# Shadbolt Review of Computer Sciences Degree Accreditation and Graduate Employability – Annexes C-H

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# Annex C – Shadbolt Review Terms of Reference

## Terms of Reference for The Shadbolt Review of Computer Science Degree Accreditation and Graduate Employability

### Summary

1. Professional accreditation systems have a crucial role to play in setting standards and supporting professional development, ensuring that courses equip individuals with high quality, relevant skills, and that they continue to refine their skills and knowledge.

2. It is widely accepted across academia, professional bodies and industry that improvements need to be made to the accreditation systems for computer science degrees, to ensure that they are fit for the future. There is also a consensus that this will require a fundamental review of the systems, including going back to first principles about the purpose and role of accreditation, as well as how it is discharged. The Government is therefore commissioning an independent review of computer science degree accreditation in England, leading to recommendations on how the degree accreditation systems could be reformed to ensure that it keeps pace with the needs of the profession.

3. The Review will be led by a senior independent figure with expertise in computer science within higher education, and strong connections to the profession and industry. The Reviewer will be supported by the Higher Education Funding Council for England (HEFCE) in carrying out the Review. The Review should also work with relevant accrediting bodies, including the British Computer Society (BCS), the Institution of Engineering and Technology (IET), and other relevant bodies such as the Engineering Council, the Council of Professors and Heads of Computing (CPHC), the Tech Partnership, the National Centre for Universities and Business (NCUB),the Information Economy Council (IEC) and appropriate academies and chartered bodies. Where appropriate, the review should take into account the findings of other reviews which may address similar issues.

4. The Review should include a specific focus on how the accreditation system can help address the issue of computer science graduate employability. Evidence gathered as a result of a joint BIS-DfE review of Science, Technology, Engineering, Mathematics (STEM) Skills provision has highlighted issues around employment outcomes for computer science graduates. Evidence shows that computer science graduates have higher rates of post-degree unemployment than other subjects. This may be significantly influenced by student characteristics and local economic conditions. It may also be a function of the way data is collected and classified. The Review will consider the extent to which computer science graduates might benefit from degree courses which feature increased employer engagement, more up to date course content and, where appropriate, increased levels of work experience, taking into account the particular characteristics of students and the industry. The Review will direct a more detailed report on the state of computer science employability.

## Interdependencies

5. The Review will start ahead of a wider independent review of STEM degree accreditation, which will look at whether there are other areas of STEM degree course provision that would merit similar investigation. It is expected that the findings of this review will inform the work of the wider review.

## Key areas for investigation

6. The Review should consider, but not be limited to, examining:

- The purpose of accreditation – why is it being undertaken and what is it meant to achieve?
- What is the accreditation system assessing when making judgements about professional competence and course expectations?
- How should accreditation be carried out, to ensure the necessary speed and agility to keep up with the profession's changing needs, whilst also minimising burden?
- How is accreditation used in practice and how is it updated – what benefits does it/should it bring to students, industry, course providers, and the profession overall?
- More specifically, how can the accreditation system ensure that degree course content is up to date and relevant for the needs of the industry? In particular ensuring employer engagement in course design, and where appropriate incorporating work experience/placements in degrees, for both students and staff?
- How can accreditation systems address continuing professional development needs as well as skills and professional competence arising from higher education courses?

7. The Reviewer will also be supported by work being undertaken by HEFCE to interrogate data on computer science graduate employment outcomes. The first major output of this work will be the publication of more granular data on the employment outcomes of computer science graduates than is currently published, in March/April 2015. This publication will highlight differences in employment outcomes among computer science graduates, and will examine the type and nature of any employment they enter. Subsequent work to be published in summer 2015 will further enhance the understanding of employability outcomes: addressing issues relating to the impact of social background and personal characteristics on graduate employment outcomes. These publications will also include an analysis of the impact of geographic factors on employability outcomes, and the flows of graduates into computer science occupations on both a local and national basis. The reports will incorporate case studies that identify good practice that could be scaled up more widely across the sector.

## Timing

8. The review should report in the autumn of 2015.

# Annex D – Background on accreditation of computer science degree programmes

## What is Academic Accreditation?

A Professional Engineer / Computer Scientist develops competence through a combination of academic study and experiential application of knowledge in a relevant job role. Competence is maintained through continuous professional development, throughout their careers.

Professional Engineering Institutions (PEIs), including the Institution of Engineering and Technology (IET)[1] and the British Computer Society (BCS)[2] are authorised to award suitable candidates Professional Registration at various levels, according to their competence.

The PEIs can review a candidate's education and experience on an individual basis, but many Higher Education Institutions submit their degree programmes to an accreditation review to help their graduates, and as a quality indicator to prospective students and employers. Graduates from degree programmes which have passed this academic accreditation process, are accepted as having achieved certain academic competencies at a (threshold) level defined during the accreditation process. As well as considering how the graduates will develop the learning outcomes, accreditation needs to consider the robustness and sustainability of the delivery, and hence accreditation looks at aspects such as staff capability, facilities and quality assurance processes.

Accreditation visits are undertaken by teams of peers and industrialists, with a good knowledge of the subject area of the programmes. An important part of accreditation is to recognise examples of good practice at the host institution and to impart suggestions for improvement gleaned from other institutions. Accreditation is NOT a process of harmonisation, rather part of a progressive process of continuous improvement.

Accreditation can be sought at different levels. The most common levels relevant to Computer Sciences graduates would be:

| Level of Accreditation | | Defining Body | Accrediting PEI |
|---|---|---|---|
| Chartered Engineer | CEng | Engineering Council UK[3],[4] | IET, BCS |
| Incorporated Engineer | IEng | | |
| Chartered IT Professional | CITP | British Computer Society[5] | BCS |
| Chartered Scientist | CSci | Science Council[6] | BCS |

[1] www.theiet.org/academics/accreditation/
[2] www.bcs.org/category/5844
[3] UK-SPEC – www.engc.org.uk/UKSPEC
[4] AHEP – www.engc.org.uk/standards-guidance/standards/accreditation-of-higher-education-programmes-ahep/
[5] BCS – www.bcs.org/category/10972
[6] BCS – www.bcs.org/category/14960

# Annex E – Additional information on the employment indicators used based on destinations data from the DLHE and LDLHE

DLHE respondents who were self-employed/freelance, in voluntary or unpaid work (including on a placement or internship) or who were creating a professional portfolio, all count as being in employment.

The unemployment rates presented in this report show DLHE respondents who responded that at the time of the survey they were unemployed and seeking work, as a proportion of all DLHE respondents. Those who were in employment and/or further study, or were unavailable for employment (on account of caring responsibilities, taking time out to travel etc.), do not count towards the unemployment rate.

Non-graduate jobs are those that fall outside of the three Standard Occupational Classification (SOC2010) major groupings of 'managers and senior officials', 'professional occupations' and 'associate professional and technical occupations'. Proportions shown are based on qualifiers who reported that they were in employment (only).

'Low' salaries are defined as those less than £20,000. Proportions shown throughout the report exclude qualifiers with unknown salaries from the calculation and are based on qualifiers who reported that they were in full-time paid employment (only) in the UK.

# Annex F – Description of courses within the Computer Sciences broad discipline group, including numbers of full-time, UK-domiciled Computer Sciences undergraduate entrants in 2013-14 by course

| Course category | Number of 2014-15 undergraduate entrants | % of total 2013-14 Computer Sciences undergraduate entrants |
|---|---|---|
| Computer Sciences | 15,290 | 66.5% |
| Information Systems | 4,620 | 20.1% |
| Software Engineering | 1,190 | 5.2% |
| Others in Computer Sciences | 1,885 | 8.2% |
| Computer Sciences total | 22,985 | 100% |

Source: HEFCE analysis of the HESA standard registration population, undergraduate entrants to publicly-funded English HEIs in 2014-15.

- Computer Sciences – the study of the design and application of electronic computer systems, including computer architectures, software and systems design
- Artificial Intelligence – the study of principles and techniques for the computer-based simulation and modelling of intelligent animal behaviour patterns
- Information Systems – the study, design or application of computer systems which capture, process and transmit information
- Software Engineering – the study of techniques and principles for the design, construction, testing and maintenance of computer programs to satisfy the requirements of specific operational problems
- Others in Computer Sciences – miscellaneous grouping for related subjects which do not fit into the other computer sciences categories, including but not limited to health informatics, computer generated visual and audio effects, and games

# Annex G – Shadbolt Review stakeholder survey

## The Shadbolt Review of Computer Sciences degree accreditation and graduate employability

### 1. Introduction

Computer science skills are vital to the UK's economy across the full range of business and industry. The Government has commissioned an Independent Review led by Sir Nigel Shadbolt to understand the employment situation amongst graduate computer scientists and the role of professional accreditation of courses in this area.

The review seeks to investigate whether graduates meet the needs of employers and are considered employable. Professional accreditation has a role to play in ensuring that current arrangements for computer science skills are fit for the future. There is potential for improvements to be made to accreditation systems for computer science degrees. The independent review will explore the provision of computer science degree accreditation, leading to recommendations on how the degree accreditation systems could be reformed to ensure it keeps pace with the needs of the profession.

At this stage we are inviting stakeholders, including universities and colleges; business and industry; and from professional, statutory and regulatory bodies to provide their perspective on employability and accreditation systems in computer science. We will begin with some general questions to gather your views on graduate skills in computer science. We will then ask some specific questions related to some preliminary investigations which have been undertaken. Finally we will ask a few questions related to your organisation's perspective.

The review has links to a separate independent review that the Government has commissioned to look more generally at science, technology engineering and mathematics (STEM) subjects. A separate questionnaire related to this more general review was launched on 11th June 2015.

If you have any questions regarding the survey or the Review in general then please contact Duncan Shermer and Joe Garrood.

### 2. Completing the survey

The survey should take around 20 to 30 minutes to complete and we would be grateful if you could respond by 21 August 2015.

Our preference is to receive responses on behalf of organisations or departments and you may wish to consult with colleagues in order to provide such a response. If you or your organisation have no strong opinion on any of the questions asked, then please select the N/A option or leave it blank.

As far as possible your response should be based on your experience and supported by concrete examples or evidence. We have conducted some initial investigation of data collected by the Higher Education Statistics Agency and these data are available on HEFCE's website. You may wish to review these data to help inform your response to the survey or alternatively you may wish to rely on your own sources of evidence.

## 3. Demographic Information

Please provide some details of your organisation and your role within it. This will help us to analyse responses to this questionnaire from particular sectors.

We will take account of all responses in the final report, but responses will remain anonymous. You will be given an opportunity to indicate whether you are happy to be contacted regarding your response to the questionnaire and whether you would be interested in being involved in any followup events.

| | |
|---|---|
| **Your name** | [free text] |
| **Your role or job title** | [free text] |
| **Name of your organisation** | [free text] |
| **Name of your department (if applicable)** | [free text] |
| **Broadly which option best represents your type of organisation?** | Select from:<br>• University or college (HEI or FEC)<br>• Business or industry<br>• Professional, statutory or regulatory body (PSRB)<br>• Other (please specify) |
| **Does your response represent your personal view, the view of your department/division or the view of your whole organisation?** | Select from:<br>• Personal view<br>• Opinion of department/division<br>• Organisational opinion<br>• Other (please specify) |

Depending on how respondents answer the question: 'Broadly which option best represents your type of organisation?' they will see different questions as the progress through the survey. Sections which will only appear to respondents identifying themselves as a 'University or college' will be highlighted in yellow, sections which only appear to respondents identifying themselves as 'Business or industry' will be highlighted in green and sections which will only appear to respondents identifying themselves as 'Professional, statutory or regulatory bodies' will be highlighted in blue.

## 4. Different types of computer science

| | |
|---|---|
| **Broadly which category best fits your job role?** | Select from:<br>• Pro-Vice Chancellor (or equivalent)<br>• Dean of faculty (or equivalent)<br>• Head of careers services (or equivalent)<br>• Head of department (or equivalent)<br>• Programme leader (or equivalent)<br>• Other (please specify) |

| | |
|---|---|
| **Are you responsible for graduate recruitment within your organisation?** | Select from:<br>• Yes<br>• No<br>• N/A |
| **In total, roughly how many people does your organisation employ?** | Select from:<br>• 49 or fewer employees<br>• 50 to 249 employees<br>• 250 to 999 employees<br>• 1000 or more employees<br>• N/A |
| **On average, roughly how many graduates does your organisation recruit each year?** | Select from:<br>• 10 or fewer recruits<br>• 11 to 49 recruits<br>• 50 to 99 recruits<br>• 100 or more recruits<br>• N/A |
| **Broadly which option best represents your type of business?** | Select from:<br>• A company which is engaged in computer science research.<br>• A company that provides IT software and services.<br>• A company that provides IT hardware and services.<br>• A company which is a user of IT systems and services which are necessary to the success of the business.<br>• Other (please specify) |

To what extent do you agree that recent graduates from the different areas of computer science below meet the employability requirements of employers? The options provided are taken from the list of JACS course codes, and are therefore focussed on provision of courses from an academic perspective; for further information please see the complete course list on HESA's website.

Please answer for all areas you feel able to speak for. For those disciplines you feel unable to speak for, please tick N/A.

| | Strongly agree | Agree | Neither agree nor disagree | Disagree | Strongly disagree | N/A |
|---|---|---|---|---|---|---|
| **General computer science** | | | | | | |
| **Information systems** | | | | | | |
| **Software engineering** | | | | | | |
| **Artificial intelligence** | | | | | | |
| **Health informatics** | | | | | | |
| **Other (please specify)** | | | | | | |

For your information, relevant descriptions from HESA's website are given below:

| | |
|---|---|
| **General computer science:** | The study of the design and application of electronic computer systems, including computer architectures, software and systems design. |
| **Information systems:** | The study, design or application of computer systems which capture, process and transmit information. |
| **Software engineering:** | The study of techniques and principles for the design, construction, testing and maintenance of computer programs to satisfy the requirements of specific operational problems. |
| **Artificial intelligence:** | The study of principles and techniques for the computer-based simulation and modelling of intelligent animal behaviour patterns. |
| **Health informatics:** | The study and design of systems for information capture, processing and use in healthcare. |

## 5. General questions

We have published some data around employment outcomes on HEFCE's website and some of our initial findings are discussed in a blog post. In short we believe there is an issue around employability of computer science graduates and are interested in exploring whether accreditation systems for computer science degrees may be a way to address this. We are anxious to have your views (or the views of your organisation). You may wish to arrive at your view using your own sources of information or by analysis of the information available through HEFCE's website.

| **Please describe up to three difficulties around graduate employability in computer science.**<br><br>For example, do graduates in the discipline lack certain knowledge (for example in data analytics or specific programming languages)? Do graduates lack general 'work ready' skills or business awareness? | **What concrete evidence is available or could be provided to support each of the difficulties you have identified in the previous question?**<br><br>You may wish to arrive at your view using your own sources of information, for example reports, data sets, or analyses carried out either by your organisation or by a third party; or by analysis of the information available through HEFCE's website. |
|---|---|
| 1<br>[free text] | 1<br>[free text] |
| 2<br>[free text] | 2<br>[free text] |
| 3<br>[free text] | 3<br>[free text] |

## 6. Specific questions

Thinking about university and college courses in computer science, to what extent do you agree with the following statements?

| | Strongly agree | Agree | Neither agree nor disagree | Disagree | Strongly disagree | N/A |
|---|---|---|---|---|---|---|
| Most computer science graduates find roles in an industry which utilises their specific knowledge in computer science. | | | | | | |
| Institutional or departmental engagement of HEIs or FECs with industry leads to enhanced employability (e.g. staff placements, guest lectureships, research concordats, strategic partnerships). | | | | | | |
| Current accreditation of courses in computer science enhances graduate employability | | | | | | |
| Different course syllabuses have significantly different employability outcomes. | | | | | | |
| Student characteristics (e.g. economic or demographic background) have a significant effect on employability outcomes. | | | | | | |
| The reputation of the institution or department has a significant effect on employability outcomes. | | | | | | |

| | |
|---|---|
| What benefits does accreditation of computer science degrees bring to your organisation and to the profession as a whole? | [free text] |
| How could the current accreditation of computer science degrees be improved? | [free text] |
| Any further comments? | [free text] |

## 7. Specific questions for HEIs and FECs

The following questions are specific to respondents who have identified themselves as HEIs.

To what extent do you agree with the following statements?

| | Strongly agree | Agree | Neither agree nor disagree | Disagree | Strongly disagree | N/A |
|---|---|---|---|---|---|---|
| Entry requirements or qualifications when entering higher education have a significant effect on employability outcomes. | | | | | | |
| The resource requirements on higher education institutions for accreditation by professional bodies are appropriate for the benefits of the process. | | | | | | |

| | |
|---|---|
| Do you capture evidence of work experience of your students? Is this limited to formal 'sandwich type' placements or does it strive to include informal placements and other work experience such as internships and 'vacation work' arranged by the students themselves? | [free text] |
| Any further comments? | [free text] |

## 8. Specific questions for Business or Industry

The following questions are specific to respondents who have identified themselves as Business or Industry. To what extent do you agree with the following statements?

| | Strongly agree | Agree | Neither agree nor disagree | Disagree | Strongly disagree | N/A |
|---|---|---|---|---|---|---|
| My organisation understands what course accreditation means. | | | | | | |
| My organisation values course accreditation in its recruitment process. | | | | | | |
| My organisation specifically targets computer science graduates when recruiting. | | | | | | |
| Graduates have appropriate subject knowledge required. | | | | | | |
| Graduates have appropriate practical subject specific skills required. | | | | | | |
| Graduates have the required 'work ready' skills or business awareness. | | | | | | |
| Industrial experience of graduates leads to enhanced employability (e.g. sandwich placements, other placements, general work experience). | | | | | | |
| Most 'computer science related' roles are filled by graduates in computer science (as opposed to other disciplines e.g. mathematics or engineering) | | | | | | |
| The supply of graduates is sufficient for the needs of employers. | | | | | | |

| | |
|---|---|
| What type of computer science graduates should be produced to better meet the needs of your business or industry? What knowledge do they need? What skills do they need? | [free text] |
| How can accreditation systems ensure that degree course content is uptodate and relevant to the needs of industry? | [free text] |
| Any further comments? | [free text] |

## 9. Specific questions for PSRBs

The following questions are specific to respondents who have identified themselves as Professional, Statutory or Regulatory Bodies.

| | |
|---|---|
| Are there basic skills that computer science graduates are required to have by employers? Do employers agree on what those core skills should be? Or, are the needs of employers too disparate to make any sensible assertions? | [free text] |
| In respect of the above question, what role should accreditation play? For example, should there be different types of accreditation to align with different types of course and the differing needs of industry? | [free text] |
| How can accreditation systems address continuing professional development needs as well as skills and professional competence arising from higher education courses? | [free text] |
| Should the processes you use for the accreditation of courses require the involvement of business or industry as a condition for accreditation? If so, what form should this involvement take? | [free text] |
| How can accreditation systems remain agile to ensure that degree course content is uptodate and relevant to the changing needs of industry while also minimising the resource requirements of higher education institutions? | [free text] |
| What is the benefit that derives from accreditation of HE degree courses? In particular how can it add value to graduate employment outcomes? | [free text] |
| Any further comments? | [free text] |

## 10. Thank you

Thank you for participating in this questionnaire.

Your responses will be treated in confidence and will be used to develop agendas for a programme of focussed workshops in the autumn. We may use aggregate data from the questionnaire in the final report.

| | |
|---|---|
| Would you be happy to be contacted regarding your response to the questionnaire? | Select from:<br>• Yes<br>• No |
| Would you be interested in being involved in a workshop related to this review? | Select from:<br>• Yes<br>• No |
| Your email address: | [free text] |
| Your phone number: | [free text] |

Please feel free to pass on the details of the survey to anyone who you feel would be interested in providing input: www.hefce.ac.uk/kess/csreview/.

# Annex H – Focus Groups

1. The focus groups built on work earlier in the review to interrogate data available from the Destinations of Leavers from Higher Education (DLHE) survey and Longitudinal DLHE (LDLHE) survey, and additional insights captured from an online survey of relevant stakeholders.

2. The objectives of the focus groups were to gather together a body of interested HEIs, relevant employers, professional bodies and students, to explore in more detail the potential reasons for the observed employment outcomes for computer science graduates. Discussion was not intended to come to definitive conclusions about solutions to problems in these areas, but where examples of good practice or ideas were put forward attempts were made to capture these.

3. Each focus group was organised around a specific theme:

   - **The supply and demand for computer science graduates (FG1)**
   - **Measuring the skills gap (FG2)**
   - **What is the role of degree course accreditation? (FG3)**

## Composition of the focus groups

4. For each focus group, invitations were extended to HEIs, employers, professional bodies and students. A summary of the organisations that attended each focus group is below:

| Focus Group 1 | Focus Group 2 | Focus Group 3 |
|---|---|---|
| Tech Partnership<br>Capgemini<br>Skyscape<br>Network Rail<br>Sheffield Hallam University<br>University of Hertfordshire<br>NCUB<br>BCS<br>Fujitsu<br>EMC<br>IBM<br>University of the West of England<br>CRAC | BCS<br>Tech Partnership<br>University of the West of England<br>Xmos<br>Sheffield Hallam University<br>STEMNET<br>Manchester Metropolitan University<br>AGR<br>De Montfort University<br>Network Rail<br>Oxford Brookes University | IET<br>QAA<br>University of Bath<br>University of Wales Trinity St David<br>University of Westminster<br>Xerus<br>Brunel University<br>IBM<br>Imperial College London<br>BCS<br>De Montfort University<br>University of Greenwich<br>Intel<br>Network Rail<br>Sheffield Hallam University<br>Tech Partnership<br>Southampton Solent University<br>Wambiz<br>John Lewis |
| Total number of organisations represented: 13 | Total number of organisations represented: 11 | Total number of organisations represented: 20 |