



# **Computer Science: Driving Entrepreneurship**

White Paper sponsored by the Council of  
Professors and Heads of Computing

Dr Peter Norrington

© Council of Professors and Heads of Computing, April 2014

[cphc.ac.uk](http://cphc.ac.uk)

## **Executive Summary**

This report presents the findings of a snapshot review to highlight spin-out, start-up and student-based models for entrepreneurship throughout computer science departments in the UK, showing how computer science can create jobs and growth. The report was undertaken with a view to celebrating the contribution of computer science to economic growth. It can also be used to generate and source ideas where institutions are considering how this might work in their departments.

Information for the review was gathered through the CPHC's Enterprise and Entrepreneurship in the Computing Curriculum resources; desktop research including an investigation of institutional websites as significant public and student-facing sources of information; and a small-scale survey, conducted to gather further information on positive aspects of entrepreneurship.

Four case studies of entrepreneurship activities are presented, noting that the publication of case studies in the Research Excellence Framework will not occur until spring 2015.

Both to support positive recognition in the press and to offer institutions and departments ideas for their development, several key features of successful entrepreneurial activity are identified. The report also identifies barriers to the visibility of entrepreneurial computer science.

Please see <http://cphc.ac.uk/publications/reports/> for the report.

## **Acknowledgements**

This report was undertaken with financial support from the Council of Professors and Heads of Computing.

Thank you to those who took part in the anonymous survey.

The author also thanks the following for their support in preparing the case studies:

Professor Ian Ruthven, School of Computer & Information Sciences,  
University of Strathclyde

Jason Marshall, Manager, Kent IT Clinic, University of Kent at Canterbury

Professors John Keane and Jim Miles, School of Computer Science,  
University of Manchester

Professor Roger Woods, School of Electronics Electrical Engineering and  
Computer Science, Queen's University of Belfast, and Chief Technology  
Officer, Analytics Engines, Belfast

Dr Peter Norrington

April 2014

[www.peternorrington.com](http://www.peternorrington.com)

# Contents

<b>1.</b>	<b>Introduction .....</b>	<b>1</b>
1.1	Context .....	1
1.2	Focus and evaluation.....	2
<b>2.</b>	<b>Entrepreneurship .....</b>	<b>3</b>
2.1	Introduction .....	3
2.2	Entrepreneurship in education .....	3
2.3	Entrepreneurship and computer science .....	4
<b>3.</b>	<b>Entrepreneurship in practice .....</b>	<b>8</b>
3.1	Whole institution approaches .....	8
3.2	Working in Partnership.....	8
3.3	Student-led entrepreneurship.....	10
3.4	Staff Spin-outs / Start-ups.....	12
3.5	Course Searches .....	12
3.6	Developing curricula .....	12
3.7	Industrial Doctorate Centres .....	13
3.8	Skills profiling and diagnostic tools .....	13
3.9	The enterprise and entrepreneurship mix for intra- and extra-curricular activities .....	14
<b>4.</b>	<b>Case studies.....</b>	<b>16</b>
4.1	Vertically-Integrated Projects at the University of Strathclyde.....	17
4.2	Spin-outs at the University of Manchester .....	18
4.3	Disruptive technology spin-out at Queens University Belfast.....	19
4.4	Student IT Consultants at the University of Kent.....	20
<b>5.</b>	<b>Concluding comments .....</b>	<b>21</b>
	<b>Appendix 1 The context of computer science graduate unemployment</b>	<b>22</b>
	<b>Appendix 2 Some UK university websites with entrepreneurship content</b> .....	<b>24</b>
	<b>Appendix 3 Entrepreneurship resources.....</b>	<b>31</b>

# 1. Introduction

## 1.1 Context

Computer science underpins much of the technology that makes the modern world possible; communications, navigation and logistics, banking and stock trading, security, internet and web technologies, health and creative arts.

Computer science is innovative and of fundamental importance to the economy; individuals and companies are willing to take entrepreneurial risks in the development of new technologies to maximise impact.

Following some recent negative press (see Appendix 1), this report was commissioned to evidence computer science departments' impact on the economy, to show their strengths and successes, and how computer science can create jobs and growth, with a particular focus on entrepreneurship. With information from a wide variety of sources, the report can also be used to generate and source ideas where institutions are considering how this might work in their departments.

The Council of Professors and Heads of Computing (CPHC) represents the interests of a UK membership engaged in the management of university computing education and university computing research within the UK higher education sector. Currently it has over 700 members, drawn from over 100 universities.

The CPHC works closely with all the professional and statutory organisations relevant to the sector and to act as a lobby organisation on behalf of its membership, representing their interests and concerns to central and local government, the funding councils, the research councils, the professional bodies, national and international special interest groups, learned societies, and a wide range of commercial and industrial organisations. CPHC is recognised as the Subject Body for Computing by the Funding Councils and by the Quality Assurance Agency (QAA), and it works in conjunction with the UK Computing Research Committee (UKCRC) to address research issues with the research councils, particularly the Engineering and Physical Sciences Research Council (EPSRC).

The CPHC has previously published work on Enterprise and Entrepreneurship in the Computing Curriculum<sup>1</sup>.

---

<sup>1</sup> [cphc.ac.uk/members-area/working-groups/learning-development-group/wg2-enterprise-and-entrepreneurship-in-the-computing-curriculum/](http://cphc.ac.uk/members-area/working-groups/learning-development-group/wg2-enterprise-and-entrepreneurship-in-the-computing-curriculum/)

## **1.2 Focus and evaluation**

### **Focus**

This report presents the findings of a snapshot review to highlight the spin-outs, start-ups and student-based models for entrepreneurship throughout computer science departments in the UK. The variation in individual mission statements – entrepreneurial, enterprise, fundamental research, etc. – and institutional and departmental focus<sup>2</sup>, structure and approach to student-led or staff-led entrepreneurship makes comparison or any notion of best practice inappropriate. Moreover, judging any particular institution by whether it includes ‘entrepreneurship’ in its mission statement is not especially productive given that institutions and departments operate in a range of local, regional, national and indeed, international environments that combine elements of collaboration, co-operation and competition. Even as employability (or employment) are critical features of student recruitment, this may be fulfilled with other mission statements around ‘enterprise’, ‘innovation’, ‘sustainability’, ‘environment’, to name but a few.

### **Evaluation**

This report provides examples of good practice, highlighting successes and opportunities in this area. It is not, however, an exhaustive review.

Much of the information for the review was gathered through investigation of various departmental websites, plus some adjacent entrepreneurship sites, as these are significant public- and student-facing arenas for these departments. A small-scale survey was conducted to gather further information on positive aspects of entrepreneurship.

Further information has been acquired from a variety of public reports and websites of various organisations. Some additional material is collated in appendices.

The report presents examples of the opportunities for entrepreneurship taken by departments, institutions and other organisations. Four case studies of entrepreneurship activities have been developed specifically for this paper, noting that the publication of case studies in the Research Excellence Framework will not occur until spring 2015.

Both to support positive recognition in the press and to offer institutions and departments ideas for their development, several key issues are identified.

---

<sup>2</sup> 102 current member departments with 48 different domain-focus names for department/school/faculty

## 2. Entrepreneurship

### 2.1 Introduction

The Global Entrepreneurship Monitor (GEM)<sup>3</sup> defines entrepreneurship as;

... any attempt at new business or new venture creation, such as self-employment, a new business organization, or the expansion of an existing business, by an individual, teams of individuals, or established businesses.<sup>4</sup>

Where entrepreneurial skills are applied within an existing organisation, this is called 'intrapreneurship'. A complementary definition of entrepreneurship comes from e-skills UK, one of the UK's Sector Skills Councils;

Identifying and acting upon opportunities in the marketplace and introducing change; combining new and existing ideas together to develop unique propositions and taking economic and reputational risks in order to bring new ventures into existence.<sup>5</sup>

Entrepreneurship goes beyond having ideas (broadly, innovation) and beyond business management (broadly, enterprise); entrepreneurship essentially requires acts of creation or expansion in new ways often with associated risks. For a general overview of entrepreneurial and employability skills, see the HEA's 2011 *Models of employability development in undergraduate Business Education – a critical review of current practice*<sup>6</sup>

### 2.2 Entrepreneurship in education

A key guide to the background and development of enterprise and entrepreneurship education is the QAA's 2012 guidance<sup>7</sup>, which offers a framework for higher education. This is referred to again within section 3, on the enterprise and entrepreneurship mix.

---

<sup>3</sup> [www.gemconsortium.org](http://www.gemconsortium.org)

<sup>4</sup> N Bosma, A Coduras, Y Litovsky and J Seaman (2012) "GEM Manual: A report on the design, data and quality control of the Global Entrepreneurship Monitor, Version 2012-9: May", Global Entrepreneurship Monitor (GEM) p.20 Available at [www.gemconsortium.org/docs/download/2375](http://www.gemconsortium.org/docs/download/2375) (The definition stems from GEM's inception in 1999.)

<sup>5</sup> e-skills UK (31 January 2011) *IT Professional Standards: Transferable Skills Version 1.0*, e-skills UK Sector Skills Council Ltd [www.itskillsacademy.ac.uk/Site/ITPS/0033.pdf](http://www.itskillsacademy.ac.uk/Site/ITPS/0033.pdf)

<sup>6</sup> K Pond, A Harrington (1 December 2011) *Models of employability development in undergraduate Business Education – a critical review of current practice*, HLST Network [www.heacademy.ac.uk/hlst/resources/detail/resources/critical-reviews/models-of-employability-development](http://www.heacademy.ac.uk/hlst/resources/detail/resources/critical-reviews/models-of-employability-development)

<sup>7</sup> QAA (September 2012) *Enterprise and entrepreneurship education: Guidance for UK higher education providers*, Quality Assurance Agency for Higher Education ISBN 978 1 84979 692 7 [www.qaa.ac.uk/Publications/InformationAndGuidance/Pages/enterprise-entrepreneurship-guidance.aspx](http://www.qaa.ac.uk/Publications/InformationAndGuidance/Pages/enterprise-entrepreneurship-guidance.aspx)

The largest guide to entrepreneurship strategies and their impacts in higher education – in England – is PACEC’s Knowledge exchange funding report<sup>8</sup> on HEFCE’s Higher Education Innovation Funding (HEIF) 2011-15 and the 99 individual knowledge exchange strategies<sup>9</sup>.

A further, and significant addition to the educational entrepreneurship literature is the recent All-Party Parliamentary Group for Micro Businesses’s *An Education System fit for an Entrepreneur*<sup>10</sup>. This cradle-to-grave view of entrepreneurship education duly notes where and how higher education has a role to play across educational sectors.

### **2.3 Entrepreneurship and computer science**

Given the range of opportunities for computer science entrepreneurial activity, this would perhaps never be an easy matter to determine exactly. However, there are fundamental problems with the data sets available at this time.

The only notionally current statistic on entrepreneurial computer science graduates is derived from HESA Destinations respondents’ data for those leaving programmes within computer science in 2011-12<sup>11</sup>, for self-employment/freelance, 1.8% or setting up their own business, 0.5%. As HESA has only made ‘entrepreneurship’ a separate employment destination in 2012, it is not yet possible to draw any conclusions. As this is based on the usual HESA statistic point of six months after graduation, this will not provide information on entrepreneurial activities occurring beyond that time frame. However, HESA would not be the natural place to enquire about the impact of computer science courses in the long-run, as it would be unable to collect such long-term data.

According to the House of Lords Select Committee on Science and Technology<sup>12</sup> 2012 higher education report, the British Computer Society

---

<sup>8</sup> PACEC (April 2012) *Strengthening the Contribution of English Higher Education Institutions to the Innovation System: Knowledge Exchange and HEIF Funding*, Public and Corporate Economic Consultants

[www.hefce.ac.uk/media/hefce/content/whatwedo/knowledgeexchangeandskills/heif/HEIF11-15-FullReport.pdf](http://www.hefce.ac.uk/media/hefce/content/whatwedo/knowledgeexchangeandskills/heif/HEIF11-15-FullReport.pdf)

<sup>9</sup> [www.hefce.ac.uk/whatwedo/kes/heif/](http://www.hefce.ac.uk/whatwedo/kes/heif/) available in a zip file

<sup>10</sup> All-Party Parliamentary Group for Micro Businesses (February 2014) *An Education System fit for an Entrepreneur*, Fifth Report by the All-Party Parliamentary Group for Micro Businesses

[www.isbe.org.uk/ISBE-contributes-to-groundbreaking-new-cross-party-report-on-enterprise-education](http://www.isbe.org.uk/ISBE-contributes-to-groundbreaking-new-cross-party-report-on-enterprise-education)

<sup>11</sup> HEIDI reports run 26 February 2014. Destinations: Subjects – JACS codes G2 G4 G5 G6 G7 G92; Qualifications – Degree, Masters, Doctorate or other higher, total 25,690. self-employed or freelance 470; setting up own business 125.

<sup>12</sup> House Of Lords Select Committee on Science and Technology (24 July 2012), *Higher Education in Science, Technology, Engineering and Mathematics (STEM) subjects*, Report, 2nd Report of Session

described HESA computer science employment statistics as ‘misleading’, over-estimating the true unemployment situation for computer science graduates ‘because degrees with very little computer science content are bundled with true computer science degrees when calculating the statistics’. The Committee were themselves<sup>13</sup> “also frustrated by the inability to disaggregate data beyond the high level subject categories to determine where graduates progress following their studies.”

Their report, however, while noting that, “[i]t is clear that STEM *postgraduates* [emphasis added] play a significant role in driving innovation, undertaking research and development, and providing leadership and entrepreneurship.”<sup>14</sup>

Equally, the Office for National Statistics (ONS) reports<sup>15</sup> that many of the data sources<sup>16</sup> for UK business start-ups are not reliable indicators of activity, for many conceptual and methodological reasons. Furthermore, ONS publications do not break new business start-ups by sector in a way which is compatible with tracking students graduating from courses, or those who may have completed a course some time before moving into an entrepreneurial role.

However, the ONS does produce annual reports on ICT and e-commerce, which in 2012<sup>17</sup> showed that website sales (£164 billion) represented 6% of business turnover in 2012, up from 5% (£133 billion) in 2011. That report also gives Eurostat<sup>18</sup> data placing the UK fifth in Europe for proportion of turnover from e-commerce. Whilst this is not assessable as specifically new business activity it does indicate the fundamental – and growing – impact of computer science on national economic performance, even if only in one area.

The UUK publishes new research in April 2014<sup>19</sup>, *The impact of universities on the UK economy*, but on the basis of their fourth report in November

---

2012–13, HL Paper 37, London: The Stationery Office Limited

[www.publications.parliament.uk/pa/ld201213/ldselect/ldsctech/37/37.pdf](http://www.publications.parliament.uk/pa/ld201213/ldselect/ldsctech/37/37.pdf) para.67, p.30

<sup>13</sup> Ibid.

<sup>14</sup> Op. cit. para.106, p.40 and para.271, p.81

<sup>15</sup> Office for National Statistics (2005) *Identifying Sources of Entrepreneurship and the Informal Economy: Final Report on Identifying Data Sources on Entrepreneurship and the Informal Economy*. 15 July 2005. Available at [www.ons.gov.uk](http://www.ons.gov.uk) This report is still listed as part of ONS methodology.

<sup>16</sup> The Small Business Service, Inter-Departmental Business Register (IDBR), The Beta Model, YELL – Yellow Pages, Regional Intelligence Network, Small Firms Consultation Database: Inland Revenue, High Street Banks, The Phoenix Fund: Small Business Service, Annual Small Business Survey.

<sup>17</sup> Office for National Statistics (2012) “E-Commerce and ICT Activity, 2012”. 04 December 2013.

Available at [www.ons.gov.uk](http://www.ons.gov.uk)

<sup>18</sup> [ec.europa.eu/eurostat](http://ec.europa.eu/eurostat)

<sup>19</sup> UUK (3 April 2014, forthcoming) *The impact of universities on the UK economy*

[www.universitiesuk.ac.uk/highereducation/Pages/TheimpactofuniversitiesontheUKeconomy.aspx](http://www.universitiesuk.ac.uk/highereducation/Pages/TheimpactofuniversitiesontheUKeconomy.aspx)

2009<sup>20</sup>, this is not broken down into sectors, or into entrepreneurial contributions. They cited £59 billion as the wide economic impact of universities. In May 2013, HEFCE reported<sup>21</sup> that for the UK, “Universities in the UK contributed £3.4 billion to the economy in 2011-12 through services to business, including commercialisation of new knowledge, delivery of professional training and consultancy.” The HEFCE report<sup>22</sup> this headline is drawn from also does not break this down by sector, so no specific conclusions can be drawn, for 2011-12, on the 191 formal spin-offs set up “based on the world-class research carried out by UK universities” or on the 2,726 new enterprises established by graduates. The HESA data underlying this is not publically available.

The claims for the future impact of information technology are similarly high. The National Skills Academy for IT states that, “Both start-ups and growing businesses can realise enormous benefits from using technology. If more organisations do so, we can create an extra £47 billion GVA for the UK economy over the next 5 to 7 years.”<sup>23</sup> It is not possible to determine what part of this would stem directly from ‘core’ computer science, or from students studying such subjects; nevertheless, in terms of direct, indirect and diffuse impact, this is significant.

In England, the National Centre for Entrepreneurship in Education produces the Enterprise and Entrepreneurship in Higher Education survey, with the Institute for Small Business and Entrepreneurship (ISBE). Comparisons between 2010 (with some earlier data)<sup>24</sup> and 2012<sup>25</sup> for England are shown below.

The lower response rate in 2012 makes comparison with 2010 hard; again there is not enough information to bring out the contribution of computer science. They do, however, indicate the institutional range of environments,

---

<sup>20</sup> U Kelly, D McLellan, I McNicol (4 Nov 2009) *The impact of universities on the UK economy: fourth report*, Universities UK, ISBN 978 1 84036 219

[www.universitiesuk.ac.uk/highereducation/Pages/EconomicImpact4Full.aspx](http://www.universitiesuk.ac.uk/highereducation/Pages/EconomicImpact4Full.aspx)

<sup>21</sup> HEFCE (23 May 2013) “UK universities contribute to economic growth”, *News Archive*, [www.hefce.ac.uk/news/newsarchive/2013/news81928.html](http://www.hefce.ac.uk/news/newsarchive/2013/news81928.html)

<sup>22</sup> HEFCE (May 2013) *Higher Education – Business and Community Interaction survey 2010-11*, HEFCE 2013/11 [www.hefce.ac.uk/pubs/year/2013/201311/](http://www.hefce.ac.uk/pubs/year/2013/201311/)

<sup>23</sup> The National Skills Academy for IT (undated) “Digital Skills Academy” [www.itskillsacademy.ac.uk/digital-skills-academy/](http://www.itskillsacademy.ac.uk/digital-skills-academy/)

<sup>24</sup> D Rae, L Martin, V Antcliffe, P Hannon (November 2010) *The 2010 Survey of Enterprise and Entrepreneurship in Higher Education*, (Version 1.2), National Council for Graduate Entrepreneurship & Institute for Small Business & Entrepreneurship [www.ncee.org.uk/publication/ISBE\\_Report.pdf](http://www.ncee.org.uk/publication/ISBE_Report.pdf)

<sup>25</sup> NCEE (2012) *Enterprise and Entrepreneurship in Higher Education: England 2012 Survey*, National Centre for Entrepreneurship in Education [www.ncee.org.uk/publication/NCEE\\_2012\\_Mapping\\_Report.pdf](http://www.ncee.org.uk/publication/NCEE_2012_Mapping_Report.pdf)

so that a computer science department may recognise its own position in relation to the averages.

	<b>2012</b>	<b>2010</b>	<b>&lt;2010</b>
<b>Response Rate</b>	79% 89 of 113	92% 116 of 126	
<b>No of HEIs reporting accredited enterprise courses</b>	75	117	
<b>Student Engagement Rate (SER)</b>	18%	16%	2007: 11% 2006: 7%
<b>% male:female in accredited provision</b>	57:43 6% had no female students	53:47 19% had no female students	2007 as 2010
<b>HEIs providing general entrepreneurship support</b>	99		
<b>Start-up mentoring support</b>	71%		
<b>Average student/graduate start-ups per HEI</b>	35	28	22 in 2009
<b>New ventures</b>	1650	3277	2371 in 2009

#### **Institutional Support**

<b>Business and Management Provision</b> (rather than other departments)	50%	60%	2007, 2009 similar to 2010
<b>Start-up funds</b>	66%	66%	

#### **Institutional Policy and Infrastructure**

<b>Explicit Enterprise and Entrepreneurship (E&amp;E) policies</b>	49%	50%	
<b>PVCs for E&amp;E</b>	61%	60%	
<b>have appointed academic staff to teach enterprise</b>	87%	83%	
<b>have appointed professors</b>	55%	44%	
<b>have visiting positions for entrepreneurs</b>	35%	(around) 44%	
<b>Staff development support</b>	58%	64%	
<b>Student enterprise clubs</b>	70%	67%	
<b>E&amp;E as part of HEI mission</b>	57%	63%	
<b>Faculty-level action plans</b>	33%	40%	

### **3. Entrepreneurship in practice**

This section offers a range of approaches and connections to entrepreneurship education.

#### **3.1 Whole institution approaches**

The National Centre for Entrepreneurship in Education (NCEE)<sup>26</sup> sponsors the Entrepreneurial University of the Year award in the Times Higher Education Awards<sup>27</sup>. The University of Strathclyde won the 2013 award and their computing department is one of the case studies in this report. Some interesting points from the University's THE Award were that the university teaches entrepreneurial skills to its researchers; the network of alumni and businesses that supports emerging local entrepreneurs opened a chapter in Dubai; and that a specific career pathway has been created for staff who want to advance by concentrating on knowledge transfer.

#### **3.2 Working in Partnership**

Computer science departments, institutions and individuals – staff and students – take part in many organisations; this selection is not exhaustive.

The BCS (British Computer Society), the Chartered Institute for IT, runs an Entrepreneurs Specialist Group<sup>28</sup>, offering mentoring, access to interns, resources and events. Its objective is “to engage with entrepreneurial communities to grow the digital ecosystem for the benefit of members and society.”

The National Centre for Entrepreneurship in Education (NCEE)<sup>26</sup> aims to raise the profile of entrepreneurship in FE and HE; stimulate pro-entrepreneurial cultural change in institutions; build institutional capacity through staff development; and support entrepreneurship as a life choice amongst students, graduates and staff.

Enterprise Educators UK (EEUK)<sup>29</sup> is a national network which brings together over 800 enterprise and entrepreneurship educators and practitioners from 100 UK Higher and Further Education Institutions. They support members to increase the scale, scope and effectiveness of enterprise and entrepreneurship.

---

<sup>26</sup> [ncee.org.uk](http://ncee.org.uk) until 2011 the National Council for Graduate Entrepreneurship (NCGE)

<sup>27</sup> [www.the-awards.co.uk](http://www.the-awards.co.uk)

<sup>28</sup> [www.bcs.org/category/17002](http://www.bcs.org/category/17002)

<sup>29</sup> [www.enterprise.ac.uk](http://www.enterprise.ac.uk) It evolved from the UK Science Enterprise Centres (UKSEC) network.

The Graduate Entrepreneurship Project<sup>30</sup> (GEP), a partnership, which formed part of the University of Huddersfield's success in the 2012 THE Entrepreneurial University of the Year award, brings together all ten institutions in Yorkshire and the Humber to provide enterprise and business start-up support to their students and graduates. In addition to advice, it can provide proof-of-concept funding, start-up grants, and a residential boot-camp. The project has attracted £1.3million of investment from the European Regional Development Fund.

The Alacrity Foundation<sup>31</sup> is a collaboration between the Welsh Government, the independent grant-making Waterloo Foundation, and equity and investment management firm Wesley Clover Corporation. They develop graduates as entrepreneurs, to launch their own UK based demand-driven technology company.

The Scottish Institute for Enterprise<sup>32</sup> helps create new student businesses and social enterprises across Scotland, while specifically for computing, the Scottish Informatics and Computer Science Alliance (SICSA)<sup>33</sup> aims to “exploit and enhance the research capabilities and reputation of Scottish universities”, working with companies of all sizes to transfer advanced research to industry. SICSA works with Informatics Ventures<sup>34</sup> which helps early-stage companies, SMEs, corporates and public sector organisations engage with world-leading research; and ScotlandIS<sup>35</sup> which is the trade body for the digital technologies industry, representing over 270 software, telecomms, IT and digital agency businesses throughout Scotland. SICSA offers funding opportunities through SICSA Elevate<sup>36</sup>, an applied research accelerator program, which supports early career and early stage researchers, and can include a mixture of PhDs, postdocs and MSc students.

The Institute for Small Business and Entrepreneurship (ISBE) is a professional association of researchers, educators and practitioners concerned with entrepreneurship and small business in the UK. The registered charity's Board has trustees drawn from universities, small business and enterprise organisations.

---

<sup>30</sup> [graduateentrepreneurship.co.uk](http://graduateentrepreneurship.co.uk)

<sup>31</sup> [alacrityfoundation.co.uk](http://alacrityfoundation.co.uk)

<sup>32</sup> <http://www.sie.ac.uk/home.aspx>

<sup>33</sup> [www.sicsa.ac.uk](http://www.sicsa.ac.uk)

<sup>34</sup> [www.informatics-ventures.com](http://www.informatics-ventures.com)

<sup>35</sup> [www.scotlandis.com](http://www.scotlandis.com)

<sup>36</sup> [www.sicsa.ac.uk/funding/sicsa-elevate](http://www.sicsa.ac.uk/funding/sicsa-elevate)

The Creative Science Foundation<sup>37</sup> is a charity – funded by Intel, the University of Essex and four US HE institutions – which supports, explores and promotes the application of methods that encourage creative, multidisciplinary thought processes as part of science and engineering innovation.

The Industrial Partnership for the Information Economy<sup>38</sup> brings together clusters of small, high growth digital companies across England with national and global organisations, some of which have an obvious computer science core, such as Cisco, HP, IBM, Microsoft, SAS Software. If plans for an Industrial Partnership are approved, employers will, supported by government, collaborate to address the structural issues in the supply of skills which are constraining technology-enabled growth and innovation right across the economy.

### **3.3 Student-led entrepreneurship**

There is some evidence that membership of peer-led student enterprise societies enhances student learning, improves student confidence and changes students' intentions to become entrepreneurs<sup>39</sup>.

The National Association of College and University Entrepreneurs (NACUE)<sup>40</sup> is a nationwide network of nearly 200 student societies. NACUE directly supports the creation of enterprise societies in education institutions throughout the UK; organises regular events where students can learn from experts and each other; distributes funds to societies; and is a national advocate for students in discussions of employment and education.

NACUE has published a national guide to incubators<sup>41</sup>, to guide enterprise society leaders through the process of setting up incubators

Enactus is an international non-profit organisation, present in 36 countries including the UK<sup>42</sup>. Some 3,000 students at more than 50 UK universities are involved, out of the 1,650 universities world-wide. In the UK, there is also an

---

<sup>37</sup> [www.creative-science.org](http://www.creative-science.org)

<sup>38</sup> [www.techskillspartnership.com](http://www.techskillspartnership.com)

<sup>39</sup> L Pittaway, E Rodriguez-Falcon, O Aiyegbayo, A King (2011) "The role of entrepreneurship clubs and societies in entrepreneurial learning", *International Small Business Journal*, February 2011, 29 pp.37-57 [isb.sagepub.com/content/29/1/37.short](http://isb.sagepub.com/content/29/1/37.short)

<sup>40</sup> [nacue.com](http://nacue.com)

<sup>41</sup> NACUE (August 2011) The Official Incubator Notes [www.nacue.com/wp-content/uploads/2011/09/the-official-incubator-notes1.pdf](http://www.nacue.com/wp-content/uploads/2011/09/the-official-incubator-notes1.pdf)

<sup>42</sup> [www.enactusuk.org](http://www.enactusuk.org) Enactus was formerly Students in Free Enterprise (SIFE).

alumni network<sup>43</sup>. Computing-related partners and donors include Dell and Microsoft. In its own words;

Enactus brings together student, academic and business leaders who are committed to using the power of entrepreneurial action to improve the quality of life and standard of living for people in need. Guided by academic advisors and business experts, the student leaders of Enactus create and implement community empowerment projects.

One of its alumni, Alex Kantor (Kings College London, Computer Sciences, 2010) said of his experience;

Everyday I come across problems which are similar to those faced in my three years with Enactus and I know immediately from experience a way to try and solve the problem.<sup>44</sup>

FLUX, now in its 7<sup>th</sup> year, was held at the University of Lancaster 1-2 April 2014<sup>45</sup>. FLUX is the higher education sector's "largest annual competition to encourage entrepreneurship and bridge the gap between education and work." Students met entrepreneurs who have established their own companies within the special business co-location facilities in the Lancaster Environment Centre and InfoLab21<sup>46</sup>, a centre of excellence for research in information and communication technologies.

Google's first UK acquisition<sup>47</sup> was a student start-up, Plink, founded in 2008 by Mark Cummins and James Philbin, then PhD students at the University of Oxford's mobile robotics and visual geometry groups in the department of engineering. Google's noticed their app during the Android Develop Challenge, an initiative to promote innovative new applications for Google's mobile platform, when the pair won \$100,000. After selling to Google, they went to work on Google Glasses.

Working Knowledge<sup>48</sup> is a social enterprise which partners with the Further and Higher Education sectors to support the education of full time learners through employer engagement.

---

<sup>43</sup> [www.enactusukalumni.org](http://www.enactusukalumni.org)

<sup>44</sup> [www.enactusuk.org/careers/alumni-profiles/alex-kantor](http://www.enactusuk.org/careers/alumni-profiles/alex-kantor)

<sup>45</sup> Lancaster University (10 October 2013) "Lancaster University to host competition for UK's hottest young business brains", *News* [www.lancaster.ac.uk/lums/news/lancaster-university-to-host-competition-for-uks-hottest-young-business-brains/](http://www.lancaster.ac.uk/lums/news/lancaster-university-to-host-competition-for-uks-hottest-young-business-brains/) and [www.facebook.com/flux14lancaster](https://www.facebook.com/flux14lancaster)

<sup>46</sup> [www.infolab21.lancs.ac.uk](http://www.infolab21.lancs.ac.uk)

<sup>47</sup> J Kriss (12 April 2010) "Google buys UK startup Plink", *PDA, The Digital Content Blog*, The Guardian Online [www.theguardian.com/technology/pda/2010/apr/12/google-buys-uk-startup-plink](http://www.theguardian.com/technology/pda/2010/apr/12/google-buys-uk-startup-plink)

<sup>48</sup> [www.workingknowledge.org.uk](http://www.workingknowledge.org.uk)

### 3.4 Staff Spin-outs / Start-ups

In addition to those which feature in the case studies, see Appendix 2 for some additional spin-outs and start-ups.

### 3.5 Course Searches

For a prospective entrepreneurial student, discovering undergraduate and postgraduate courses with entrepreneurship may not be straightforward.

Searching UCAS<sup>49</sup> for undergraduate courses returns nine BSc variations on Entrepreneurship (plus Business Computing or Computing or Internet Computing) at Canterbury Christ Church University; a BSc or MSci in Computer Science Innovation at Lancaster University; and a BSc with or without a placement year in Business Entrepreneurship and Computing Innovations at the University of Cumbria.

UKPASS's postgraduate course search<sup>50</sup> returns 43 (computing and) entrepreneurship entries, though at most 13 of these are computer science courses (removing those in computer games, business or outside the UK). Searching for innovation returns 270 entries, but many of these are MAs or otherwise outside of computer science.

However, UKPASS's significant advantage is that the search is within both the title and the course summary, whereas UCAS only searches the title.

### 3.6 Developing curricula

Although many universities already work with industry to provide undergraduate and postgraduate curricula which meet industry's needs, the Industrial Partnership for the Information Economy's plans are that;

employers will, supported by government, collaborate to address the structural issues in the supply of skills which are constraining technology-enabled growth and innovation right across the economy.

The intention is to create so-called "Industry Gold Degrees and Internships", so that<sup>51</sup>;

Industry will work with universities to increase the availability and uptake of sector-backed degrees and internships which increase graduate employability. [and thus...] a suite of industry-accredited

---

<sup>49</sup> UCAS undergraduate course search [search.ucas.com](http://search.ucas.com) *comput entrepreneur* or *comput innovat*

<sup>50</sup> UKPASS postgraduate course search [ukpass.prospects.ac.uk/pgsearch/UKPASSCourse](http://ukpass.prospects.ac.uk/pgsearch/UKPASSCourse) within 'Computer sciences and IT', for *entrepreneurship* (stemmed words do not work)

<sup>51</sup> [www.techskillspartnership.com/our-plans.html](http://www.techskillspartnership.com/our-plans.html)

undergraduate provision related to growth markets; and industry standards for internships that increase uptake and employability.

### 3.7 Industrial Doctorate Centres

The Industrial Doctorate is an alternative, four-year programme to the traditional PhD for students who want a career in industry. It combines PhD-level research projects with taught courses, and students spend about 75% of their time working directly with a company. The centres<sup>52</sup> are EPSRC-funded. Of these, two are notably computer science-orientated, though many others have computer science underpinning them.

UCL's Centre in Virtual Environments, Imaging & Visualisation (VEIV)<sup>53</sup> advances the science and engineering of computational capture, rendering and simulation.

The University of York's Department of Computer Science runs the Engineering Doctorate in Large Scale Complex IT Systems<sup>54</sup> (LSCITS). Its aim is to produce the next generation of systems engineers and technology innovation leaders.

### 3.8 Skills profiling and diagnostic tools

Although much is made of employability skills in the current higher education environment, for example the joint work of the CBI (Confederation of British Industry) and NUS (National Union of Students) on their employability guide<sup>55,56</sup>, there is little relevant to the full depth of skills and experiences that computer science courses provide, or that mention entrepreneurship directly.

The National Skills Academy for IT hosts the profile-builder, My IT Professional Profile, an extensive, free tool that allows students and professionals to evaluate their IT professional skills against the industry benchmark, the IT Professional Standards<sup>57</sup> (currently version 4.0). Entrepreneurship is listed as a Leadership skill within the Transferable competencies. The tool also provides performance criteria.

---

<sup>52</sup> [www.epsrc.ac.uk/skills/students/centres/current/Pages/indd.aspx](http://www.epsrc.ac.uk/skills/students/centres/current/Pages/indd.aspx)

<sup>53</sup> [engdveiv.ucl.ac.uk](http://engdveiv.ucl.ac.uk)

<sup>54</sup> [www.cs.york.ac.uk/postgraduate/research-degrees/engd/](http://www.cs.york.ac.uk/postgraduate/research-degrees/engd/)

<sup>55</sup> CBI/NUS (16 May 2011) "Universities must embed employability skills in course structures: CBI and NUS launch new employability skills guide", *Press release*, CBI [www.cbi.org.uk/media-centre/press-releases/2011/05/universities-must-embed-employability-skills-in-course-structures-cbi-nus/](http://www.cbi.org.uk/media-centre/press-releases/2011/05/universities-must-embed-employability-skills-in-course-structures-cbi-nus/)

<sup>56</sup> CBI/NUS (March 2011) *Working towards your future: Making the most of your time in higher education*, CBI. Available on above web page.

<sup>57</sup> [www.itskillsacademy.ac.uk/standards/it-professional-standards/](http://www.itskillsacademy.ac.uk/standards/it-professional-standards/)

### **3.9 The enterprise and entrepreneurship mix for intra- and extra-curricular activities**

The QAA's guidance on enterprise and entrepreneurship education<sup>7</sup> states that "the ultimate goal of enterprise and entrepreneurship education is to develop entrepreneurial effectiveness", which through a variety of intra- and extra-curricular activities is built through four key stages: enterprise awareness, developing an entrepreneurial mindset, developing entrepreneurial capability and entrepreneurial effectiveness.

The document gives explicit guidance on what students should be able to do, and what opportunities delivery should provide.

These high-level lists of enterprise and entrepreneurship activities are derived from the 2010 Survey of Enterprise and Entrepreneurship in Higher Education<sup>24</sup>. Categories include:

**Extracurricular enterprise & entrepreneurship provision:** workshops, entrepreneur events, business plan competitions, ideas competitions, enterprise or entrepreneurship games workshops, enterprise or entrepreneurship summer schools.

**Enterprise skills development:** enterprise or entrepreneurship skills training programmes, careers services events or workshops, student enterprise placement programmes, student employability workshops, placements or internships with entrepreneurs & small businesses, personal coaching.

**Universities funding from all sources:** university core funds; university special funds; central government contracts; EU funding; international country-specific initiative; global agency; overseas foundation; private sector funds; paid fee income; endowments; sponsorship; higher education funding; regional or local government or development funds; other.

**Policies for enterprise support:** student and graduate entrepreneurship; graduate employability; research and knowledge transfer; innovation teaching and learning; business incubation / venture creation.

**HEI infrastructure provision:** student incubator; hot-desking; start-up funds; student-led society; enterprise interns; enterprise champions; student enterprise centre; academic enterprise technology transfer office; specialist female, ethnic or social enterprise centre; webpage for enterprise support; adjunct visiting entrepreneurs; entrepreneurs-in-residence; on-campus enterprise clinics/surgeries.

**Venture creation support activities:** mentoring for start-up; start-up support programmes; enterprise awareness events / festivals; technical, professional, funding & specialist advice; access to funding workshops; student enterprise conferences; investor events.

## 4. Case studies

The 2014 Research Excellence Framework<sup>58</sup> (REF) is expected to provide entrepreneurship-orientated material for Computer Science and Informatics (Unit of Assessment 11) in higher education in various ways, such as figures for income, pedagogical research, REF-impact case studies, or contributions to the research environment. However, the REF documentation will not become public until spring 2015, leaving a gap of another year.

These four examples of approaches to entrepreneurship are ones of good practice. However, this is only a small number amongst the many that could be developed. These are intended to inspire interest and ideas.

The variation in institutional mission statements – entrepreneurial, enterprise, fundamental research, etc. – and institutional and departmental structures and approaches to student-led or staff-led entrepreneurship makes comparison or any notion of ‘best practice’ inappropriate.

Thus, no particular view of transferability has been taken, and no ‘acceptance criteria’ for the case studies have been insisted upon. The case studies are presented ‘as is’.

There is additional material in Appendix 2 listing links to the start-ups and spin-offs, and to other pages of related interest.

Whilst noting that the REF will provide further evidence of entrepreneurial activities, it is also worth indicating some of the limitations of that data, some of which also cannot be dealt with in this study.

The income figures are collated according to HESA’s generic categories, and will not show enough detail for start-ups and spin offs, nor the longevity of individual entrepreneurial enterprises. The REF impact and environment submission templates are limited in page length; the number of case studies is also limited, and start-ups are only one of the possible types for inclusion. The case studies are, for REF purposes, indicative of an institution’s quality of work, not exhaustive or representative of the range of work of any individual institution. Additionally, the REF does not recognise student entrepreneurship at all; however, this is one feature that is addressed in this paper.

---

<sup>58</sup> [www.ref.ac.uk](http://www.ref.ac.uk)

## 4.1 Vertically-Integrated Projects at the University of Strathclyde

The University of Strathclyde won the THE Award for Entrepreneurial University of the Year 2013/14. The Vertically-Integrated Projects are part of the University's undergraduate education programme, based on the VIP programme developed by Prof Ed Coyle at Georgia and Purdue Universities.

Strathclyde's Principal, Prof Jim MacDonald, says he is personally committed to VIPs in the long-term, and that they are about capitalising on the energy between their staff, students and resources.

These projects give first year to postgraduate students the opportunity to work with academic staff and research students in multi-disciplinary teams on cutting-edge research and development projects. Undergraduate students who join VIP teams earn academic credit, and may have work published. Some teams are open and some are specified, but always multidisciplinary.

Teams are 'vertically-integrated', maintaining a mix of first year undergraduate students through to PhD students, and long-term: each undergraduate student may participate in a project for up to three years, and PhD students may take part for the duration of their time.

Three current VIPs are open to students from the School of Computer & Information Sciences. *TextLab* aims to select, prepare, analyse and preserve digital texts using techniques and technologies drawn from Digital Humanities, Linguistics, Statistics, and Information Science. *Robotic Vehicles for Education and Research* aims to design, build and develop completely autonomous, robotic vehicles to improve sensing capabilities of the environment and the smart cities of the future. *Building Strathclyde's Enterprise Community* aims to help develop and run an integrated system at the University enabling entrepreneurial students and alumni to flourish; help Strathclyde Entrepreneurial Network to increase its impact; and help to prepare for a step change in services to entrepreneurs with the opening of the Technology and Innovation Centre.

[www.strath.ac.uk/viprojects/](http://www.strath.ac.uk/viprojects/), [www.youtube.com/watch?v=EyoBx5A-eBc](http://www.youtube.com/watch?v=EyoBx5A-eBc)  
[www.strath.ac.uk/cis/](http://www.strath.ac.uk/cis/) and Georgia Tech [vip.gatech.edu](http://vip.gatech.edu)

## 4.2 Spin-outs at the University of Manchester

Manchester Computer Science has a strong history and culture of impact and industrial linkage: early computers were commercialised by Ferranti; virtual memory is central to the most widely-shipped operating systems; more recently, software building upon Manchester research has shipped with Microsoft Windows and on over 14 million Apple computers. In 2008-13, there were 50 invention disclosures in Computer Science, involving 29 people.

In the 2008-13, 10 spin-outs directly marketed their research employing over 250 staff, from organisations with computer science central to their mission – e.g. Transitive and binary translation – to those applying computing in other domains – e.g. KSS Fuel and KSS Retail and intelligent pricing support systems. Further, licensing arrangements and collaborations on knowledge exchange projects enabled applications such as text mining services for large document archives with Elsevier and scientific workflow platforms with Eagle Genomics.

In terms of economic impact, Transitive software was used in approximately 25M Mac computers in 2006-9; it is estimated that, partly as a consequence, Apple revenue increased by over \$20B (200% increase in sales 2006-9) and Intel chip revenue increased by \$1B. KSS Fuel and KSS Retail are the leading global suppliers of pricing software with combined revenues of £18.2M; KSS Fuel (now Kalibrate) floated in 2013 with a market capitalisation of £26.2M.

IBM's Manchester Development Laboratory has its origins in technologies (Transitive) developed at Manchester. The quality of Manchester's graduates played a key role in the decision to open the Lab, a strong pool of talent – many of the Lab's staff and several of the management team are alumni.

Research groups receive an annual budget over £200K to support activities enabling rapid creation and follow-up of opportunities.

Their innovation company provides expertise on IP commercialisation and incubation, managing the largest single-university dedicated seed fund in Europe (£32M).

Related activities include: the Industry Club, over 50 organisations that have employed graduates; a LinkedIn alumni group, around 1000 members worldwide; and more than 70 undergraduate students on industrial placement in 2013-14.

[www.cs.manchester.ac.uk](http://www.cs.manchester.ac.uk) Manchester Enterprise Centre  
[mec.portals.mbs.ac.uk](http://mec.portals.mbs.ac.uk)

### **4.3 Disruptive technology spin-out at Queens University Belfast**

Analytics Engines is a Belfast-based specialist in accelerating applications for databases and Big Data. It received a “Highly Commended” award from the InterTrade Ireland Seedcorn Investor Readiness Competition 2013, and in February 2014 announced the completion of £1,000,000+ investment from Crescent Capital. This venture capital firm believes that their investment is further evidence that high technology firms with market-changing export potential are emerging from the indigenous entrepreneurial culture in Northern Ireland.

Analytics Engines acceleration technology is currently implemented in finance, image processing and data analytics domains, on which they have published case studies. Their products have benefits to further sectors needing faster, more accurate analytics on large data volumes, e.g. in genomics, utilities and databases. The investment will enable more rapid productisation and exploitation of intellectual property, diversify current offerings into new sectors, support the product development roadmap and expand the company’s global footprint.

Analytics Engines previously won the Silicon Valley 2013 Best Emerging Technology Award from the Irish Technology Leadership Group. The company has used its partnerships with Philips Healthcare, SAP, Credit Suisse and others to demonstrate significant performance benefits over systems in current usage. The company actively promotes its achievements in the media.

Analytics Engines works closely with the School of Electronics Electrical Engineering & Computer Science. CTO Professor Roger Woods is currently seconded under an EPSRC Impact award from Queen’s University Belfast.

Meanwhile, in the School, employer engagement is a key strength of their courses. Links with around 500 technology companies provide placement opportunities. Furthermore, the School’s Industrial Advisory Board enables employers to feed into the modules that they teach.

The School runs innovation and enterprise modules, such as the Industrial Project where student teams explore creating a technology company; some groups have taken their ideas into external funding competitions. It also runs a “Tournaments in Computing” module, where successful projects compete through poster, demonstration, presentation and viva.

[www.analyticsengines.com](http://www.analyticsengines.com) and [www.qub.ac.uk/schools/eeecs](http://www.qub.ac.uk/schools/eeecs)

#### **4.4 Student IT Consultants at the University of Kent**

The KITC, Kent IT Consultancy, is part of the University of Kent's School of Computing. It is run by IT consultants who are students at the University of Kent. Many of the consultants have completed industrial placements for major companies such as Intel, IBM and Microsoft, giving them significant experience in both business and technical roles. The relationships between the KITC consultants and their clients are managed by full-time IT professionals and are closely mentored by staff members of the School of Computing.

IBM UK has been a strong supporter of the KITC since inception in 2004, precisely because of the skill set it imparts to students. The KITC was conceived to satisfy two important goals. The School of Computing sees it as natural to partner with industry to give students practical experience complementing their academic studies. Looking at the environment of Kent, they realised that nearly all industrial activity is in SMEs and indeed micro businesses, so they conceived of something that could both serve the needs of these businesses and give their students valuable experience as consultants working directly with customers.

Thus, KITC's mission is to solve business problems for local start-ups and small businesses with technology, and make their student consultants more employable. Supporting this, KITC delivers three core services:

- Technology Foundations – workshops and whitepapers that focus on how small businesses can harness the power of current trends in information technology to solve their business problems.
- Guidance – individual guidance to businesses, to help them understand their IT needs, formulating requirements, and identifying matching solutions.
- Implementation – support to implement solutions and provide the training required to get them up and running.

The client-led work the student consultants undertake enables them to apply their academic studies and experience in a real-life setting. This is backed up by the provision of specific, industry-focused training and support from both academics and professional IT consultants.

Students apply, and are interviewed, to become a consultant within modules for IT consultancy practice or projects, for 15, 30 or 60 credits, with a consultancy methods module.

[www.kitc-solutions.co.uk](http://www.kitc-solutions.co.uk) and [www.cs.kent.ac.uk/students/careers/KITC](http://www.cs.kent.ac.uk/students/careers/KITC)

## 5. Concluding comments

Entrepreneurship in Computer Science departments has a clear presence and impact across the UK. Impact will become more visible with the publication of the Research Excellence Framework, in spring 2015, although this will not be a comprehensive survey of activity.

Some of the significant issues concerning availability of entrepreneurship data are noted throughout the paper.

Some key features of successful entrepreneurial activity:

- High-level leadership and commitment
- Staff with entrepreneurship skills, and also those with the ability to teach them, are valued and rewarded
- Start-ups and spin-offs have access to funds during their early years
- Alumni are involved in networks
- Early-stage entrepreneurs receive mentoring
- The institution is able to offer consultancy for businesses
- Students have opportunities to work on projects, and projects can involve working with businesses on live projects
- Students engage in self-organised activities
- There is significant networking and cross-provision of entrepreneurial and enterprise knowledge and skills
- Connections and successes are communicated visibly on relevant websites and released through various media channels

Barriers observed to the visibility of entrepreneurial computer science include:

- The dearth of public data on entrepreneurship and computer science, relating to course uptake and graduate destinations.
- Collated data on computer science start-ups and spin-offs, whether led by staff or students is not available.
- UCAS course search only uses the course title, not the course summary (unlike UKPASS), or any of the deeper information on modules.

Computer science graduates' contributions to entrepreneurial activity in the UK is strong and computer science departments throughout the UK HE sector are facilitating this activity in a range of ways including curriculum development, student incubators and rewarding staff engaged in entrepreneurial activity. In this report we have presented a snapshot of activity as a means of capturing and celebrating success.

## Appendix 1 The context of computer science graduate unemployment

In 2013 negative press relating to computer science graduate employment rates appeared, questioning the impact of computer science students and hence departments.

In August 2013, Times Higher Education ran an article, “Try turning it off and on again: Computer science graduates face highest unemployment rates”<sup>59</sup>, based on data from HESA’s “Destination of Leavers from Higher Education 2011-12”<sup>60</sup>. The only news for computer science students was this; “More than 14 per cent of UK-domiciled first-degree computer science graduates were unemployed six months after graduation. This compares with less than 1 per cent in medicine and dentistry subjects and 4 per cent in education.” What the article did not say was that the average was 9% across all subjects, or that those going into employment (68%), rather than going on to further study, was higher than the all-subject average (63%).

Professors Liz Bacon and Lachlan MacKinnon responded robustly in September 2013 in the online Guardian Higher Education Network to explain, “Computer science graduates: why do they top unemployment tables?”<sup>61</sup>. The story contained good news about demand for IT and telecoms recruitment, and presented a wider, multi-faceted and nuanced picture of the relatively high percentage of computer science graduates that are unemployed, based on research<sup>62</sup> commissioned by the CPHC, also derived from the HESA data.

A key finding was the lower employment rates of black and minority ethnic (BME) students. Computer science’s active widening participation agenda, which particularly influences post-92 institutions in terms of student numbers, although also affects Russell Group BME students, has worked to attract applicants from under-represented groups in to HE. Another key finding

---

<sup>59</sup> E Gibney (22 August 2013) “Try turning it off and on again: Computer science graduates face highest unemployment rates”, *News*, Times Higher Education. Available at [www.timeshighereducation.co.uk/news/try-turning-it-off-and-on-again/2006683.article](http://www.timeshighereducation.co.uk/news/try-turning-it-off-and-on-again/2006683.article)

<sup>60</sup> HESA (27 June 2013) “Table 3 - Destinations of full-time first degree leavers by gender, activity and subject area 2011/12”, *Destinations of Leavers from Higher Education in the United Kingdom for the Academic Year 2011/12*, (HESA SFR 192), Higher Education Statistics Agency Limited. Available via [www.hesa.ac.uk/index.php?option=com\\_content&task=view&id=1899&Itemid=239](http://www.hesa.ac.uk/index.php?option=com_content&task=view&id=1899&Itemid=239)

<sup>61</sup> L Bacon and L MacKinnon (16 September 2013) “Computer science graduates: why do they top unemployment tables?” The Guardian Higher Education Network. Online. Available at [www.theguardian.com/higher-education-network/blog/2013/sep/16/computer-science-graduates-unemployment-bme](http://www.theguardian.com/higher-education-network/blog/2013/sep/16/computer-science-graduates-unemployment-bme)

<sup>62</sup> R Mellors-Bourne (July 2012 with Executive Summary by the CPHC Committee) *CS Graduate Unemployment Report 2012*, CPHC. Available at [cphc.ac.uk/members-area/reports/](http://cphc.ac.uk/members-area/reports/)

reflects changes in the structure of employment opportunities, loss of graduate training schemes and increased off-shoring of graduate jobs.

The CPHC published a report on computer science unemployment in July 2012; a year before the HESA data was published and picked up in the press.

The solutions are most easily left to Bacon and MacKinnon's own words;

Firstly, the employment prospects of BME graduates need to be tackled at a national level. Only parity of treatment by employers will enable the benefits of widening access to higher education, and the particular success of computer science in attracting students from diverse communities.

Secondly, employers need to be incentivised to reintroduce graduate training schemes and stop offshoring graduate jobs, to provide employment prospects for new graduates that will rebuild the pool of talent and experience for the UK IT industry. These issues can be tackled locally or nationally, but they must be tackled or the UK will lose its current world-leading position as a knowledge economy.

New evidence and press reports on women in computer science have emerged, which link through, as for BME students, from school and university to employment. The destination of leavers in Higher Education (DLHE) report on 2011/2012<sup>63</sup> reports female first degree unemployment rate of 13% overall compared with male students unemployment rate of 21%. 83% of all computer science graduates are male<sup>64</sup> so higher male unemployment rates are likely to affect computer science disproportionately.

Graduates could, however, have other expectations than taking up graduate employment, for example, becoming entrepreneurs. How computer science departments approach entrepreneurship is addressed in this paper.

---

<sup>63</sup> [http://www.hesa.ac.uk/index.php?option=com\\_content&task=view&id=1899&Itemid=](http://www.hesa.ac.uk/index.php?option=com_content&task=view&id=1899&Itemid=)

<sup>64</sup> <http://www.theguardian.com/education/datablog/2013/jan/29/how-many-men-and-women-are-studying-at-my-university#data>

## Appendix 2 UK university websites – some featured entrepreneurship content

Items in this listing were generally chosen as follows:

- does the CPHC member institution's computer science or equivalent department contain obvious, links related to spin-outs, start-ups, entrepreneurial activity, or industry? (There may be some missing.)
- If not, list the university's general business services.

Aberystwyth University, Department of Computer Science	Aberystwyth works with Codiki td <a href="http://www.codiki.co.uk">www.codiki.co.uk</a> to develop and commercialise apps.
Aston University, Department of Computer Science	Student-created software product development company, Codevate Ltd <a href="http://www.codevate.com">www.codevate.com</a> inks to business <a href="http://www.aston.ac.uk/business/links-to-business">www.aston.ac.uk/business/links-to-business</a>
Bangor University, School of Computer Science	Inventorium <a href="http://www.inventorium.org">www.inventorium.org</a> works with start-ups, existing businesses, social enterprises, institutions and individuals. It is a partnership between the Centre for Advanced Software Technology (CAST) <a href="http://www.bangor.ac.uk/cs/Business/cast.php">www.bangor.ac.uk/cs/Business/cast.php</a> in Bangor and NDRC in Dublin, and is a three-year, European-funded programme.
Birkbeck, University of London, Computer Science & Information Systems	London Knowledge Lab <a href="http://www.lkl.ac.uk">www.lkl.ac.uk</a> collaboration between the Institute of Education and Birkbeck. The Lab brings together computer and social scientists from a very broad range of fields.
Birmingham City University, School of Computing, Telecommunications & Networks	Zibit Datalab <a href="http://www.linkedin.com/company/zibit-datalab">www.linkedin.com/company/zibit-datalab</a> student start-up.
Bournemouth University, School of Design, Engineering & Computing	Festival of Design & Innovation <a href="http://dec.bournemouth.ac.uk/festival.html">dec.bournemouth.ac.uk/festival.html</a> showcases the designs, models and prototypes created by their design and creative technology students as their final year project.
Brunel University, School of Information Systems, Computing & Mathematics	Business collaboration <a href="http://www.brunel.ac.uk/business">www.brunel.ac.uk/business</a> including the Science Park
Canterbury Christ Church University, Department of Computing	Business services <a href="http://www.canterbury.ac.uk/business-services">www.canterbury.ac.uk/business-services</a>
Cardiff Metropolitan, Department of Information Systems & International Studies	Event Rater Ltd <a href="http://www.event-rater.com">www.event-rater.com</a> student startup shortlisted for the 'Best New Event Technology Startup' award at the Event Technology Awards 2013. Centre for Student Entrepreneurship <a href="http://www3.uwic.ac.uk/english/businessservices/cse">www3.uwic.ac.uk/english/businessservices/cse</a>
Cardiff University, School of Computer Science & Informatics	Research, Innovation and Enterprise Services Department <a href="http://www.cardiff.ac.uk/racdv">www.cardiff.ac.uk/racdv</a>

Coventry University, Department of Computing	Business services <a href="http://www.coventry.ac.uk/life-on-campus/faculties-and-schools/faculty-of-engineering-and-computing/engineering-and-computing-business-services">www.coventry.ac.uk/life-on-campus/faculties-and-schools/faculty-of-engineering-and-computing/engineering-and-computing-business-services</a> Institute of applied Entrepreneurship: Student Enterprise Fund <a href="http://www.coventry.ac.uk/research/research-directory/business-management/institute-of-applied-entrepreneurship-2/institute-of-applied-entrepreneurship-services-for-business/sef">www.coventry.ac.uk/research/research-directory/business-management/institute-of-applied-entrepreneurship-2/institute-of-applied-entrepreneurship-services-for-business/sef</a>
De Montfort University, School of Computer Science & Informatics	Working with industry <a href="http://www.dmu.ac.uk/about-dmu/schools-and-departments/school-of-computer-science-and-informatics/working-with-industry.aspx">www.dmu.ac.uk/about-dmu/schools-and-departments/school-of-computer-science-and-informatics/working-with-industry.aspx</a>
Edinburgh Napier University, School of Computing	Spin-Outs ZoneFox, <a href="http://www.inquisitive-systems.com">www.inquisitive-systems.com</a> ; Cloud4Health <a href="http://cloud4health.com">cloud4health.com</a> Bright Red Ventures student incubator for computing <a href="http://www.napier.ac.uk/business-school/bright-red-triangle/Pages/Links.aspx">www.napier.ac.uk/business-school/bright-red-triangle/Pages/Links.aspx</a>
Glasgow Caledonian University, School of Engineering & Built Environment	Consultancy case studies <a href="http://www.gcu.ac.uk/ebe/businessservices/casestudies">www.gcu.ac.uk/ebe/businessservices/casestudies</a>
Glyndŵr University, School of Computing & Communications Technology	Recent research grants/income <a href="http://www.glyndwr.ac.uk/CARDS/Income">www.glyndwr.ac.uk/CARDS/Income</a>
Goldsmiths, University of London, Department of Computing	(Related, but not DC, it appears) i2 media research <a href="http://www.gold.ac.uk/i2">www.gold.ac.uk/i2</a> digital consumer research spin out
Heriot-Watt University, School of Mathematical & Computer Science	Works with Scottish Informatics and Computer Science Alliance (SICSA), see Appendix 3.
Imperial College London, Department of Computing	The university's Imperial Consultants (ICON) <a href="http://www.imperial-consultants.co.uk">www.imperial-consultants.co.uk</a>
Keele University, School of Computing & Mathematics	Science & Business Park <a href="http://www.kusbp.co.uk">www.kusbp.co.uk</a>
King's College London, Department of Informatics	Innovation & Enterprise <a href="http://www.kcl.ac.uk/nms/depts/informatics/innovation">www.kcl.ac.uk/nms/depts/informatics/innovation</a>
Kingston University, School of Computing & Information Systems	InKUbator <a href="http://sec.kingston.ac.uk/gameslab">sec.kingston.ac.uk/gameslab</a> brings together programmers, writers, artists, commercialisers as undergraduates and postgraduates in the Faculty of Science, Engineering and Computing and the Faculty of Art, Design and Architecture to help students produce finished, working games.
Leeds Metropolitan University, School of Computing, Creative Technologies & Engineering	Business services <a href="http://www.leedsmet.ac.uk/business">www.leedsmet.ac.uk/business</a>
Liverpool Hope University, Department of Computing & Mathematical Sciences	Hope Business Gateway <a href="http://www.hope.ac.uk/businessgateway">www.hope.ac.uk/businessgateway</a>
Liverpool John Moores University, School of Computing & Mathematical Sciences	Enterprise and commercial activities <a href="http://www.ljmu.ac.uk/cmp/enterprise">www.ljmu.ac.uk/cmp/enterprise</a>
London City University, Department of Computer Science	London City Incubator (LCI) <a href="http://www.city.ac.uk/for-business/business-services/london-incubator">www.city.ac.uk/for-business/business-services/london-incubator</a>

London Metropolitan University, School of Computing	Student Enterprise Workshop (SEW) <a href="http://www.londonmet.ac.uk/faculties/faculty-of-life-sciences-and-computing/school-of-computing/employability/employability/student-enterprise-workshops">www.londonmet.ac.uk/faculties/faculty-of-life-sciences-and-computing/school-of-computing/employability/employability/student-enterprise-workshops</a>
London South Bank University, Department of Informatics	Business services <a href="http://www.lsbu.ac.uk/business-and-partners/business">www.lsbu.ac.uk/business-and-partners/business</a>
Loughborough University, Department of Computer Science	Staff projects <a href="http://www.lboro.ac.uk/departments/compsci/enterprise">www.lboro.ac.uk/departments/compsci/enterprise</a>
Manchester Metropolitan University, The School of Computing, Mathematics & Digital Technology	Business services <a href="http://www.scmdt.mmu.ac.uk/business_services">www.scmdt.mmu.ac.uk/business_services</a>
Middlesex University, School of Computing	Entrepreneurship for students <a href="http://unihub.mdx.ac.uk/Employability/selfemployment">unihub.mdx.ac.uk/Employability/selfemployment</a>
Newcastle University, School of Computing Sciences	Research impact <a href="http://www.ncl.ac.uk/computing/research/resimpact">www.ncl.ac.uk/computing/research/resimpact</a> including spin-off Arjuna Technologies <a href="http://www.arjuna.com">www.arjuna.com</a> News: EPSRC Centre for Doctoral Training in Cloud Computing for Big Data <a href="http://www.ncl.ac.uk/computing/about/news/item/newcastle-university-named-as-the-centre-for-doctoral-training-in-cloud-computing">www.ncl.ac.uk/computing/about/news/item/newcastle-university-named-as-the-centre-for-doctoral-training-in-cloud-computing</a>
Northumbria University, School of Computer Science and Digital Technologies	Research and business <a href="http://www.northumbria.ac.uk/sd/academic/ee/work">www.northumbria.ac.uk/sd/academic/ee/work</a>
Nottingham Trent University, Department of Computing & Technology	Business services <a href="http://www.ntu.ac.uk/sat/business">www.ntu.ac.uk/sat/business</a>
Open University, Department of Computing & Communication	(Research pages <a href="http://www.computing.open.ac.uk/research">www.computing.open.ac.uk/research</a> )
Oxford Brookes University, Department of Computing & Communication Technologies	Support for entrepreneurship and Innovation <a href="http://business.brookes.ac.uk/commercial/work/entrepreneurship-innovation">business.brookes.ac.uk/commercial/work/entrepreneurship-innovation</a>
Queen Mary, University of London, School of Electronic Engineering & Computer Science	Spin-outs <a href="http://www.eecs.qmul.ac.uk/research/impact">www.eecs.qmul.ac.uk/research/impact</a> , including Actual Experience <a href="http://www.eecs.qmul.ac.uk/news/view/fourfold-rise-in-actual-experience-shares-on-first-day-of-trading">www.eecs.qmul.ac.uk/news/view/fourfold-rise-in-actual-experience-shares-on-first-day-of-trading</a>
Queen's University of Belfast, School of Electronics Electrical Engineering & Computer Science	Spin-outs <a href="http://www.qub.ac.uk/schools/eeecs/ResearchImpact/Spin-outCompanies">www.qub.ac.uk/schools/eeecs/ResearchImpact/Spin-outCompanies</a> including Analytics Engines <a href="http://www.analyticsengines.com">www.analyticsengines.com</a>
Robert Gordon University, School of Computer Science & Digital Media	interesting scrolling approach to news <a href="http://wordpressweb.comp.rgu.ac.uk">wordpressweb.comp.rgu.ac.uk</a> AmbieSense <a href="http://www.ambiesense.com">www.ambiesense.com</a> innovative products and services for the distribution and delivery of mobile content, spin-out from a European Union funded R&D project. <a href="http://www.plansea.co.uk">www.plansea.co.uk</a> commercialisation in progress of developed PSV fleet planning/vessel scheduling/voyage reporting software

Royal Holloway, University of London, Department of Computer Science	Business services <a href="http://www.rhul.ac.uk/forbusiness">www.rhul.ac.uk/forbusiness</a>
Sheffield Hallam University, Department of Computing	Business services <a href="http://www.shu.ac.uk/business">www.shu.ac.uk/business</a>
Southampton Solent University, Technology School	Enterprise activities <a href="http://www.solent.ac.uk/business-community/services/enterprise-activities.aspx">www.solent.ac.uk/business-community/services/enterprise-activities.aspx</a>
Staffordshire University, School of Computing	Computing, Engineering, Sciences & Technology graduate exhibition <a href="http://www.staffs.ac.uk/events/gradex">www.staffs.ac.uk/events/gradex</a> Services for business <a href="http://www.staffs.ac.uk/for_business">www.staffs.ac.uk/for_business</a>
Swansea University, Department of Computer Science	Business and Community Engagement <a href="http://www.swansea.ac.uk/compsci/businessandcommunityengagement">www.swansea.ac.uk/compsci/businessandcommunityengagement</a>
Teesside University, School of Computing	Business services <a href="http://www.tees.ac.uk/schools/scm/business_services.cfm">www.tees.ac.uk/schools/scm/business_services.cfm</a>
University College London, Department of Computer Science	Spin-outs <a href="http://www.cs.ucl.ac.uk/business/spin_outs">www.cs.ucl.ac.uk/business/spin_outs</a>
University of Aberdeen, Department of Computer Science	Aberdeen Software Factory student-run software house <a href="http://www.abdn.ac.uk/ncs/departments/computing-science/aberdeen-software-factory-338.php">www.abdn.ac.uk/ncs/departments/computing-science/aberdeen-software-factory-338.php</a>
University of Abertay Dundee, School of Engineering, Computing & Applied Maths	Business services <a href="http://www.abertay.ac.uk/business">www.abertay.ac.uk/business</a>
University of Bath, Department of Computer Science	Meanbee student start-up <a href="http://www.meanbee.com">www.meanbee.com</a> Services for business <a href="http://www.bath.ac.uk/business">www.bath.ac.uk/business</a>
University of Bedfordshire, Computer Science and Technology	European partnership programme offering training <a href="http://www.beds.ac.uk/knowledgehub/entrepreneurship/basic">www.beds.ac.uk/knowledgehub/entrepreneurship/basic</a>
University of Birmingham, School of Computer Science	Business services <a href="http://www.birmingham.ac.uk/partners">www.birmingham.ac.uk/partners</a>
University of Bradford, Department of Computing	Business services <a href="http://www.bradford.ac.uk/business">www.bradford.ac.uk/business</a>
University of Brighton, School of Computer Science, Engineering & Mathematics	Business services <a href="http://www.brighton.ac.uk/cem/business">www.brighton.ac.uk/cem/business</a>
University of Bristol, Department of Computer Science	Business services <a href="http://www.bristol.ac.uk/business">www.bristol.ac.uk/business</a>
University of Buckingham, Department of Applied Computing	(Research <a href="http://www.buckingham.ac.uk/research/appliedcomputing">www.buckingham.ac.uk/research/appliedcomputing</a> )
University of Cambridge, Computer Laboratory	Opportunities include Accelerate Cambridge <a href="http://www.accelerate.jbs.cam.ac.uk">www.accelerate.jbs.cam.ac.uk</a>
University of Central Lancashire, School of Computing, Engineering & Physical Sciences	Business and Innovation <a href="http://www.uclan.ac.uk/schools/computing_engineering_physical_sciences/business_innovation.php">www.uclan.ac.uk/schools/computing_engineering_physical_sciences/business_innovation.php</a>
University of Chester, School of Computer Science, Department of Computer Science	The Informatics Centre <a href="http://www.chester.ac.uk/departments/csis/infocent">www.chester.ac.uk/departments/csis/infocent</a> development of web and mobile applications
University of Derby, School of Computing and Mathematics	Business services <a href="http://www.derby.ac.uk/business">www.derby.ac.uk/business</a>

University of Dundee, School of Computer Science	For all students <a href="http://www.enterprise-gym.com">www.enterprise-gym.com</a> Business partnerships, Industrial Advisory Board, Placements (may be credit-bearing) <a href="http://www.computing.dundee.ac.uk/industry">www.computing.dundee.ac.uk/industry</a>
University of Durham, School of Engineering & Computing Science	Industry <a href="http://www.dur.ac.uk/ecs/industry">www.dur.ac.uk/ecs/industry</a>
University of East Anglia, School of Computing Sciences	Business and enterprise opportunities <a href="http://www.uea.ac.uk/computing/working-with-business">www.uea.ac.uk/computing/working-with-business</a>
University of Edinburgh, School of Informatics	Innovation for Industry, including spin-offs, <a href="http://www.ed.ac.uk/schools-departments/informatics/innovation-industry">www.ed.ac.uk/schools-departments/informatics/innovation-industry</a>
University of Essex, School of Computing Science and Electronic Engineering	Industry <a href="http://www.essex.ac.uk/csee/research/industry.aspx">www.essex.ac.uk/csee/research/industry.aspx</a>
University of Exeter, Department of Computer Science	Business services <a href="http://www.exeter.ac.uk/business">www.exeter.ac.uk/business</a>
University of Glasgow, School of Computing Science	Business services <a href="http://www.gla.ac.uk/businessandinnovation">www.gla.ac.uk/businessandinnovation</a>
University of Gloucestershire, School of Computing and Technology	Business services <a href="http://www.glos.ac.uk/forbusiness">www.glos.ac.uk/forbusiness</a>
University of Greenwich, School of Computing & Mathematical Sciences	Business services <a href="http://www2.gre.ac.uk/about/schools/cms/services">www2.gre.ac.uk/about/schools/cms/services</a> GWizards student-run company <a href="http://www2.gre.ac.uk/about/schools/cms/services/gwizards">www2.gre.ac.uk/about/schools/cms/services/gwizards</a>
University of Hertfordshire, School of Computer Science	Business services <a href="http://www.herts.ac.uk/apply/schools-of-study/computer-science/commercial-services">www.herts.ac.uk/apply/schools-of-study/computer-science/commercial-services</a>
University of Huddersfield, School of Informatics	Business services <a href="http://www.hud.ac.uk/business">www.hud.ac.uk/business</a>
University of Hull, Department of Computer Science	Business services <a href="http://www2.hull.ac.uk/administration/business.aspx">www2.hull.ac.uk/administration/business.aspx</a>
University of Kent at Canterbury, School of Computing	Student IT consultants <a href="http://www.kitclinic.co.uk">www.kitclinic.co.uk</a>
University of Lancaster, School of Computing & Communication	Centre of Excellence for research in information and communication technologies <a href="http://www.infolab21.lancs.ac.uk">www.infolab21.lancs.ac.uk</a>
University of Leeds, School of Computing	Engineering Research & Innovation Service (ERIS) <a href="http://www.engineering.leeds.ac.uk/faculty/business">www.engineering.leeds.ac.uk/faculty/business</a>
University of Leicester, Department of Computer Science	Industry <a href="http://www2.le.ac.uk/departments/computer-science/industry">www2.le.ac.uk/departments/computer-science/industry</a>
University of Lincoln, The Lincoln School of Computer Science	Business services <a href="http://www.lincoln.ac.uk/home/businessemployers">www.lincoln.ac.uk/home/businessemployers</a>
University of Liverpool, Department of Computer Science	Industry partners <a href="http://www.liv.ac.uk/computer-science/industry-partners">www.liv.ac.uk/computer-science/industry-partners</a>
University of Manchester, School of Computer Science	Spin-Outs <a href="http://www.cs.manchester.ac.uk/industry/spin-outs">www.cs.manchester.ac.uk/industry/spin-outs</a> Manchester Enterprise Centre <a href="http://mec.portals.mbs.ac.uk">mec.portals.mbs.ac.uk</a>
University of Northampton, School of Computing & Immersive Technologies	Business services <a href="http://www.northampton.ac.uk/business-and-enterprise">www.northampton.ac.uk/business-and-enterprise</a>

University of Nottingham, Computing Laboratory	Certification of staff and student social enterprise <a href="http://www.changemakercampus.org.uk">www.changemakercampus.org.uk</a>
University of Oxford, Department of Computer Science	Industrial relations <a href="http://www.cs.ox.ac.uk/industry/partners">www.cs.ox.ac.uk/industry/partners</a> Oxford Entrepreneurs <a href="http://www.oxfordentrepreneurs.co.uk">www.oxfordentrepreneurs.co.uk</a> Business services <a href="http://partnership.ox.ac.uk/expertise-and-knowledge">partnership.ox.ac.uk/expertise-and-knowledge</a>
University of Plymouth, School of Computing & Mathematics	Business services <a href="http://www.plymouth.ac.uk/businessandpartners">www.plymouth.ac.uk/businessandpartners</a>
University of Portsmouth, Department of Creative Technologies	Business services <a href="http://www.port.ac.uk/business-services">www.port.ac.uk/business-services</a>
University of Reading, School of Systems Engineering	Industry <a href="http://www.reading.ac.uk/sse/businessdevelopment/sse-workingwithindustry.aspx">www.reading.ac.uk/sse/businessdevelopment/sse-workingwithindustry.aspx</a>
University of Salford, School of Computing, Science & Engineering	Business services <a href="http://www.salford.ac.uk/business">www.salford.ac.uk/business</a>
University of Sheffield, Department of Computer Science	Industrial Liaison Board <a href="http://www.sheffield.ac.uk/dcs/about/ilb">www.sheffield.ac.uk/dcs/about/ilb</a> Spin-outs <a href="http://www.k-now.co.uk">www.k-now.co.uk</a> , <a href="http://www.theflow.com">www.theflow.com</a> , <a href="http://quoratetechnology.com">quoratetechnology.com</a> , <a href="http://www.epigenesys.org.uk">www.epigenesys.org.uk</a> . Genesys Solutions, student-run software company in the UK <a href="http://www.shef.ac.uk/dcs/genesys">www.shef.ac.uk/dcs/genesys</a>
University of South Wales, School of Computing and Mathematics	Business services <a href="http://business.southwales.ac.uk">business.southwales.ac.uk</a>
University of Southampton, Electronics and Computer Science	Entrepreneur First (recent graduate start-ups from scratch) <a href="http://www.ecs.soton.ac.uk/careers/companies/entrepreneur-first">www.ecs.soton.ac.uk/careers/companies/entrepreneur-first</a> Business services <a href="http://www.ecs.soton.ac.uk/business">www.ecs.soton.ac.uk/business</a>
University of St Andrews, School of Computer Science	Research Impact@St Andrews blog (label 'Commercial') <a href="http://univstandrews-impact.blogspot.co.uk/search/label/Commercial">univstandrews- impact.blogspot.co.uk/search/label/Commercial</a> Business services (Knowledge Transfer Centre) <a href="http://www.st-andrews.ac.uk/ktc">www.st-andrews.ac.uk/ktc</a>
University of Stirling, Computing Science & Mathematics	Business services <a href="http://www.stir.ac.uk/research/working-with-business-and-industry">www.stir.ac.uk/research/working- with-business-and-industry</a>
University of Strathclyde, School of Computer & Information Sciences	Vertically Integrated Projects <a href="http://www.strath.ac.uk/viprojects">www.strath.ac.uk/viprojects</a> Spin-outs <a href="http://www.strath.ac.uk/science/knowledgeexchange">www.strath.ac.uk/science/knowledgeexchange</a>
University of Sunderland, Department of Computing, Engineering & Technology	Industry (as part of department description) <a href="http://www.sunderland.ac.uk/faculties/apsc/ourdepartments/ce">www.sunderland.ac.uk/faculties/apsc/ourdepartments/c et</a> including links with Sunderland Software City <a href="http://www.sunderlandsoftwarecity.com">www.sunderlandsoftwarecity.com</a>
University of Surrey, Department of Computing	Business services <a href="http://www.surrey.ac.uk/business">www.surrey.ac.uk/business</a>

University of Sussex, Department of Informatics	Industry <a href="http://www.sussex.ac.uk/informatics/industry">www.sussex.ac.uk/informatics/industry</a> including Start-ups and spin-outs <a href="http://www.sussex.ac.uk/informatics/industry/startupsandspinouts">www.sussex.ac.uk/informatics/industry/startupsandspinouts</a>
University of the West of England, Department of Computer Science & Creative Technologies	Environment and Technology Partnerships <a href="http://www1.uwe.ac.uk/et/partnerships.aspx">www1.uwe.ac.uk/et/partnerships.aspx</a> Business services <a href="http://www1.uwe.ac.uk/business.aspx">www1.uwe.ac.uk/business.aspx</a>
University of the West of Scotland, School of Computing	Business services <a href="http://www.uws.ac.uk/about-uws/services-for-business">www.uws.ac.uk/about-uws/services-for-business</a>
University of Ulster, Faculty of Computing & Engineering	Business services <a href="http://www.ulster.ac.uk/businessservices">www.ulster.ac.uk/businessservices</a>
University of Wales Trinity St David, School of Applied Computing	School blog <a href="http://appliedcomputin.wordpress.com">appliedcomputin.wordpress.com</a> Tagged 'entrepreneurship' <a href="http://appliedcomputin.wordpress.com/tag/entrepreneurship">appliedcomputin.wordpress.com/tag/entrepreneurship</a> (also 'entrepreneur', 'tech-entrepreneurs', 'innovation') Business services <a href="http://www.uwtsd.ac.uk/for-business">www.uwtsd.ac.uk/for-business</a>
University of Warwick, Department of Computer Science	Start-ups <a href="http://www2.warwick.ac.uk/fac/sci/dcs/research">www2.warwick.ac.uk/fac/sci/dcs/research</a>
University of West London, School of Computing & Technology	Business services <a href="http://www.uwl.ac.uk/academic-schools/computing/cat-enterprise">www.uwl.ac.uk/academic-schools/computing/cat-enterprise</a>
University of Westminster, Department of Computer Science & Software Engineering	Business services <a href="http://www.westminster.ac.uk/business">www.westminster.ac.uk/business</a>
University of Wolverhampton, School of Mathematics and Computer Science	Business services (School) <a href="http://www.wlv.ac.uk/default.aspx?page=26858">www.wlv.ac.uk/default.aspx?page=26858</a> Business services (Uni) <a href="http://www.wlv.ac.uk/default.aspx?page=6849">www.wlv.ac.uk/default.aspx?page=6849</a>
University of York, Department of Computer Science	Business services <a href="http://www.cs.york.ac.uk/services-for-business">www.cs.york.ac.uk/services-for-business</a> including spin-offs <a href="http://www.cs.york.ac.uk/services-for-business/spin-offs">www.cs.york.ac.uk/services-for-business/spin-offs</a>

## Appendix 3 Entrepreneurship resources

Many of these are referenced in the report.

Alacrity Foundation	<a href="http://alacrityfoundation.co.uk">alacrityfoundation.co.uk</a>
Association for University Research and Industry Links (AURIL)	<a href="http://www.auril.org.uk">www.auril.org.uk</a>
BCS (British Computer Society) (the Chartered Institute for IT)	BCS Entrepreneurs Specialist Group <a href="http://www.bcs.org/category/17002">www.bcs.org/category/17002</a>
Computing At School (in collaboration with BCS)	<a href="http://computingatschool.org.uk">computingatschool.org.uk</a>
Creative Science Foundation (CSf)	<a href="http://www.creative-science.org">www.creative-science.org</a>
Enactus	<a href="http://www.enactusuk.org">www.enactusuk.org</a>
Engineering and Physical Sciences Research Council (EPSRC) and Industrial Doctorate Centres	<a href="http://www.epsrc.ac.uk">www.epsrc.ac.uk</a> <a href="http://www.epsrc.ac.uk/skills/students/centres/current/Pages/indd.aspx">www.epsrc.ac.uk/skills/students/centres/current/Pages/indd.aspx</a>
Enterprise Educators UK (EEUK)	<a href="http://www.enterprise.ac.uk">www.enterprise.ac.uk</a>
Enterprise Village is the online element of the Enterprise In Schools Network	<a href="http://www.enterprisevillage.org.uk">www.enterprisevillage.org.uk</a>
Entrepreneur First	<a href="http://www.entrepreneurfirst.org.uk">www.entrepreneurfirst.org.uk</a>
e-skills UK	<a href="http://www.e-skills.com">www.e-skills.com</a>
FLUX	Website information moves each year.
Global Entrepreneurship Monitor (GEM)	<a href="http://www.gemconsortium.org">www.gemconsortium.org</a>
Graduate Entrepreneurship Project	<a href="http://graduateentrepreneurship.co.uk">graduateentrepreneurship.co.uk</a>
Guardian Small Business Network	<a href="http://www.theguardian.com/small-business-network">www.theguardian.com/small-business-network</a>
HEFCE: Knowledge exchange and skills	<a href="http://www.hefce.ac.uk/whatwedo/kes/">www.hefce.ac.uk/whatwedo/kes/</a>
Informatics Ventures	<a href="http://www.informatics-ventures.com">www.informatics-ventures.com</a>
Institute for Small Business and Entrepreneurship (ISBE) and Conferences	<a href="http://www.isbe.org.uk">www.isbe.org.uk</a>
International Entrepreneurship Educators Conference (IEEC)	<a href="http://ieec.co.uk">ieec.co.uk</a>
National Association of College and University Entrepreneurs (NACUE)	<a href="http://nacue.com">nacue.com</a>
National Centre for Entrepreneurship in Education (NCEE), formerly National Council for Graduate Entrepreneurship (NCGE)	<a href="http://ncee.org.uk">ncee.org.uk</a>
National Enterprise Educator Awards (NEEA)	<a href="http://neea.org.uk">neea.org.uk</a>
ScotlandIS	<a href="http://www.scotlandis.com">www.scotlandis.com</a>
Scottish Informatics and Computer Science Alliance (SICSA)	<a href="http://www.sicsa.ac.uk">www.sicsa.ac.uk</a> applied research accelerator program <a href="http://www.sicsa.ac.uk/funding/sicsa-elevate">www.sicsa.ac.uk/funding/sicsa-elevate</a>
Silicon Milkroundabout	<a href="http://siliconmilkroundabout.com">siliconmilkroundabout.com</a>
StartUp Britain	<a href="http://www.startupbritain.co">www.startupbritain.co</a>
Student Upstarts	<a href="http://studentupstarts.com">studentupstarts.com</a>

Technology Strategy Board	<a href="http://www.innovateuk.org">www.innovateuk.org</a>
The National Skills Academy for IT	<a href="http://www.itskillsacademy.ac.uk">www.itskillsacademy.ac.uk</a>
Times Higher Education Award for Entrepreneurial University of the Year	<a href="http://www.the-awards.co.uk">www.the-awards.co.uk</a>
Working Knowledge	<a href="http://www.workingknowledge.org.uk">www.workingknowledge.org.uk</a>

As GEM reports entrepreneurial activity is higher in the USA than the UK, here are some sites which may provide further ideas.

Carnegie Mellon University, Women@SCS	<a href="http://women.cs.cmu.edu">women.cs.cmu.edu</a>
Cornell University, Department of Computing and Information Science	<a href="http://www.cs.cornell.edu/masters/entrepreneurism">www.cs.cornell.edu/masters/entrepreneurism</a>
Georgia Tech, Vertically Integrated Projects	<a href="http://vip.gatech.edu">vip.gatech.edu</a>
MIT, Martin Trust Center for MIT Entrepreneurship	<a href="http://entrepreneurship.mit.edu">entrepreneurship.mit.edu</a>
Video (and related ones): Defining Entrepreneurship and Innovation at the Martin Trust Center for MIT Entrepreneurship	<a href="http://video.mit.edu/watch/defining-entrepreneurship-and-innovation-at-the-martin-trust-center-for-mit-entrepreneurship-13382/">video.mit.edu/watch/defining-entrepreneurship-and-innovation-at-the-martin-trust-center-for-mit-entrepreneurship-13382/</a>
Stanford University, Entrepreneurship@Stanford Project	<a href="http://cs.stanford.edu/people/eroberts/cs181/projects/2010-11/EntrepreneurshipAtStanford/index-2.html">cs.stanford.edu/people/eroberts/cs181/projects/2010-11/EntrepreneurshipAtStanford/index-2.html</a>
UC Berkeley, CSGE (Computer Science Graduate Entrepreneurs), Computer Science Department	<a href="http://csg.berkeley.edu">csg.berkeley.edu</a>
University of Texas at Austin, Department of Computer Science	News items tagged 'entrepreneurship' <a href="http://www.cs.utexas.edu/news-events/news/tag/entrepreneurship">www.cs.utexas.edu/news-events/news/tag/entrepreneurship</a>