006. It is a key reference point for employers, higher education providers and PEIs. AHEP was first published by the Engineering Council in 2004. The latest version of the standard is AHEP Edition 4.

AHEP supports the UK Standard for Professional Engineering Competence (UK-SPEC), first published by the Engineering Council in in 2003. UK-SPEC defines professional standards for registration as a Chartered Engineer (CEng), Incorporated Engineering (IEng) or Engineering Technician (EngTech). AHEP defines the academic standards for degree programmes that provide the underpinning knowledge and understanding for professional registration, and also the requirements and process for academic accreditation.

Engineering Council standards, including UK-SPEC and AHEP, are regularly reviewed to ensure they remain fit-for-purpose and reflect the evolving needs of the engineering profession in the UK and internationally. AHEP Edition 3 was published in May 2014, with all accredited degrees expected to align with the revised standard from September 2016.

The latest review of AHEP took place from 2019 to 2020. The revised standard, AHEP Edition 4, was launched in August 2020 and will be implemented by 31 December 2021. The review included extensive consultation with stakeholders through surveys and workshop sessions, and the review working group had membership drawn from industry and higher education with considerable experience of academic accreditation across a range of engineering disciplines.

There are some important changes between Edition 3 and Edition 4 and this paper will examine the changes to the coverage of the standard, its relationship to international accords, the accreditation process and the learning outcomes for an accredited degree.

Degree Types

AHEP expresses the expected learning from an accredited degree through a set of learning outcomes for each of the main degree types that can be accredited. For the first time in AHEP Edition 4, learning outcomes are defined for Foundation degrees and equivalent qualifications. These qualifications had been accredited previously, typically alongside a top-up Bachelors or Bachelors (Hons) degree, or using a subset of the learning outcomes for an IEng accredited programme. For completeness, and to provide an equivalent approach to CEng accredited programmes, learning outcomes are also expressed for the top-up degree needed to achieve the full academic base for IEng registration.

The accreditation of Doctoral programmes, while considered in Edition 3, is now fully assimilated into the standard. To facilitate application of the standard internationally, all qualifications that can be accredited are referenced to the International Standard Classification of Education (ISCED 2011). Degree awards for all nations in the United Kingdom are mapped to ISCED 2011 so this approach is inclusive and ensures the

continued alignment of the standard to qualifications frameworks in England, Scotland, Wales and Northern Ireland.

A comparison of the degree types covered in AHEP Edition 3 and Edition 4 is shown in Table 1, along with ISCED 2011 qualification levels.

	Qualification	ISCED 2011 Level	AHEP3	AHEP4
Incorporated Engineer	Foundation degrees and equivalent qualifications accredited as partially meeting the underpinning knowledge and understanding requirement for IEng registration	5		✓
	Bachelors and Bachelors (Honours) degrees accredited as meeting in full the underpinning knowledge and understanding requirement for IEng registration	6	✓	✓
	Bachelors Top-up Degrees accredited as meeting the requirement for Further Learning for IEng registration	6		✓
Chartered Engineer	Bachelors (Honours) degrees accredited as partially meeting the underpinning knowledge and understanding requirement for CEng registration	6	✓	✓
	Integrated Masters (e.g. MEng) degrees accredited as meeting in full the underpinning knowledge and understanding requirement for CEng registration	7	✓	✓
	Other Masters degrees accredited as meeting the further learning requirement for the underpinning knowledge and understanding requirement for CEng registration	7	✓	✓
	Doctoral programmes accredited as meeting the further learning requirement for the underpinning knowledge and understanding requirement for CEng registration	8	✓	✓

Table 1: A comparison of degree types – AHEP Edition 3 and 4

International Accords

The United Kingdom, through the Engineering Council, is a signatory of major international agreements that provide for mutual recognition of engineering degree programmes as the basis for professional registration and practice. The agreements relevant to AHEP are:

- Washington Accord
- Sydney Accord
- EUR-ACE® System

The Washington and Sydney accords are international agreements between jurisdictional agencies responsible for accreditation of engineering degree programmes. Membership (being a signatory of an accord) is voluntary, but the signatories agree to recognise the 'substantial equivalence' of degree programmes accredited within the jurisdiction of any signatory. The accords support the mobility of engineering practitioners and commit signatories to the development and recognition of good practice in engineering education. Mutual recognition of degree programmes is achieved through a peer review process at the time of admission as a signatory and periodically thereafter. This process ensures the academic standards required for accreditation by each signatory are 'substantially

equivalent' and also verifies the accreditation process employed within the jurisdiction. Academic standards for each accord are expressed through a set of graduate attributes.

The Washington and Sydney accords (along with the Dublin Accord) are constituents of the International Engineering Alliance (IEA), a global not-for-profit organisation that seeks to improve engineering education and competence globally across the whole spectrum of engineering.

The Washington Accord, first signed in 1989 by six founding members, currently has 20 signatories and is concerned with the mutual recognition of degree programmes that provide the academic preparation for professional engineers (equivalent to Chartered Engineer registration in the UK). The Sydney Accord, first signed in 2001 by seven founding members, provides for mutual recognition of degree programmes for engineering technologists (equivalent to Incorporated Engineer registration in the UK). The Sydney Accord now has eleven signatories. The Dublin Accord, while not relevant for AHEP, is concerned with the educational base for engineering technicians.

Concerns have been expressed in recent years about the position of UK engineering degrees in relation to the Washington Accord. The Engineering Council chose to certify only the MEng degree against the Washington Accord standard, while some other signatories, for example Engineers Australia, nominated their Bachelor of Engineering degree. This leads to unhelpful international comparisons for the MEng and means that graduates holding an accredited UK Bachelor of Engineering degree do not enjoy the benefits conferred by recognition of their qualification under the Washington Accord.

To assist efforts to secure recognition for the UK Bachelor of Engineering degree, along with the MEng, under Washington Accord, the latest review of AHEP has demonstrably positioned the learning outcomes for the Bachelors (Honours) degree accredited as partially meeting the academic requirements for CEng registration against the Washington Accord standard. Furthermore, the postgraduate learning required for the award of an MEng degree accredited for full CEng registration has been clearly articulated.

The EUR-ACE® system, administered by the European Network for Accreditation of Engineering Education (ENAEE), provides a quality label for engineering degree programmes at Bachelors and Masters level. The Engineering Council is authorised to award the EUR-ACE® label to degree programmes accredited within its jurisdiction and AHEP Edition 4 maintains alignment with the standards and guidance for accreditation of engineering degree programmes set out in the EUR-ACE® Framework Standards and Guidance (EAFSG). Alignment with the EAFSG learning outcomes has been maintained for Bachelors (Honours), again with additional learning evident for MEng.

Accreditation Process

The Engineering Council has licensed some 35 Professional Engineering Institutions (PEIs) to accredit degree programmes. This approach, while affording some choice for higher education providers, means that many are working with several PEIs who may have different policies and procedures for academic accreditation. Accreditation is not mandatory and the workload involved in preparing for an accreditation visit is considerable. In an attempt to reduce differences in practice between PEIs, the expected evidence base for an accreditation visit has been defined:

- *Programme specification or equivalent showing programme aims, learning outcomes and curriculum structure*
- *A mapping or explanation showing where and how each AHEP learning outcome is assessed within the programme*

- *For each unit or module that contributes to the achievement of AHEP learning outcomes:*
    - *the unit or module specification*
    - *examination papers and coursework assessments with marking schemes/guides*
    - *samples of marked student work covering the full range of student achievement*
- *Where programmes include major projects:*
    - *student project handbook(s)*
    - *a representative sample of project reports*
    - *the completed marking scheme or feedback sheet for each project*
- *Information about industry involvement in programme design and delivery*
- *Information about student and staffing numbers, outline CVs for all staff who teach on the programme to show their highest academic qualifications and teaching qualifications*
- *Information about specialist practical facilities used by students on the programme, if applicable*
- *Information about library resources (print and digital) available to students on the programme*
- *The academic regulations for student progression and award of a degree (to evidence compliance with Engineering Council policy on Compensation and Condonement*
- *Arrangements for student academic and pastoral support*
- *Quantitative data showing student progression rates from entry through each level or year of study to graduation*
- *Information about the operation of quality assurance processes at programme level, in particular the arrangements for:*
    - *programme approval*
    - *annual monitoring*
    - *periodic review*
- *Information about student involvement in quality assurance and enhancement processes*
- *For UK programmes: external examiner reports and responses from the department for the three most recent years*
- *Evidence that the programme is at an appropriate level commensurate with ISCED and the Frameworks for Higher Education Qualifications of UK Degree-Awarding Bodies*

There is also more detail about the expected format of the accreditation visit itself:

The visit typically takes place over two or three days.

The panel will expect to meet staff and students. Where practical, panels may wish to meet industry representatives involved in programme design and delivery, who may be members of an Industrial Advisory Board (IAB) (or equivalent). Meetings may be face-to-face or use a suitable telecommunication technology or platform.

During the visit, the panel will expect to see laboratories and other teaching spaces and be provided with examples of the full range of marked student work including any major projects, along with marking schemes/assessment criteria and written feedback to students. The operation of internal quality assurance systems will also be reviewed, which in the UK will include external examiner reports.

The Engineering Council, through AHEP, has never mandated any particular approaches to teaching, learning or assessment. AHEP Edition 4 underlines this agnostic approach by stating:

Higher Education providers are encouraged to develop innovative degree programmes in response to industry needs and the Engineering Council does not favour any particular approach to teaching, learning or assessment.

Indeed, there is no requirement for traditional closed book written examinations or the inclusion of major 'capstone' group or individual projects. It is likely, however, that individual PEIs will continue to mandate particular approaches.

While not ostensibly concerned with assessment practice, the Engineering Council has chosen to take a firm position on the use of compensation and condonement. Guidance on these matters existed previously but was found in the Registration Code of Practice, a document aimed largely at PEIs licensed to accredit degree programmes and was probably applied inconsistently. The previous guidance has been strengthened and is now a requirement for academic accreditation and stated within AHEP. Further information about the operation of the policy is given in the Engineering Council's Guidance Note on Compensation and Condonement. This position, which limits accreditation to 15 ECTS credits in a Bachelors or Integrated Masters degree, may be considered somewhat arbitrary and surprising given the obligations placed on UK degree providers to assure the quality and academic standards of their degree awards.

There is now a clear expectation that accredited degree programmes 'should feature student engagement with relevant scholarship, research and/or professional practice and an accreditation panel will expect to see evidence of ongoing industry involvement in programme design and delivery'. The nature and extent of this engagement will, of course, depend on the level of study and educational aims of the degree programme.

There is a new requirement placed on academic departments:

Departments delivering accredited degrees are expected to promote equality, diversity and inclusion in line with applicable national regulatory frameworks, as well as embedding inclusive design within the curriculum where relevant.

Many departments are involved in outreach activity and encourage applications from under-represented groups, and also take steps to close attainment gaps where these exist. Mindful that AHEP is an international standard, there is no explicit steer towards the charter marks favoured by some UK degree providers, for example Athena SWAN, Race Equality Charter and Stonewall. PEIs will presumably ask for information about the action that is being taken to promote equality, diversity and inclusion (EDI) and may choose to consider these charter marks or the act of working towards an application as a positive indicator. There is now explicit coverage of inclusive design within the AHEP text and learning outcomes. For example, in the case of an Integrated Masters degree:

M5. Design solutions for complex problems that meet a combination of societal, user, business and customer needs as appropriate. This will involve consideration of applicable health & safety, diversity, inclusion, cultural, societal, environmental and commercial matters, codes of practice and industry standards

Recognising the benefits and importance of equality, diversity and inclusion to the engineering profession as a whole, learning outcomes have been added to AHEP Edition 4 that deal with these matters. For example, a graduate from a Bachelors degree for Partial CEng accreditation is required to 'Adopt an inclusive approach to engineering practice and

recognise the responsibilities, benefits and importance of supporting equality, diversity and inclusion' [C11].

There is additional emphasis given to the sustainability of engineering practice and reference to the UN Sustainable Development Goals has been added to AHEP Edition 4:

Sustainability of engineering practice is an issue of concern for the profession and degree providers are encouraged to make use of the United Nations Sustainable Development Goals and Engineering Council Guidance on Sustainability in programme design and delivery.

The learning outcomes in this area have also been revised and are now action-oriented and linked directly to practice and the minimisation of adverse impacts. For example, AHEP Edition 3 required graduates from a Bachelors degree for Partial CEng accreditation to have an 'Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate' while AHEP Edition 4 requires graduates to 'Evaluate the environmental and societal impact of solutions to complex problems and minimise adverse impacts' [C7].

In line with the desire to make AHEP a single point of reference for academic accreditation, material from previously separate guidance notes on distance learning programmes and degree programmes included as part of a degree apprenticeship has been incorporated within the main text.

Learning Outcomes

There has been considerable change to the learning outcomes, although building on previous editions of the standard. AHEP Edition 4 introduces a single progressive set of learning outcomes that extend from Level 5 to Level 7. These learning outcomes have also been adopted for the Engineering Council standard Accreditation and Approval of Qualifications and Apprenticeships (AAQA) and extended to cover levels 3 and 4. Hence the expected learning from a degree programme, apprenticeship or vocational qualification is now covered by a single framework with common expectations and standards.

AHEP Edition 4 introduces definitions for 'complex problems' and 'broadly-defined problems', with these terms used to differentiate between the levels of learning required in the educational base for Chartered Engineer and Incorporated Engineer registration. This approach echoes the approach of the Washington and Sydney accords, but with an important difference. The accords refer to 'complex engineering problems' and 'broadly-defined engineering problems', while the emphasis in AHEP Edition 4 is the application of engineering science and principles to secure beneficial change in any application domain. For example engineers will continue to help address wider societal concerns such as the Sustainable Development Goals or the novel coronavirus pandemic (COVID-19).

The AHEP Edition 4 definitions are as follows –

Broadly-defined problems *involve a variety of factors which may impose conflicting constraints, but can be solved by the application of engineering science and well-proven analysis techniques.*

Complex problems *have no obvious solution and may involve wide-ranging or conflicting technical issues and/or user needs that can be addressed through creativity and the resourceful application of engineering science.*

These definitions also speak to the different expectations for Chartered Engineer and Incorporated Engineer registration:

Incorporated Engineers *maintain and manage applications of current and developing technology, and may undertake engineering design, development, manufacture, construction and operation.*

Chartered Engineers *develop solutions to complex engineering problems using new or existing technologies, and through innovation, creativity and technical analysis.*

AHEP Edition 4 learning outcomes have been substantially revised and are now divided into five areas –

- Science and Mathematics
- Engineering Analysis
- Design and Innovation
- The Engineer and Society
- Engineering Practice

The learning outcomes subsume the 'Additional General Skills' from AHEP Edition 3. This was a set of four learning outcomes common to all types of accredited degree that covered areas such as teamwork, communication and skills for lifelong learning.

Compared to previous editions of AHEP, the number of learning outcomes has been reduced significantly through the elimination of duplication and redrafting to better differentiate between the levels of learning associated with particular degree types. A comparison of the numbers of learning outcomes in AHEP Edition 4 and Edition 3 is shown in Table 2.

	Qualification	ISCED 2011 Level	AHEP3	AHEP4
Incorporated Engineer	Foundation degrees and equivalent qualifications accredited as partially meeting the underpinning knowledge and understanding requirement for IEng registration	5	N/A	18
	Bachelors and Bachelors (Honours) degrees accredited as meeting in full the underpinning knowledge and understanding requirement for IEng registration	6	29	18
	Bachelors Top-up Degrees accredited as meeting the requirement for Further Learning for IEng registration	6	N/A	9
Chartered Engineer	Bachelors (Honours) degrees accredited as partially meeting the underpinning knowledge and understanding requirement for CEng registration	6	32	18
	Integrated Masters (e.g. MEng) degrees accredited as meeting in full the underpinning knowledge and understanding requirement for CEng registration	7	42	18
	Other Masters degrees (and Doctoral programmes) accredited as meeting the further learning requirement for the underpinning knowledge and understanding requirement for CEng registration	7(8)	23	8

Table 2: Comparing the number of learning outcomes – AHEP Edition 3 and 4

There is now demonstrable equivalence in the learning outcomes expressed for the main educational routes to professional registration (Table 3). Hence the eight learning outcomes specified for Other Masters degrees define the additional learning beyond Bachelors (Honours) required to achieve equivalence with an Integrated Masters (e.g. MEng) degree accredited for Chartered Engineer registration. Similarly, the nine learning outcomes for Bachelors Top-up degrees define the additional learning beyond a Foundation Degree required to achieve equivalence with a Bachelors or Bachelors (Honours) degree accredited for Incorporated Engineer registration.

The reduced number of learning outcomes compared with previous editions of AHEP will confer a number of benefits:

- Reduced complexity and bureaucracy for higher education providers involved in the design of degree programmes and preparation for accreditation visits where work is required to demonstrate how and where each AHEP learning outcome is assessed within the programme.
- Greater clarity and focus in academic accreditation activity where consideration of a maximum of 18 learning outcomes for each programme will allow a more meaningful and constructive dialogue.
- Greater focus on areas of importance to the engineering profession.

Chartered Engineer	**Incorporated Engineer**
Bachelors (Honours) PLUS Other Masters degree (often MSc) OR Integrated Masters (e.g. MEng) degree	Foundation Degree PLUS Bachelors Top-up degree OR Bachelors or Bachelors (Honours)

Table 3: Accredited educational routes to professional registration

The learning outcome coverage is not significantly different to AHEP Edition 3 despite the overall reduction in the number of learning outcomes (Figure 1). There are two substantially new areas, ‘Equality, Diversity and Inclusion’ and ‘Security’.

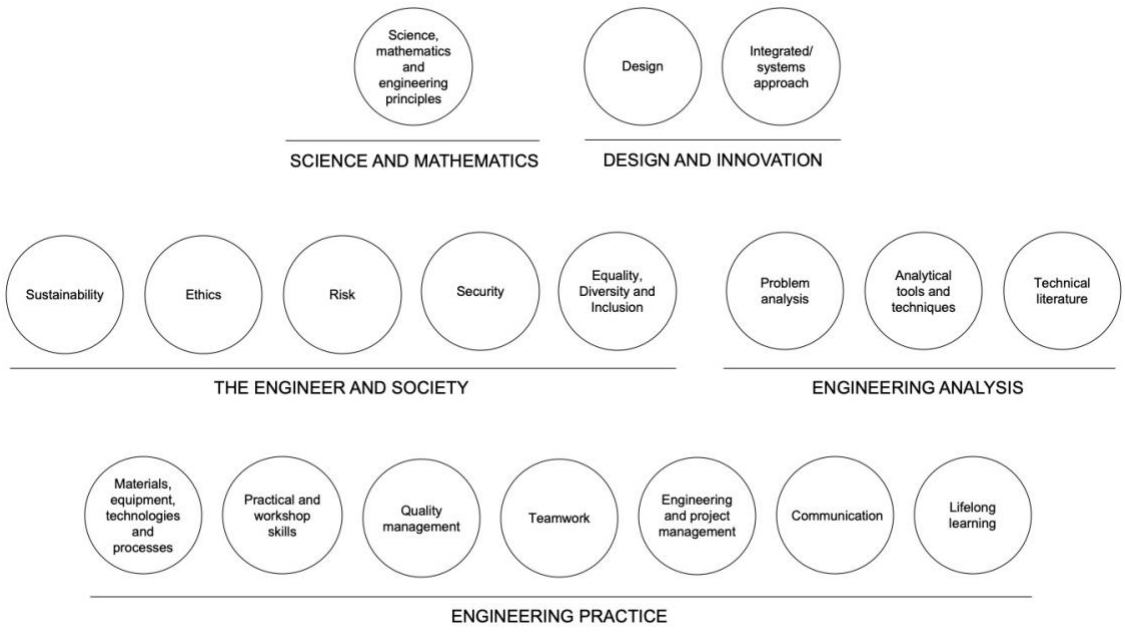

Fig.1: AHEP Edition 4 learning outcome coverage

The tabular presentation of learning outcomes in AHEP Edition 4 helps to demonstrate the progression in each area of learning and learning outcomes have been numbered. Although a small detail, previous editions of AHEP did not number the learning outcomes, meaning that different PEIs adopted their own nomenclature, with the potential for confusion for academic departments dealing with multiple PEIs and potentially navigating joint accreditation visits. These changes should improve the usability of the standard.

Three learning outcomes have been selected for further discussion (Table 4) and this will illustrate the overall approach and introduce the two new areas.

The 'Science, mathematics and engineering principles' learning outcomes require graduates to apply their knowledge to broadly-defined or complex problems depending on the level of the accreditation sought. At higher levels of study there is an expectation that some or much of the knowledge is at the forefront of the particular subject of study. These expectations speak to the requisite qualifications descriptors in the Frameworks for Higher Education Qualifications of UK Degree-Awarding Bodies published by QAA. This alignment was expected previously but is now stated explicitly. It is hoped this will be helpful for readers unfamiliar with the detail of the UK Quality Code for Higher Education and allow the standard to better function as a single point of reference for degree providers and other stakeholders, including those from outside the UK.

The treatment of 'Security' is new and introduced to support engineers from all disciplines consider the security implications of their practice. The learning outcomes are accompanied by a reference to the Engineering Council guidance note on this matter. According to this guidance –

Security can be defined as the state of relative freedom from threat or harm caused by deliberate, unwanted, hostile or malicious acts. It operates on a number of levels ranging from national security issues to countering crime. It includes preserving the value, longevity and ongoing operation and function of an enterprise's assets, whether tangible or intangible, and the handling of privacy issues such as the protection of personally identifiable information.

Security issues are often covered within engineering degree programmes, for example information security and cybersecurity, and there is now a requirement that relevant coverage is included within all degree programmes. Specifically graduates should 'Adopt a holistic and proportionate approach to the mitigation of security risks'. This learning outcome is not mandated for Bachelors Top-up degrees or Other Masters degrees as it is covered in the Foundation Degree or Bachelors (Honours) degree respectively. As noted above, this approach ensures overall equivalence in the two educational routes to professional registration (Table 3) and is pragmatic given the obvious challenge of covering all 18 areas of learning (Fig. 1) to any depth in a Top-up degree of 60 ECTS credits or Other Masters degree (often 90 ECTS credits in the UK and typically focussed on a specialist area of engineering).

Area of Learning	Incorporated Engineer			Chartered Engineer		
	Foundation degrees and equivalent qualifications accredited as fully meeting the academic requirement for EngTech registration and partially meeting the academic requirement for IEng registration	**Bachelors Top-up Degrees accredited as meeting the requirement for Further Learning for IEng registration**	**Bachelors degrees and Bachelors (Honours) degrees accredited as fully meeting the academic requirement for IEng registration**	**Bachelors (Honours) degrees accredited as fully meeting the academic requirement for IEng registration and partially meeting the academic requirement for CEng registration**	**Masters degrees other than the Integrated Masters and Doctoral programmes accredited as meeting the requirement for Further Learning for CEng registration**	**Integrated Masters degrees accredited as fully meeting the academic requirement for CEng registration**
Science, mathematics and engineering principles	F1. Apply knowledge of mathematics, statistics, natural science and engineering principles to broadly-defined problems	B1. Apply knowledge of mathematics, statistics, natural science and engineering principles to broadly-defined problems. Some of the knowledge will be informed by current developments in the subject of study	B1. Apply knowledge of mathematics, statistics, natural science and engineering principles to broadly-defined problems. Some of the knowledge will be informed by current developments in the subject of study	C1. Apply knowledge of mathematics, statistics, natural science and engineering principles to the solution of complex problems. Some of the knowledge will be at the forefront of the particular subject of study	M1. Apply a comprehensive knowledge of mathematics, statistics, natural science and engineering principles to the solution of complex problems. Much of the knowledge will be at the forefront of the particular subject of study and informed by a critical awareness of new developments and the wider context of engineering	M1. Apply a comprehensive knowledge of mathematics, statistics, natural science and engineering principles to the solution of complex problems. Much of the knowledge will be at the forefront of the particular subject of study and informed by a critical awareness of new developments and the wider context of engineering

Security	F10. Adopt a holistic and proportionate approach to the mitigation of security risks	Learning outcome achieved at previous level of study	B10. Adopt a holistic and proportionate approach to the mitigation of security risks	C10. Adopt a holistic and proportionate approach to the mitigation of security risks	Learning outcome achieved at previous level of study	M10. Adopt a holistic and proportionate approach to the mitigation of security risks
Equality, diversity and inclusion	F11. Recognise the responsibilities, benefits and importance of supporting equality, diversity and inclusion	Learning outcome achieved at previous level of study	B11. Recognise the responsibilities, benefits and importance of supporting equality, diversity and inclusion	C11. Adopt an inclusive approach to engineering practice and recognise the responsibilities, benefits and importance of supporting equality, diversity and inclusion	Learning outcome achieved at previous level of study	M11. Adopt an inclusive approach to engineering practice and recognise the responsibilities, benefits and importance of supporting equality, diversity and inclusion

Table 4: AHEP Edition 4: Selected learning outcomes

An accompanying note to the table of learning outcomes states -

These learning outcomes are threshold standards and should be interpreted in the context of a particular disciplinary or multidisciplinary engineering practice, and the level of study.

Hence the 'Security' learning outcome, while using the same text for each level of accreditation, should also reflect the level of study. This differentiation can be expected to occur routinely as students engage with problems and scenarios that have greater complexity at higher levels of study. There is, however, an inherent tension in this approach as a Bachelors (Honours) graduate who achieves this learning outcome in their Level 6 programme is not required to achieve the learning outcome at Level 7.

Crucially, this does not compromise overall academic standards as the learning outcomes for Bachelors (Honours) have been aligned to the Washington Accord standard and additional learning to Masters level is required in the eight areas shown in Table 5.

These 'M' learning outcomes articulate the higher level learning expected of a Masters degree graduate in engineering and build on the learning outcomes for undergraduate study (denoted 'C' for a Partial CEng programme). As mentioned in the standard, the AHEP learning outcomes are threshold standards and a degree provider is free to set higher academic standards for their awards. And there is no restriction on degree providers who choose to extend learning in any of the 18 areas of learning to Level 7 or beyond. Indeed, this would be expected in some cases, for example an MSc in Cybersecurity would certainly cover the 'Security' learning outcome at postgraduate level.

A graduate from an accredited degree must meet all of the learning outcomes for the level of accreditation sought, however there is no expectation that student learning hours or teaching effort will be directed equally to all areas of learning. This is covered in a note accompanying the table of learning outcomes -

An individual who has completed an accredited or approved programme must meet all of the identified learning outcomes, however student learning hours are likely to vary between the five areas of learning.

While recognising that engineers require a broad range of skills, AHEP Edition 4 continues to demand that graduates have a substantial grounding in engineering principles, science and mathematics, and well-developed quantitative analytical skills commensurate with the level of study. Hence a degree in engineering continues to require a strong technical orientation and focus on so-called 'hard skills'.

The inclusion of learning outcomes dealing with Equality, Diversity and Inclusion (EDI) is also new to AHEP Edition 4. This may be considered overdue given the longstanding concerns about workforce demographics in the profession and growing recognition of the ethical and business drivers for change, and also legal obligations such as the Equality Act 2010. The Royal Academy of Engineering (RAEng) has done some important work to highlight the issue and provides resources for employers and other stakeholders.

Under AHEP Edition 4, all graduates from an engineering degree will have considered the importance of EDI, their personal responsibilities in this regard, and the benefits for individuals, employers and society more broadly. These changes should raise the overall level of awareness of EDI matters in the profession and support further positive change in this important area.

Area of Learning	Learning Outcome	
	Masters Degree	**Bachelors (Honours)**
Science, mathematics and engineering principles	M1. Apply a comprehensive knowledge of mathematics, statistics, natural science and engineering principles to the solution of complex problems. Much of the knowledge will be at the forefront of the particular subject of study and informed by a critical awareness of new developments and the wider context of engineering	C1. Apply knowledge of mathematics, statistics, natural science and engineering principles to the solution of complex problems. Some of the knowledge will be at the forefront of the particular subject of study
Problem analysis	M2. Formulate and analyse complex problems to reach substantiated conclusions. This will involve evaluating available data using first principles of mathematics, statistics, natural science and engineering principles, and using engineering judgment to work with information that may be uncertain or incomplete, discussing the limitations of the techniques employed	C2. Analyse complex problems to reach substantiated conclusions using first principles of mathematics, statistics, natural science and engineering principles
Analytical tools and techniques	M3. Select and apply appropriate computational and analytical techniques to model complex problems, discussing the limitations of the techniques employed	C3. Select and apply appropriate computational and analytical techniques to model complex problems, recognising the limitations of the techniques employed
Technical literature	M4. Select and critically evaluate technical literature and other sources of information to solve complex problems	C4. Select and evaluate technical literature and other sources of information to address complex problems
Design	M5. Design solutions for complex problems that evidence some originality and meet a combination of societal, user, business and customer needs as appropriate. This will involve consideration of applicable health & safety, diversity, inclusion, cultural, societal, environmental and commercial matters, codes of practice and industry standards	C5. Design solutions for complex problems that meet a combination of societal, user, business and customer needs as appropriate. This will involve consideration of applicable health & safety, diversity, inclusion, cultural, societal, environmental and commercial matters, codes of practice and industry standards
Sustainability	M7. Evaluate the environmental and societal impact of solutions to complex problems (to include the entire life-cycle of a product or process) and minimise adverse impacts	C7. Evaluate the environmental and societal impact of solutions to complex problems and minimise adverse impacts
Teamwork	M16. Function effectively as an individual, and as a member or leader of a team. Evaluate effectiveness of own and team performance	C16. Function effectively as an individual, and as a member or leader of a team
Communication	M17. Communicate effectively on complex engineering matters with technical and non-technical audiences, evaluating the effectiveness of the methods used	C17. Communicate effectively on complex engineering matters with technical and non-technical audiences

Table 5: AHEP Edition 4 – Masters level learning outcomes

Conclusions

AHEP Edition 4 builds on previous editions of the standard but introduces some significant changes. The learning outcomes have been reviewed, better aligned with international standards, notably the Washington and Sydney accords, and significantly reduced in number. There is a progressive approach that differentiates the learning required for each type of accredited degree across 18 areas of learning. Learning outcomes have been introduced for Foundation Degree and equivalent qualifications and also Top-up degrees.

There is also a paradigm shift in the learning outcomes, with graduates required to use their engineering knowledge to address problems in any application domain rather than solve 'engineering problems'. This reflects the crucial role that engineers play in tackling societal concerns such as the Sustainable Development Goals.

There are two new learning outcomes covering security and EDI. The coverage of security reflects concerns about information security and other threats to individual, corporate and national assets. The inclusion of EDI responds to longstanding concerns about the demographics of the engineering workforce and compelling ethical and business drivers for greater diversity in the profession.

The revised standard provides more information about the accreditation process and lists the evidence base that will be required for an accreditation visit. This and other clarifications are intended to help reduce the unhelpful differences between PEIs in accreditation policy and practice. It remains to be seen whether this will have the desired effect.

It is hard to ferment revolution when the detail of every change must be negotiated and agreed with a diverse group of stakeholders. Employers, higher education providers and PEIs have different interests, priorities, expectations, traditions and practices, while the standard itself must remain aligned to fixed external reference points. Overall, however, AHEP Edition 4 represents a significant evolution of the standard. It should better meet the needs of all stakeholders and support the future development of the engineering profession, helping deliver sustainable economic growth and wider societal benefits.

About the Author

Professor Sean Wellington is Pro Vice-Chancellor and Executive Dean of the Faculty of Science and Technology at Middlesex University. He chaired the Engineering Council Working Group that developed AHEP Edition 4 and was lead author for the revisions to the standard. The views expressed here are personal opinions and not endorsed by the Engineering Council.