Response to Call for Evidence –

House of Commons

SELECT COMMITTEE ON EDUCATION

Challenges Posed And Opportunities Presented by the Fourth Industrial Revolution

On behalf of the UK Computing Research Committee, UKCRC.

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The UK CRC is an Expert Panel of all three UK Professional Bodies in Computing: the British Computer Society (BCS), the Institution of Engineering and Technology (IET), and the Council of Professors and Heads of Computing (CPHC). It was formed in November 2000 as a policy committee for computing research in the UK. Members of UKCRC are leading researchers who each have an established international reputation in computing. Our response thus covers UK research in computing, which is internationally strong and vigorous, and a major national asset. This response has been prepared after a widespread consultation amongst the membership of UKCRC and, as such, is an independent response on behalf of UKCRC and does not necessarily reflect the official opinion or position of the BCS or the IET.

Response to Questions

1. The interaction between the Government's industrial, skills and digital strategies.

   As the representative UK body for Computing Science research we recognize that the scope of this call extends well beyond information technology and control systems engineering. However, our evidence focuses on those areas of our core expertise that coincide with the technical foundations of Industry 4.0 ranging from AI/Machine Learning through to the Industrial Internet of Things.

   We welcome greater clarity on the role of UK Universities in general, and Computing Science as an important engine for growth, providing momentum at the interface between the Government's industrial, skills and digital strategies. This role has arguably been neglected. Universities directly support regional development (linking to the 'place' pillar in the industrial strategy), across all relevant skills (the 'people' pillar) and in

nurturing innovation ('ideas'). In the digital strategy, UK Computing research delivers international excellence across the seven strands – with recognized strengths in cyberspace, in supporting the data economy and in the innovations that support greater connectivity[1]. However, we have seen recent falls in the numbers of students applying to study computing[2]. Some Universities buck this trend through a significant expansion of overseas students rather than home applicants. If this situation is not addressed, the UK will face a significant skill deficit compared to competitor nations.

2. The suitability of the current curriculum to prepare young people for the Fourth Industrial Revolution.

   There have been significant improvements across the UK curriculum. England's New National Curriculum for computing was introduced from September 2014. Scotland's Curriculum for Excellence – Technologies was refreshed as part of the 2016 Digital Learning and Teaching Strategy[3]. In Wales, the new Curriculum for Life includes aspects of computer science and 'Using ICT' has been integrated across the Northern Ireland Curriculum. However, there is huge variation in the delivery. Some schools have interacted with their local Universities and with companies, including Microsoft[4], to deliver evidence-based approaches to pedagogy. In consequence, a larger number of UK students seem better prepared for the technical challenges associated with the connected economy than in previous decades. They have exposure to more industrially relevant programming techniques and algorithmic concepts. Other schools continue to teach computing as if it were an exercise in using spreadsheets. We would reiterate the Royal Society's review 'Rebooting the Curriculum', which emphasizes the need for evidence-informed education policy and practice and for structural changes to increase both the competence and confidence of teachers in this area. At present, many students are poorly prepared for the challenges of employment in a network enabled environment; lacking the underlying skills needed to diagnose and correct network failures or even to participate as a knowledgeable user in the procurement of Industry4.0.

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[1] https://www.gov.uk/government/publications/uk-digital-strategy/3-the-digital-sectors-making-the-uk-the-best-place-to-start-and-grow-a-digital-business

[2] https://www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2015/patterns-and-trends-2015.pdf

[3] https://royalsociety.org/~/media/policy/projects/computing-education/computing-education-report.pdf

[4] https://www.microsoft.com/en-us/research/wp-content/uploads/2016/07/ComputingAtSchoolCACM.pdf

3. The impact of the Fourth Industrial Revolution on the delivery of teaching and learning in schools and colleges.

   The members of UKCRC have participated in teaching and learning around the globe. They have seen what is possible in the best US, German and Chinese schools. In these countries, there is a greater focus on technical fundamentals together with more exciting and relevant project based teaching methods – for example, linking computing to digital sound engineering or using the new generation of programming environments to develop robotic and IoT applications. These methods have strongly influenced University teaching – for example through the growth of the Hackathon movement, but they have had limited impact on earlier years education.

4. The role of lifelong learning in re-skilling the current workforce.

   UKCRC has promoted lifelong learning – for example, Glasgow University's industrial cyber security group has hosted some of the new EDF security apprentices to give them experience of a research environment and at the same time recruited former EDF employees to provide industrial experience to postgraduate students developing new methods for securing Industry 4.0 (this project was identified as an example of best practice in University/Industry engagement by GCHQ/NCSC). Such examples of cross-generational innovation in education are not widespread, are often based on local initiatives and rely on ad hoc funding.

5. Place-based strategies for education and skills provision.

   As mentioned, Universities represent one of the most effective means of preparing the UK for the fourth industrial revolution. We have strong roots into local communities and support education and skills provision at all levels. However, Universities respond to market forces. Strong demand from overseas students paying higher rate fees and the fall in domestic applications creates a dangerous structural weakness for the changes that lie ahead.

6. The challenges and opportunities of the Fourth Industrial Revolution for improving social justice and productivity.

   There remains a significant gender imbalance in UK Computing Science and also regional variations in delivery of core topics that support Industry

4.0 [5]. A recent Welcome Trust survey of 4,000 state funded pupils in England found that only 3% of girls were interested in computer science as a career, compared with 17% of boys. There is considerable potential to use the changes envisaged in the Fourth Industrial Revolution to address this gender imbalance as part of wider initiative to renew interest in STEM subjects; learning the lessons that seem already to have been adopted by many of our competitors.

[5] https://royalsociety.org/~/media/policy/projects/computing-education/computing-education-report.pdf education/computing-education-report.pdf