# DIGITAL SKILLS FOR TOMORROW'S WORLD

The independent report of the UK Digital Skills Taskforce
Beta Edition July 2014

INTERIM REPORT

Telefónica | O2

# Foreword

Many of you will know me from the BBC TV programme *Tomorrow's World* where we made wild, wonderful and occasionally accurate predictions about the future. Probably my most prescient moment was standing in front of the massive dishes at Goonhilly Satellite Earth Station in 1987 and proclaiming, "We're witnessing the dawn of a digital era". I can date it precisely because I was pregnant at the time and my daughter is now 26 years old.


At the time, teenagers across the UK were bent over ZX80's, the first chunky £3000 mobile phones were in the hands of sales reps and I'd recently demonstrated the world's first 'electronic stills' camera on the show. Now, scarcely a day goes by without news of how our behaviour is being transformed as a result of new technology. Our lives have become digital by default. With that the opportunities have multiplied and technology enabled change is now expected as a routine fact of modern day life. The advances look set to continue with developments such as the 'internet of things'.

Britain is in the midst of another industrial revolution and only by engendering the spirit that allowed us to thrive so well in the first will we succeed in the second. For this to happen we need our young people to see technology and related applied sciences as a future not which they might just benefit from but which they can help create. If you have the right skills, if you have the right network, if you have the right attitude, this is a time of opportunity. We have to make sure we equip everyone in the UK for the digital revolution – not just a fortunate few.

Ed Miliband, Leader of the Labour Party, asked me to write this report and I agreed to do it for the same reason I founded TeenTech: out of frustration that so many young people are missing out on the opportunities available to them in an ever-expanding digital world, in spite of being the most tech-savvy generation we've ever had. However, in order to assemble the best people onto the UK Digital Skills Taskforce and prevent any bias in our recommendations, we have undertaken this as an independent review with no input from any political party.

*Digital Skills for Tomorrow's World* puts forward recommendations for government but also for what students, parents, schools, communities and businesses can do immediately to make sure people of all ages benefit from the opportunities offered by the acquisition of digital skills. Business, education and government really do need to work together right now to make a difference. We don't need to wait until the 2015 election to start acting on some of the great ideas and thinking which has been shared with us.

I know what is recommended in this report is feasible and practical, and very much hope policy makers, educators and business decision makers will give it serious consideration.

**Maggie Philbin, Chair UK Digital Skills Taskforce**

***"The web as I envisaged it – we have not seen it yet. The future is still so much bigger than the past."***

Tim Berners-Lee, developer of the World Wide Web

## Nurturing a Digital Generation

The digital skills agenda is in vogue and much is being done across the UK to encourage young people to realise their potential – something O2 has also built its heritage on. The arrival of computing on the curriculum in schools shows that the importance of digital skills is being recognised. But we've still got a way to go if we are to create the conditions that will deliver a prosperous future for young people and ultimately the UK.

That's why I'm delighted to welcome this report from the UK Digital Skills Taskforce. This impressive cross-sector review highlights key recommendations to support the digital skills eco-system across the UK, including embedding digital skills within the education system, supporting digital innovation in the third sector and championing the role of business in supporting early digital careers and workforce development.

At O2, we believe that the possibilities of technology should be open to everyone, and we're working hard to make this vision a reality. Our Think Big programme is supporting thousands of young people to develop enterprise, creativity, business and digital skills, which are enabling them to participate in and shape the emerging digital economy. We're also building the digital confidence of parents as a young person's primary educator and support network. And we are working with small businesses and large enterprises to confidently map a truly digital way of operating.

This report underlines the need for collective action to shift perception, build confidence and demonstrate the value of collectively nurturing a truly digital generation. Failing to do so will result in us choking our own potential, failing our young people and stifling economic growth. The key recommendations outlined in the report are feasible and practical, and I encourage policy makers, educators and business decision makers to give it serious consideration.

**Ronan Dunne, CEO Telefonica UK**

***"Young people are brilliant. They are brave, ambitious and possess native digital talent that we need to nurture. They are the future fuel of our economy. The recommendations outlined in this report will enable us to tackle the big skills challenges inhibiting growth, including encouraging and equipping young people with the digital skills to succeed."***

Ronan Dunne, CEO
Telefonica UK (O2)

## The Challenge

As of August 2012, the digital economy accounted for 14.4% of all companies and 11% of jobs. It's not just the technology sector that needs digital skills but all sectors. Consequently, as Chief Scientist at Metaswitch Networks Chris Mairs put it at our London regional meeting, increasingly "every company is a digital company and almost every job is a digital job." The need for digital skills is only going to grow: the Science Council estimates that the ICT workforce alone will grow by 39% by 2030. A 2013 O2 report, The Future Digital Skills Needs of the UK Economy, estimated that 745,000 additional workers with digital skills would be needed to meet rising demand from employers between 2013 and 2017.

Yet as of March 2014 there were still 975,000 young people in the UK who were not in education, employment or training, despite Microsoft reporting that there were 100,000 unfilled vacancies unfilled in partner companies across the UK last year. There is clearly a lack of appropriate digital skills and unless this is addressed urgently we are in danger of losing the momentum and enthusiasm that was so wonderfully tangible all those years ago.

Technological advances offer huge benefits for the economy. Any business, no matter what its size or where it is based, can reach a global customer base. As Rob McCarthy, CEO of Goss Interactive, put it at our Plymouth regional meeting, "the great thing about digital skills is the fact you can compete in a global market in the South West which to me is really, really great because otherwise you have to move away to become a world beater, whereas with digital skills you can do that from anywhere in the planet." The internet also makes it easier for new companies to enter the marketplace and scale.

Google highlighted the example of Julie Deane:

*'Julie Deane founded The Cambridge Satchel Company from her kitchen table in 2008 with capital of just £600. She set up a basic website at little cost and with no prior training. Within six months, her turnover was £30,000, by year end £200,000 and by 2012, turnover was over £1m. Her satchels have featured on the front cover of Vogue and on the catwalks of the biggest fashion events around the world. Because her company was Internet based, she could grow her shopfront with low friction and low risk.'*

It is also important that we do not solely focus on the young digital workforce. For our economy to fully realise the benefits of the digital revolution it is also vital to properly enable two key groups: the millions of people who are still not online, and those working in jobs which will disappear through technology enabled change.

While 73% of adults in Great Britain accessed the internet on a daily basis in 2013, 13% had never used the internet. 30% of those with disabilities do not use the Internet and 52% of those who lack basic online skills are aged 65 or older. Too often, it seems that the unintended consequence of exclusion by technological advance are

***"By 2020, more than seven billion people and businesses, and at least 30 billion devices, will be connected to the Internet. With people, businesses and things communicating, transacting and even negotiating with each other, a new world comes into being."***

Gartner

not being recognised fully.

There are specific investments necessary and the present level of funding is simply not sufficient. While significant new investment is never popular, leaving people offline and lacking digital skills will result in a far higher cost to all of us.

## Review Methodology

For the past seven months, the UK Digital Skills Taskforce has engaged with hundreds of organisations to look at what needs to be done to nurture home grown talent to meet the needs of Britain's modern economy. We wanted to gather practical suggestions and understand what people working within education and industry felt needed to change, based on real-world experience.

We've held regional roundtables across the country, from Newcastle to Plymouth, Reading to Wrexham, Doncaster to Hoxton. We've filmed contributions so we can share the thinking first hand and create a useful resource for policy makers. This represents a considerable body of evidence, which we have made available on our YouTube channel.


To complement the main review we also set up the Young Digital Taskforce, which brought together young people from across the UK to discuss the challenges we face and provide their feedback. Given so much of our report hopes to improve their education, it was important to involve them in the process. Their research helped us understand the perceptions young people had of careers in technology, and their ideas for what needed to change within schools are reflected in that chapter.

The Young Digital Taskforce will be one of the legacies of the report and their work will continue.

We held many additional meetings with organisations working in this sector. We asked for submissions of evidence and received over 60 from a range of businesses, educational establishments, learned societies, parents, employees, employers, academics and teachers. We also received many hundreds of additional emails. We also conducted surveys for teachers and businesses, which provided us with helpful insights, especially through the comments people made. We have also used data gathered by TeenTech from asking 5500 teenagers survey questions during the many TeenTech events held across the UK.

As Digital Skills are pervasive across the labour market and citizenry in general we felt we needed a simple structure to discuss tiers of skills required: Digital Citizen, Digital Worker, and Digital Maker.

Increasingly we all need basic digital skills to participate in everyday life as a **digital citizen**, whether it is to communicate, find information or purchase goods/services. These levels of basic digital skills have become an almost universal prerequisite to employment: almost

everyone needs to be able to use the internet, process simple word documents and find information online. Lack of such skills can lead to exclusion from society as well as the job market.

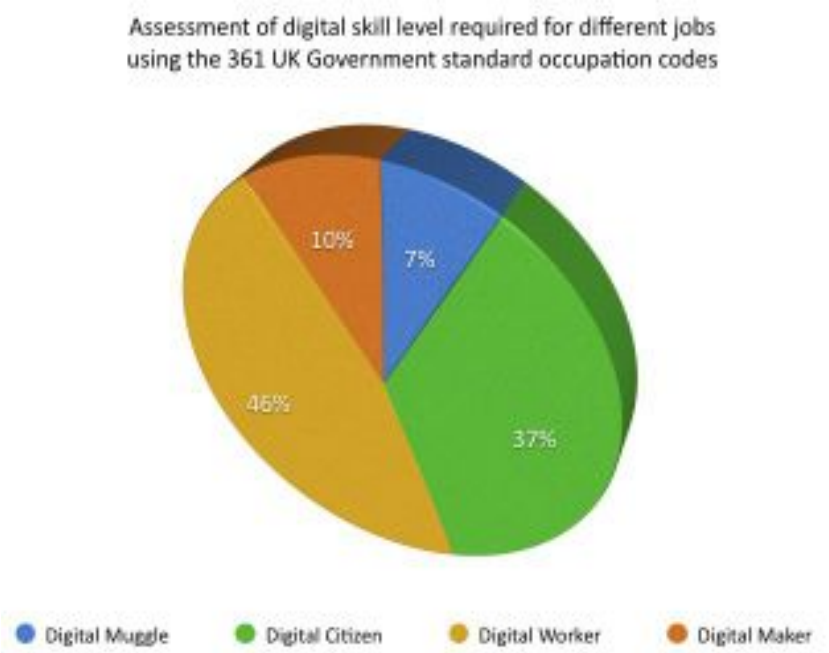
At the intermediate level, many people required deeper skills as part of their working lives. We characterised this as the **digital worker**. In essence, skills at this level might include (but not necessarily be limited to) using document formatting tools and building spreadsheets, while at the more complex end these might encapsulate using sophisticated tools directly related to a particular occupation.

Lastly, we had **digital maker** level. At this level, we are talking about those who have the skills to actually build digital technology. This could range from less advanced tasks such as writing Excel macros or creating control files for 3D printing to everything from designing the next microprocessor or implementing ground breaking machine learning algorithms.

While these definitions are necessarily broad, we believe that they help to distinguish between the different skill levels this report addresses.

In order to assess how important digital skills are to the UK economy, Chris Mairs, the Chief Scientist at Metaswitch Network and the Chair of the UK Forum on Computing Education, used our framework in an assessment of the 361 standard occupation codes used by the government to categorize the occupations of the UK workforce. Adding a **digital muggle** level for those requiring no digital skills, to whom digital technology may as well be magic, he made an assessment of what level of digital skills might be required across the workforce.

His analysis estimated that the skills requirements across the UK workforce are as follows:



This analysis suggests that well over half the workforce requires digital skills that extend beyond the basic skills of digital citizenship and that over 90% of jobs require at least those basic digital literacies.

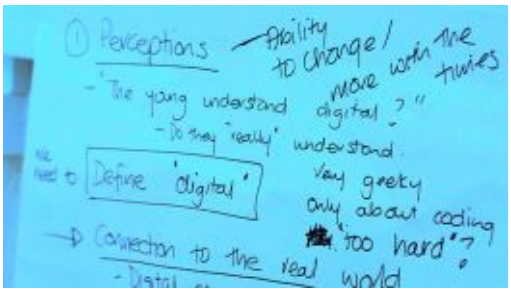
# EXECUTIVE SUMMARY

## PERCEPTION AND REALITY
## THE DIGITAL CHALLENGE FOR SCHOOLS
## THE TECH THIRD SECTOR
## APPRENTICESHIPS FOR A DIGITAL ECONOMY
## DIGITAL BY DEGREE
## DIGITAL SKILLS FOR LIFE

UK DIGITAL SKILLS TASKFORCE

## Perception and Reality

Students, teachers and parents fail to understand the opportunities within the digital workplace. All too often stereotypical perceptions prevail. There are various major problems including, but not limited to: out-dated views about what tech jobs might involve; a lack of appreciation of the importance of digital skills to all jobs; and a lack of awareness of just how successful UK digital companies are. Crucially, tech roles are far too often seen as jobs for the boys. Most people have heard of Bill Gates and Mark Zuckerberg but struggle to cite a female role model. The gender imbalance in tech is extremely damaging: it is hardly surprising that we have digital skills shortages given that we are failing to make the most of the talents of almost half of the potential workforce.




Changing the views of parents and teachers will be especially important if we are to prepare young people for the digital future. These groups are the influencers who guide young people and shape their decisions. Results from 5,500 students surveyed by TeenTech in 2012/3 found that 43% turned to parents for advice on careers, well ahead of other influencers. Despite their importance, too many parents are poorly placed to advise: a recent survey by O2 found that 23% of parents believe digital skills to be irrelevant to their children's future career success, despite the fact that almost all jobs already require at least a basic level of digital skills. Digital skills are increasingly needed at intermediate and advanced levels across all sectors.

Education needs to be properly supported and encouraged to deliver outstanding careers guidance at every age. Too often, it is woeful despite being more important than ever before. Without good careers guidance, the most disadvantaged will continue to be the ones who lose out. We also need to make it easier for businesses and education to connect so that industry can play a more active role in providing young people the information, advice and guidance that they need.

Employers have a responsibility to ensure that they take measures to improve diversity in the workplace. There are major challenges resulting from the limited number of young women who study computing at school, college and university. However, employers can and should do more to address the low numbers of women in tech jobs. In particular, we need more sponsors prepared to actively promote opportunities rather than simply mentor at all ages.

We need to do more to celebrate our successful tech companies from across the UK so that people appreciate that the latest technology is not just built on the West coast of America but in the UK. Here the media has a responsibility to ensure that we champion technology as much as we do physics and maths.

**We recommend that:**

1. Government should coordinate a campaign involving all stakeholders to tackle the gap between the perceptions and the reality of the growing importance of digital skills. This campaign should focus particularly on key influencers such as parents and teachers.
2. Regional groups should collaborate to establish websites dedicated to connecting education and tech businesses in order help improve careers guidance and facilitate work experience. Local Enterprise Partnerships, local authorities or self-organising collaborations could lead this.
3. Businesses and professional bodies should collaborate to create a national online Wiki dedicated to digital careers. This should be for people at all stages in their lives.
4. Employers need to take steps to improve diversity in the tech workplace. They need to go beyond appointing more women to boards to examining the reasons for the low numbers of recruitment and retention of women at all levels.

## The Digital Challenge for Schools

To improve our digital skills for the longer term we need to start with our schools. Following warnings from Google's Eric Schmidt, the Royal Society and Computing at School, England has a new computing curriculum starting in September 2014. This represents both an excellent opportunity and a major challenge. If we can teach our young people a balanced curriculum of digital literacy, ICT and computer science, they will be well prepared for a digital future. However, teachers will need considerable help to prepare and retrain for the new curriculum. Only 44.9% of secondary school ICT teachers have a post A-level qualification relevant to ICT and the overwhelming majority of primary school teachers do not have a computing background. A recent survey found that 60% of teachers did not feel confident delivering the new curriculum.

We need to give them the support they need. So far, the Government has provided £3.5 million, a sum that is simply not sufficient. The funding is equivalent to £175 per school. By comparison, Jersey is investing around £15,750 per school to make a similar step change to computing. The sum also compares poorly to recent provision for CPD for teachers in maths, physics and global issues.

We need to support teachers to acquire new subject knowledge and develop their teaching style for the new computing curriculum. At present, CPD is not enough of a priority across education. In addition, there is an appetite from both teachers and industry for more project based, cross curricular learning which embodies and recognises creativity, problem solving, collaboration, entrepreneurship and self directed learning. However, time for both of these is a major problem. We need to give teachers (and students) the space they need.

School leaders need to appreciate the scale of the challenge and take steps to support the transition to computing, both at primary and secondary schools. Schools, colleges, universities and industry need to collaborate to help teachers to make the transition so that our young people get the computing education they need and deserve. In addition, we need to take steps to increase the number of teachers coming into the profession to teach computing, be it from university or from industry.

**We recommend that:**

1. Government should invest at least an additional £20 million by 2020 to help successfully embed the new computing curriculum in schools across England. Government support will likely need to remain in place for the next decade.
2. Schools must provide time and support for computing teachers to deepen their subject knowledge and develop their teaching style. Dedicated time for Continual Professional Development (CPD) is essential for teachers and should be recognised as a core component of being a professional teacher.
3. Government should launch a 'Digital Challenge' for schools, modelled on the collaborative approach of the London Challenge to stimulate partnerships between schools, colleges, universities and industry to enhance careers advice and both the curricular and extra-curricular opportunities available to young people.
4. Government should treat computing as a fourth 'core science'. There should be a digital component to education and training opportunities for young people up to the age of 19.
5. England, Northern Ireland, Scotland and Wales should all ensure that their school computing curriculum includes a balance of computer science, digital literacy and information technology.
6. A network of school governors with expertise in computing should be established. Those working in the digital industries should be encouraged to apply to become school governors.
7. Universities should take urgent steps to address the severe shortage of new computing teachers. Every university should encourage their computer science students to consider teaching by offering the Undergraduate Ambassadors Scheme.
8. Government should provide a route for experienced professionals in the digital industries to enter the teaching profession via a fast track 'Teach Next' route, modelled on Teach First.

## The Tech Third Sector

Certain young people will learn digital skills outside the formal curriculum. There are a growing number of organisations, which we describe as the Tech Third Sector, aiming to teach and excite young people about computing beyond the confines of the curriculum. From the local to the international, we must do more to ensure that all young people have the opportunity to enjoy these initiatives.

There will always be limits on what teachers can do inside the classroom. The Tech Third Sector can offer a space to develop technical skills alongside the broader attributes such as creativity, problem solving, teamwork, collaborative work and communication. These organisations can help to dispel myths about what a career in tech can involve. In addition, there is scope for these organisations to support formal education. We need to do more to signpost these opportunities both to participants and supporters so as to encourage these organisations to grow.

**We recommend that:**

1. The Tech Third Sector should embrace its potential to act as a 'petri dish' for schools, providing the space to experiment with how we teach computing and learn digital skills. Collaborative research across programmes could expand our understanding of the impact of different approaches. This learning could then inform and help teachers within formal education.
2. Tech Third Sector initiatives should be mapped and signposted online to allow students, companies and communities to easily find and get involved with schemes in their local area.
3. Businesses and major trusts and foundations should promote the growth of the Tech Third Sector by providing seed funding to stimulate new initiatives and larger grants to allow successful initiatives to scale up.
4. Efforts to recognise informal learning via online portfolios or digital badges should be encouraged.

## Apprenticeships for a Digital Economy

Apprenticeships can, and increasingly do, offer an alternative route into digital jobs that can benefit businesses and young people alike. Many companies of all sizes are really enthusiastic about the benefits of apprentices. However, we need to take major steps to improve the system so that more young people and businesses seize these opportunities. There is too much snobbery in relation to apprenticeships; at the moment they are all too often seen as a second class route for the less able. Policy pushes schools to prioritise progression to university irrespective of whether that is the best route for the young person. Teachers do not have the knowledge or

understanding to recommend apprenticeship routes. The consequence is that far too many young people struggle to discover about them: one O2 apprentice we met only found out about the opportunity when looking at his mobile phone plan.

A major problem with the apprenticeship system is that it is just too complicated. From SMEs to multinationals, far too many find it too opaque and time-consuming. The problems range from the complexity of the system to a poor National Apprenticeship Service website. As Andrew Corbett of the UK IT Association puts it, "the current apprenticeship system does not work for small IT companies." We also heard similar complaints from large, multi-national employers. For apprentices to work for digital SMEs, we need a simpler, clearer system. In particular, we need to champion models which allow companies to either take apprentices on for the short-term or share apprenticeship training. Larger employers can have a role to play in assisting smaller companies here.

**We recommend that:**

1. Progression onto apprenticeships should be recognised as a good outcome for school students. At present, the system focuses overwhelmingly on university, irrespective of whether that route necessarily suits the student. Additionally, there is a need to educate the educators and the influencers about apprenticeships, helping teachers and parents to understand the benefits of apprenticeships.
2. Government should radically simplify the apprenticeship system to ensure that more digital businesses, especially SMEs, invest in apprentices. The process remains too opaque for businesses of all sizes.
3. Government must champion models that allow microbusinesses and SMEs to either share digital apprentices or to collaborate with other businesses in digital apprenticeship training.
4. All employers should ensure that their training providers are developing their apprentices' digital skills. Also, all apprentices should be offered remedial digital skills training if they have limited digital skills.

## Digital by Degree

Britain is blessed with a strong, diverse, higher education sector that makes our country well-placed to compete in the global knowledge economy of the 21st century. However, it is increasingly important that graduates leaving universities are equipped with the digital skills needed for a range of roles across the modern economy. Current graduates will require skills above those acquired at school under the old curriculum. It is important for universities to offer opportunities to students to develop these skills.

The UK needs professionals who can invent new digital technologies, create software applications and keep our online economy safe and secure. Although other graduates also become digital makers in the workforce, computer science graduates are a major source of the high level skills our businesses need. While most computer science graduates go on to well-paid, professional jobs, too many find themselves unemployed. This is concentrated among black and minority ethnic students, who tend to achieve lower grades at university and are then more likely to be unemployed. This cannot be excused and is an urgent issue that universities must address.

Industry experience can help students to further their education and develop the technical skills needed for the world of work. Taking a student on a placement also offers considerable benefits to businesses of all sizes. However, too often it is difficult for SMEs to find students. We need to make it easier for students and businesses to connect. While full year sandwich placements might suit some, there are many other types of work placement that we need to encourage. For higher education to ensure that they produce the high level skills needed by industry, we need to ensure they have the connections that make this possible.

Postgraduate level study is extremely important for equipping the UK with the high level skills needed in an information economy. However, far too few computer science graduates progress onto postgraduate study. Access to postgraduate education is determined by ability to pay rather than ability to benefit. We need to take steps to support more students to go on to postgraduate level computer science qualifications and reverse recent drops.

**We recommend that:**

1. Universities should ensure widening participation funding is used to both improve academic attainment and reduce unemployment levels amongst ethnic minority computer science graduates.
2. Government should fund the National Centre for Universities and Business (NCUB) to work with other sector bodies to establish a matching website to connect students with tech businesses across the UK.
3. Government should work with universities and industry to expand the number of tech sandwich years and summer placements undertaken by computer science students.
4. Universities should offer students of all disciplines the opportunity to develop their digital skills outside of their core subject through employability awards and other schemes.
5. University computer science departments should have active Industrial Advisory Boards to help keep them updated with industry developments.

## Digital Skills for Life

The digital skills we are concerned with stretch from the most advanced to the basic ones increasingly required to participate in society. Basic online skills can help connect people with friends and family, find cheaper deals and locate information more easily. However, there is a major digital divide between the 73% of adults who use the internet on a daily basis and the 13% who have never even been online. This is an issue of economic efficiency and social justice.

Extending basic digital skills to all would offer considerable benefits for the most marginalised sections of society, helping to connect the elderly, the disabled and the isolated. If Government is to go digital by default then we must do more to ensure all gain basic digital skills or we risk excluding large sections of society. Getting everyone online will involve a large investment. However, the cost of inaction would be far higher.

This report has made recommendations around the education of the next generation, examining schools, apprenticeships and higher education. However, it is also vital that we ensure that digital skills are being improved across the whole of our population so that all of our society benefits from technological advances. We need to target those who are unemployed. A lack of basic digital skills is common among NEETs and those on job seeker's allowance. We need to help equip these people with the skills they need to get back into the workplace.

Retraining workers with improved digital skills is a responsibility that employers cannot shirk: the Government alone cannot foot the bill for keeping the workforce's skills updated. Companies should work alongside organisations such as unions to help their staff retrain. In addition, online learning through Massive Open Online Courses offers new opportunities for people to retrain and reskill. Too many SMEs and charities lack basic online skills. A lack of appreciation of the benefits and skill limitations keep these organisations from making the most of digital, a problem we need to address.

Digital advances compound the importance of lifelong learning in an unprecedented way. If we want to make sure that people can remain in the workforce for longer, they will increasingly need to improve their digital skills at all levels. We need to make sure that the support we offer to lifelong learning is fit for purpose for our digital future.

**We recommend that:**

1. Government should make the necessary investment to extend basic digital skills to all of the UK population by 2020, taking steps to share the cost of this transition with businesses and the charitable sector.
2. Government should ensure job seekers are offered digital skills training to help them back into the workforce.

3. Businesses ought to take responsibility for ensuring existing members of staff are offered training to keep their digital skills updated.
4. Government should mount an awareness campaign about the need to improve digital skills among SMEs and charities. This should include piloting of voucher schemes to access digital skills training.
5. Government should commission a major review of the provision of lifelong learning for digital skills across the UK. Digital advances are making retraining and lifelong learning more important than ever.

## Further Input

This interim report is very much work in progress. We have gathered an enormous amount of data and opinion from around the UK. We do not pretend to have all of the answers and some of our recommendations may evolve as we learn more over the coming year. Comment is not only welcomed but also encouraged: the wider we spread the net for gathering input the better. Our aim is to make a difference rather than to simply write another report. To that end we welcome the participation of everyone and anyone.

# PERCEPTION AND REALITY


**Unruly**

Marketing technology company Unruly is the leading global platform for social video marketing and works with top brands and their agencies to get their videos watched, tracked and shared across the Open Web.

Unruly people are passionate and positive, determined and delivery-focused, ambitious and agile. We seek superheroes who can embrace change, share the love and deliver WOW for our clients and agencies, as well as for one another.

UK DIGITAL SKILLS TASKFORCE

# Perception and reality

## Recommendations

1. Government should coordinate a campaign involving all stakeholders to tackle the gap between the perceptions and the reality of the growing importance of digital skills. This campaign should focus particularly on key influencers such as parents and teachers.

2. Regional groups should collaborate to establish websites dedicated to connecting education and tech businesses in order help improve careers guidance and facilitate work experience. This could be led by local enterprise partnerships, councils or self-organising collaborations.

3. Businesses and professional bodies should collaborate to create a national online Wiki dedicated to digital careers. This should be for people at all stages in their lives.

4. Employers need to take steps to improve diversity in the tech workplace. They need to go beyond appointing more women to boards to examining the reasons for the low numbers of recruitment and retention of women at all levels.

## The Digital Disconnect

There is an urgent need to change perceptions of the importance of digital skills in both the world of work and across our lives. Students, teachers and parents fail to understand the opportunities within the digital workplace. All too often stereotypical perceptions prevail. There are various major problems including, but not limited to: outdated views about what tech jobs involve; a lack of appreciation of the importance of digital skills to all jobs; and a lack of awareness of how successful our digital businesses are. Crucially, tech roles are far too often seen as jobs for the boys. The gender imbalance in tech is extremely damaging: it is hardly surprising that we have digital skills shortages given that we are failing to make the most of the talents of almost half of the potential workforce.

We need to be much more explicit about the range of opportunities on offer, improve the way we describe the skills, broader attributes and experience needed to access those career opportunities. Kate Doodson, Business and Operations Manager at Cosmic Ethical IT and an attendee at our Plymouth regional meeting, warned that careers in tech were *"so misunderstood",* with people believing that you had to be a complete techie and know it all from day one to work in tech jobs. Instead, she emphasised the importance of the creativity alongside technical skills, a point consistently made by people who we have met. We also need to explain the increasing value of digital skills to all workplaces, not just in roles requiring advanced digital

maker skills.

According to O2's 2013 study, *The Future Digital Skills Needs of the UK Economy*, more than one fifth of the 750,000 digital jobs needed to support economic growth are ideally suited to tech-savvy young people aged 25 or under entering the workforce for the first time or retraining from other roles.[i] However, we have a digital disconnect: too many in the UK, especially teachers (of all subjects) and parents, fail to appreciate the digital opportunities which exist and those which are due to open up in the near future. A recent survey by O2 found that:

- 23% of parents believe digital skills to be irrelevant to their children's future career success.
- 18% of parents think employers do not care about digital skills.
- 38% of parents admit they do not know enough about the digital economy to help their children make informed career choices.

Already the overwhelming majority of jobs require at least basic digital skills. That 23% of parents think such skills are irrelevant is extremely concerning. Many parents do not have enough understanding of how the digital world works to be able to recognise, encourage and reinforce the strengths and behaviours their children may be demonstrating. As Chris Mairs, Chief Scientist at Metaswitch Networks, pointed out at our London meeting, they don't know enough to be able to say: *"Hey, that's fantastic: you would be a brilliant digital marketer".* David Dunne, Chief Executive of Software City, said at our Newcastle regional event that his group *"felt that one of the biggest blockers we come across on a daily basis are parents."* Even teachers can fail to recognise and nurture talent:

Giving students a greater awareness of the role of digital skills in transforming areas from science to finance is important for explaining why digital skills matter regardless of whether they become a digital worker or a digital maker. For example, scientific careers are increasingly reliant on advanced and intermediate level digital skills. The BCS highlighted that mapping the human genome was completed in 2003, and could only have succeeded because of computer-controlled and automated experiments. The Large Hadron Collider would have ceased functioning without computers to monitor and control the physics and engineering systems, as well as to automatically analyse the petabytes of data that each experiment has generated.

The Science Council highlighted in their submission that:

*"Scientists will increasingly need to be confident and adept at accurately collecting, handling, analysing and utilising large-scale data sets. The need for digital skills in the future will not just be for specialist developers, but also as part of skill set needed by scientists across disciplines and economic sectors. They will need these skills to maximise incremental advances in technology and services by*

***"One team of students wrote over 30,000 lines of code for a project which ultimately won the TeenTech Awards programming category but said that they were reprimanded by a teacher for spending all their breaks 'messing about online'. So it's obviously important that all teachers, not just those involved in ICT or careers information are better informed about the skills needed and the ways that some students may be developing them on their own."***

TeenTech

*applying digital technologies to enhance existing procedures and practices. For example:*

*The European Union has designated that any software packages used in the health profession are to be considered 'medical devices'. The application of these devices has meant the need for regulations to be developed alongside to cope with rapid technological development. Moving forward it will require software developers, doctors, scientists and lawyers specialising in regulation to develop a high-level understanding of digital technologies and their applications in order to develop appropriate laws, assessment criteria, and guidance for the safe use of such products."*

The significance of advanced digital skills in major projects is often underappreciated. Digital skills are a golden thread running through all the leading construction projects of the century from the Olympic Park to CrossRail. While we often focus on the needs of tech companies, many companies across all sectors increasingly need advanced digital maker skills. *The Guardian* says they now regard themselves as a news company that thinks like a tech company. They employ over 150 people in their tech team but often struggle to find applicants with the skills they need for jobs such as: product management roles with high-end technical skills; data scientists, engineers and analytics; client side developers; mobile and android developers; software engineers and software architects. How many people appreciate the extent to which companies like *The Guardian* now employ a considerable number of tech employees? As Sian John, Director of Security Strategy at Symantec, put it at our Reading regional meeting, *"people just don't realise how great and varied a career there is technology or in digital, how much you need digital skills to work in any industry now."*

## Narrow stereotypes among the young

The problem is not just a lack of appreciation of the importance of digital. There are narrow stereotypes among the young about what it might be like to work in a digital job. The Young Digital Taskforce ran their own informal survey within schools and across social media asking their peers and parents to name people working in the digital industries. Most people were able to name Bill Gates, Steve Jobs and Mark Zuckerberg without any trouble but then got stuck. Not a single woman was mentioned. No one mentioned a role model from black or minority ethnic communities. The same seems to be largely true of adults too: a later survey by McAfee showed that just over 70% of adults questioned had not heard of any of Sheryl Sandberg, Facebook COO, Martha Lane-Fox, founder of lastminute.com or Marissa Mayer, Yahoo CEO. However, 90% of the 4,000 surveyed had heard of Bill Gates and 78% recognised Mark Zuckerberg.

Asked about the impression of people working in technology, the descriptions offered by the Young Digital Taskforce's peers swung between geeks bashing away on keyboards or of boring middle-aged

men in badly fitting suits doing dull repetitive jobs.

The Young Digital Taskforce commented on the overwhelmingly masculine image of the industry and how they had already had direct experience of this. One Task Force student, Hollie from Oldham College, said when she walked into her first technology class she was asked if she was in the wrong classroom, simply because she was female. We need to change these perceptions through initiatives such as TeenTech.

TeenTech run interactive, sharply focused events with a supporting award scheme to help young people, their teachers and parents understand the opportunities in contemporary industry. Every event brings together 300 students from 30 different schools in a region for a day of challenges and experiments with global, national and regional industries. TeenTech targets schools in deprived areas and encourages schools to bring students of all abilities, to avoid giving yet more opportunities to those students who always get them. Each event is run in partnership with a local steering group to ensure enthusiasm and learning can be taken forward by both TeenTech and other initiatives. Students return to their schools as ambassadors, creating presentations which are shared not only in assembly but in the staffroom. Many create videos and web pages which are shared with peers and parents.

Year 8 and Year 9 students are asked to draw someone who works in science and technology at the beginning of the events. In 2010, the first time the exercise was run, only 8 of 300 students drew a woman. Numbers are changing in the right direction but far too slowly. The average in 2014 is 35/300 drawing a female engineer or scientist on arrival. Voting buttons are used to measure the impact on the day. As you might expect there's a positive shift in perceptions but most markedly amongst the girls. At the TeenTech City London event only 22% expressed any interest in a career in technology when they arrived but 78% felt that way by the end of the day.

The day is timetabled, with students working in small groups on areas of technology they may never have considered – in the run up to the Olympics students learnt about the technology behind artificial limbs and fitted an athlete's leg. Students who have no experience of programming attend half hour workshops to give them a taster session with industry experts who build software solutions to business problems.

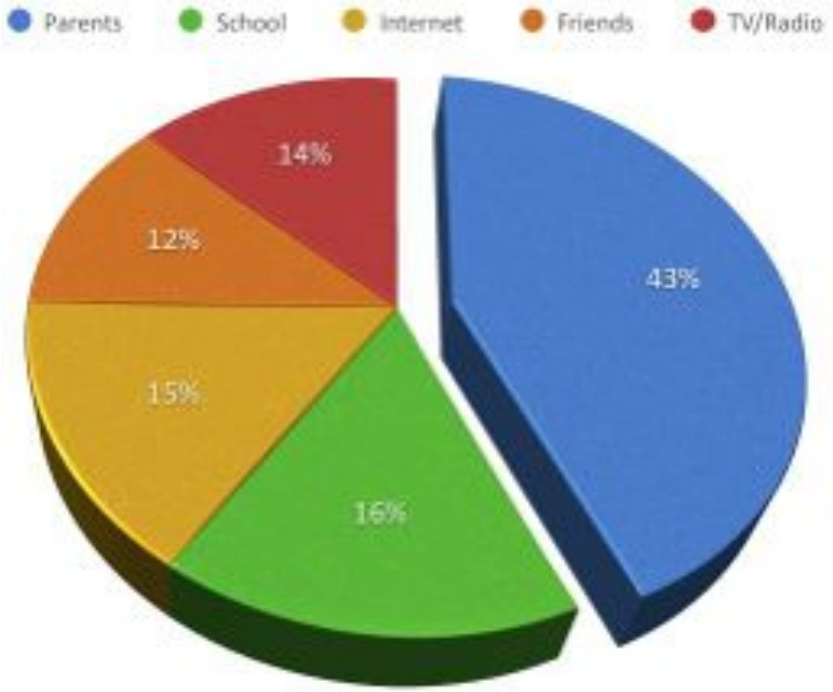
Students are then encouraged to take their new found enthusiasm further by developing their own ideas for how to make 'life better, simpler or easier' in the TeenTech Awards. Mentors from industry and academia provided by TeenTech give ongoing feedback and encouragement, providing an opportunity for quality, ongoing engagement with students. Students develop personal, academic and practical skills and also widen their knowledge of emerging industries and the opportunities within them.

***"When I asked friends what they thought about people working in tech they said 'nerds up in their bedrooms, never seeing the daylight, only coming out to eat pizza, pants up to their chests'"***

Student, Young Digital Taskforce

## The importance of teachers and parents

While many people expect teenagers to turn to the web for advice about their future decisions, TeenTech has collected data that identifies parents as the key influencer in young people's career aspirations and decisions. Results from 5,500 Year 8 and Year 9 students in 2012/3 found that 43% turned to parents for advice on careers advice, well ahead of other influencers.




Sample gathered from TeenTech – 5,500 Year 8/9 Students 2012/13

TeenTech's survey evidence is supported by research from King's College London:

In order to change the perceptions of young people, we need to tackle the perceptions and stereotypes held by parents. As Jackie Freeborn highlighted at our Doncaster regional meeting, it is no good getting kids excited about technology if their parents do not support it. Improving parental knowledge, especially the appreciation of the opportunities in small tech SMEs, is very important. However, teachers have an equally important role to play in making sure no young person is disadvantaged as a result of the lack of social and cultural capital available to them at home.

A recent report from Google identifies a number of key factors that can influence choice and perception, particularly among young women. According to their research "the impact of factors like ethnicity, family income, parental occupation and objectively measured proficiency is far less when controlling for having familial and peer encouragement and a young woman's perception of her own proficiency".[ii]

The top four influencing factors identified and recommendations made were:

1. Social Encouragement: encouragement from family, friends and educators, regardless of their technical expertise, reinforces existing interest and can foster interest where none exists. Outreach programs should include a parent education component, so that parents learn how to actively encourage their daughters.

2. Self-perception: interest in puzzles, problem solving and tinkering can lead to a passion for, and personal confidence in, computer science abilities. Providing young women with the opportunity to practice these skills in a supportive environment in activities related to their passions can help build confidence and interest.

3. Academic Exposure: experience with computer science in middle and high schools can motivate young women to pursue computing. Support for organizations working to expand these opportunities to more schools can increase academic and informal access, provide a greater understanding of computer science, and help young women make informed decisions about degree and career options.

4. Career Perception: visibility of female role models in computer science and telling stories about the positive social impact careers in computing can have, can enable young women to visualize themselves in the field.

We have heard of simple initiatives taken across the country to improve parents and teachers' appreciation of the relevance of digital skills to a wide range of careers. For example, at our Reading regional meeting, we heard about a simple homework task set by a teacher where young students needed to find as many examples of careers where computing was needed. They had to collect 20 examples to earn a merit badge, with no limit on the number of merit badges they could earn. Parents supported their children to find the examples and in the process expanded their own understanding. However, we also need to facilitate change at a national level. In particular, if teachers and parents are to encourage young people in general, and girls in particular, it would be helpful if there was a broader appreciation of the success of digital companies in the UK.

### The role of the media

The media has a role to play in changing perceptions. One example of the power of the media to influence career choices is famously that of CSI and Silent Witness. In 1990, there were only two degree courses in forensic science offered in the UK. By 2009, there were 285 on offer. The extraordinary growth has been attributed to TV dramas which presented a captivating if rather misleading picture of

***"Families exert a considerable influence on students' aspirations. This influence operates in many ways, but a key factor affecting the likelihood of a student aspiring to a science-related career by the age of 14 is the amount of 'science capital' a family has. Science capital refers to science-related qualifications, understanding, knowledge (about science and 'how it works'), interest and social contacts (e.g. knowing someone who works in a science-related job).***

***Science capital is unevenly spread across societal groups. Those with higher levels of science capital tend to be middle-class – although this is not always the case, and not all middle-class families possess much science capital. Students from families with medium or high science capital are more likely to aspire to science and STEM-related careers and are more likely to plan to study science post-16."***

Aspires

what it might be like to work in that field. It may seem a trivial example perhaps but a powerful reminder that fictional as well as real-life role models can influence interest in a subject.

We do not celebrate the success of our home grown digital companies sufficiently. Companies like ARM and Framestore should be household names in the same way as Google, Microsoft or Apple are. We should sing about the successes of companies like WANdisco, Zoopla and Deepmind.

Benjamin Ellis, CEO Socialoptic, Co-Founder of Redcatco and an attendee at our Reading regional meeting, said he was saddened by his daughter's decision to apply to US universities because her perception was that America was much better at driving innovation. At our Newcastle regional meeting David Dunn, CEO of Sunderland Software City, said that young people think *"technology is built on the West coast of America. They don't understand... the technology and the companies that are built not only in the UK but in the North East, on the same road as them, just up the street. So we really need to promote that."*

Britain has some of the most innovative companies in the world working within our shores and yet we don't bang their drum in the same way as they do in countries like the USA. While we should be delighted by our growing tech companies in East London, we have digital success stories across the UK which the Government must also celebrate.

Many have called for a 'female Brian Cox' to inspire young women into science and technology. Some attendees at our Newcastle regional event even thought that someone like Simon Cowell could change views. We see applications for physics at university rising significantly, which many, anecdotally, ascribe to media attention through science programmes on television and popular comedy series such as The Big Bang Theory: the Sheldon Cooper effect alongside the Brian Cox effect. Many of the big budget series have focussed on science. But where is the equivalent of such media interest in technology? The programme constantly cited as having inspired interest and encouraged women and men to work in technology was Tomorrow's World, which was taken off air in 2003. If we are to inspire the younger generation and their parents we need such programmes to return in prime viewing times and with decent budgets assigned to them.

***"Changing the perception of digital careers is not within the compass of education providers alone or even very significantly, it is down to the political and media classes because they have the control of mass communication to the people from single unified sources"***

Mirandanet

***"Britain's entrepreneurial spirit is evident in tech clusters around the country. From world-class games development to advanced cyber security capability, there is much to celebrate."***

Microsoft

### The importance of careers guidance in education

Careers guidance within education is especially important to changing perceptions. Young people cannot aspire to be something they do not know exists. Careers advice is pivotal in bridging this gap. In theory, careers information should be transformative, highlighting opportunities or pathways that you may never have considered as well as clarifying those already of interest. Good careers advice not only identifies specific roles and careers which someone can choose,

but also analyses preferences, personal characteristics and academic achievements in order to guide them to the most satisfying (and so productive) option. While many find their way despite our current poor approach, it does not work for those who lack those personal connections or for those who are socially disadvantaged. Helping students to understand the variety of opportunities and how they are open to all, regardless of background and gender, is particularly important. A fast changing, incredibly diverse digital jobs market is making careers advice more important than ever.

Careers advice should be an ongoing process from primary school right through to those already in work who may be seeking alternative career paths. It must begin early in education, not only once students are looking to the future at 16. Views are formed at an early age before children have often been given a chance to reflect widely on what they might do. In the absence of careers guidance, young people develop views which are difficult to change later on in their lives. By the time students are in secondary education, they may not know what they want to do as a career, but they have begun to rule out certain areas, including entire education pathways.

We need information advice and guidance on all future options on an ongoing basis. A once a year talk is not enough. This is simply not the case at present: in only 12 out of 60 schools visited by Ofsted for a survey of careers service provision was it the case the schools had *"ensured that all students received sufficient information to consider a wide breadth of career possibilities"*.[iii] Many attending our regional meetings felt that current careers advice was at best "patchy" and for the most part "woeful". Careers guidance is all too often seen as an unimportant extra, with schools lacking both the funding and incentives to actually deliver this well. The views we have heard echo the view of the House of Commons Education Committee which has argued that independent careers advice and guidance has never been as important for young people as it is today but that it was a big ask of schools to deliver this without getting more information, advice and guidance themselves:

*"Too many schools lack the skills, incentives or capacity to fulfil the duty put upon them without a number of changes being made. Young people deserve better than the service they are likely to receive under the current arrangements. Schools cannot simply be left to get on with it."* House of Commons Education Committee[iv]

We support OFSTED's recommendation to government to provide clear and explicit guidance on what constitutes a comprehensive careers guidance strategy within schools. As the Select Committee highlighted, schools in England were made responsible in September 2012 for securing access to impartial and independent careers guidance for pupils aged 13-16 but with no additional funding. The CBI Director-General John Cridland has subsequently warned in June 2013 that careers guidance was on "life support" in many areas. We believe that poor careers guidance is especially damaging given the digital disconnect.

Concern has also been raised by London's Local Enterprise

***"Rapidly evolving jobs and careers have expanded career opportunities, but choices are becoming harder, and career guidance is therefore becoming more important and more demanding."***

OECD, May 2011[c]

***"Early exposure to Computer Science is important because familiarity with a subject can generate interest and curiosity while establishing a sense of competency. Moreover, even a basic understanding of Computer Science provides insight into viable career paths within the field and how those careers can be leveraged to achieve personal goals."***

Google[ci]

***"Longitudinal tracking showed that students with low science capital who do not express STEM related aspirations at age 10 are unlikely to develop STEM aspirations by the age of 14."***

Aspires[cii]

Partnership about the state of careers advice. Specifically in relation to the tech sector, it has warned:

*"There is a real risk that schools' careers co-ordinators (many of whom are classroom teachers taking on careers as a secondary responsibility) will be unable to keep abreast of the opportunities in this fast developing sector or the most relevant education pathways for interested children."*[v]

It is not just a problem of knowledge. Teachers sometimes seem so driven to focus on exam results that they lack appreciation of how local employment changes can be important to their students: at one event in East London where a speaker talked about 7,500 new technology jobs being created locally, a Design and Technology teacher remarked that she couldn't really see how any of this was relevant to her.

School leaders and governors are especially important to target in relation to making sure careers guidance is a priority. Ofsted noted that there was a real difference in careers guidance when school leaders and school governors *"made careers guidance part of their strategic efforts to foster better achievement and economic well-being for all their students".*[vi]

One of the most obvious weaknesses seems to be alerting students to the choices they have post 16 and post 18. As described elsewhere in this report, many students are given little or no information about apprenticeships, let alone about digital apprenticeships. This needs to change. A survey of 5,500 teenagers (aged 12-13) was conducted at a series of TeenTech events during 2012/13, which revealed that 74% said they intended to go to university, 9% were thinking about apprenticeships, 9% wanted to go straight into a job while the remainder didn't know.

University can be an excellent option but it will not work for all. Careers guidance should also highlight the option of setting up your own business. If we want our young people to set up the digital companies of the future as well as work in them, information, advice and guidance on entrepreneurship should form one important part of a rounded careers guidance provision.

***"As someone who has spent a great deal of time talking in schools about digital and tech careers, it seems very clear to me that the sector is virtually invisible in schools and there is little correlation between how young people use digital technology in their social lives and a realisation they can use this passion for a lucrative, interesting career."***

Professor Andy Phippen, Plymouth University, Plymouth regional meeting

### Subject Choices

Careers guidance is also extremely important in the context of subject choices made at the age of 14. Data presented by CaSE revealed that in 2012, 83% of year 9 pupils at selective schools opted to study separate sciences whereas only 31% of state school students did the same.[vii] That is a worrying statistic that suggests too many state school students are closing down their options at a very early stage.

One of the issues routinely raised at regional meetings was the age at which teenagers have to choose and narrow the number of subjects they study. Young people have to make decisions that will affect

potential career choices before they have any idea what their career choice might be. Ute Gojrzewski from Intel said at our Reading regional meeting that she felt "we are forcing young people too early to make too specific decisions about a career without giving them the information that they need to make that a qualified decision." Instead, she thought we either had to either allow them to study a broader range of subjects for longer or make sure they understood much more about opportunities earlier. We believe that government should address this issue, possibly by adopting something more akin to Baccalaureate style approach through to the end of secondary education. Such a transition was recently advocated by the Royal Society.[viii]

Students should be helped to understand the subjects that are springboards to many different careers and, perhaps more importantly, students should be warned of the potential for closing off entry into various careers that require digital skills before they give up on that subject. Students should be made aware of the potential consequences of simply choosing subjects that they consider the 'path of least resistance'.

***"Currently the strong policy focus on the 'pipeline' metaphor (the flow from school science to post-16 STEM qualifications and STEM careers) is unhelpful. Instead, science might be usefully described as a 'springboard' – to emphasise its wide value within modern life and to convey how science qualifications can be valuable for propelling an individual to numerous careers and destinations."***

Aspires[ciii]

### Work experience and the role of employers

Schools, colleges and universities cannot deliver good careers guidance on their own. We must be realistic about how much responsibility schools can be expected to undertake in a fast changing landscape. Employer engagement is key to providing updated information about their requirements and guidance to young people about the career pathways available. They can also help to put jobs on the radar. Many people in industry have recognised their responsibility in this respect. For example, at our Newcastle regional meeting Accenture's Bob Paton said: *"We've just got to make jobs more visual for young people. We've got to show them that there are jobs in the industry in the North East."*

Interaction between schools and businesses needs to be made easier. Throughout our review, we heard complaints from within both education and industry that they didn't know who to contact or where to start. This is all the more frustrating as we found no shortage of businesses willing and able to support schools. At our Newcastle regional event, Herb Kim said that it was important to consider specific ways business could interact better with education. He recommended experimentation with businesses bringing in projects into education so that students could work on real life projects. Tasnim Khanom, a teacher from Mulberry school in London suggested there was a need for one person in the school to act as the careers champion and also help forge links with local companies. She recognised the importance of students seeing the opportunities available within local companies, *"not just those in central London"*. The need for regional links was emphasised at all of our regional events.

***"Links with employers were the weakest aspect of career guidance in the 60 schools visited."***

Ofsted[civ]

Some schools report that emails to companies are completely

ignored. We were told: *"It's alright if you're the private school down the road, everyone wants to help them. It's not so easy for us, we don't have the contacts".* Employers also reported frustration at not being able to contact the right person when offering opportunities. Encouraging more technology leaders to join boards of governors in their local area might be helpful in building successful relationships. It would also inform decisions being made about the use of and teaching of technology throughout the school. At our Plymouth meeting it was suggested there should be incentives for companies to get involved.

The need for a website to match schools and students with employment or work experience opportunities was a recurring theme throughout discussions at our regional meetings and the responses to our call for evidence. For example, one group at our Plymouth regional meeting advocated a "clearing house system" website which could help to connect students with businesses, suggesting that such an approach could be adopted regionally or sub-regionally. The idea was that it might be a version along the lines of *"LinkedIn for people going through education"*. Similarly, at our London regional meeting, we had a fantastic presentation from Juan Guerra, the CEO and Founder of Student Funder on the need for a portal to connect across education and the work of work.

We believe that it would be useful to establish a website where schools, colleges and employers could connect. This would help both sides to know who best to contact be it in relation to arranging work experience or placements, careers talks or school ambassador opportunities. The website could also include resources such as helpful advice for employers and thereby help both sides to navigate the process.

A really promising attempt to create such a platform is being pioneered in London by Centre for London's Connecting Tech City project.

Connecting Tech City is a collaboration across the tech community, digital learning programmes and schools in East London, to bring young people closer to job opportunities in tech. It aims to help address the skills shortage in tech in London and to help train talented young people who might not otherwise access jobs in tech.

The project stems from Centre for London's 2012 report 'A Tale of Tech City' which highlighted the skills gap as one priority area that needed to be addressed to support Tech City's development. As the tech cluster in East London grows, it is important that the communities of East London grow with it. In some of the boroughs around Tech City, youth unemployment is as high as 40%. At the same time, Tech City firms have job vacancies they are finding harder and harder to fill, particularly in technical jobs such developers and software engineers, and in front end services like digital marketing and sales.

Connecting Tech City aims to close the gap in three ways; firstly by creating an online platform with information about all the local

***"I think one of the fundamental challenges is that careers advice in schools is generally poor and careers advisors are not well informed about careers in the tech sector. I have lost count of the number of times I have been asked "you need A levels maths to work in IT don't you?"***

Prof Andy Phippen, Professor of Social Responsibility in IT, Plymouth University

***"Employer engagement in a reformed system of careers advice is key to ensuring the information young people receive is relevant, up to date and grounded in the realities of the labour market. It is businesses who are best placed to articulate what they are looking for in terms of skills, knowledge, qualifications and wider characteristics and behaviours. Government must work to facilitate this process, creating channels and structures to help bridge the gap between education and the workplace"***

The CBI

learning opportunities and how to access them; secondly through a series of networking events which will bring young people into Tech City; and thirdly, through research which will investigate the HR needs of tech firms and their willingness to support a collaborative CSR network to develop new young talent. The platform and the research will be launched in Spring 2015. The report will detail how this initiative worked locally in East London and how it could be replicated in other tech clusters in the UK and globally.

The platform will also enable tech firms to engage with the learning programme by assisting as mentors, teachers, role models and opening up their offices for events that bring young people in. Connecting Tech City was originally conceived by Centre for London and developed with early seed funding from City University London and the Greater London Authority. The rest of the funding was raised through crowd-funding which has raised support from start-ups, larger tech companies, public bodies, foundations and individuals.

Relationships between schools and employers need to be ongoing and long term rather than one off experiences. At present, too few employers offer work experience despite their own belief in its importance. 89% employers say *"embedding work experience within courses would help to make students more employable"*.[ix] However, only 22% currently offer job placements or internships to students. If they want to address the long term skills gaps they have, they need to inspire young people about what they might go on to do in life. At the moment, as an attendee at our Plymouth meeting said, all too often work experience is a question of *"which restaurant are you going to waiter or waitress at?"*

In addition, widening the availability of work experience placements could help to address the gender imbalance in the pipeline for digital maker roles. At present, 35% young men do work experience in STEM fields as opposed to just 21% of young women according to the Wellcome Trust Monitor.[x] We would advocate that schools and businesses should monitor the uptake of work experience to ensure that these opportunities are not the preserve of boys. This would help both to be mindful of whether they are ensuring young people are getting the opportunity to see what a tech career could offer them irrespective of their gender.

While careers advice is important during education, it is also important for people at all stages in life. Mirandanet's Ian Lynch suggested setting up a National Careers Wiki. This could be kept up to date by employers. This would *"get around the problem of keeping all the careers guidance professionals, many who are not specialists in digital technologies, up to date."* We think this a sound suggestion as it would be relatively inexpensive to establish and would provide a ready-made structure where for example, employers could provide information about their business needs. A Wiki has the added advantage of being a format with which the vast majority of young people will be familiar, and which they will know how to "graze" for information.

***"The HR team of a major company invited me to watch their new corporate video. After 5 minutes I began to wait for the token female/non-white face to make an appearance. But no, the 7 minute video comprised entirely white, middle aged men. When I pointed out I felt there was something missing the HR person, a woman, said, 'Yes, it does lack the Wow factor doesn't it?' When I clarified my comment she was shocked - not at what I said but because she hadn't noticed herself. The very lovely CTO who was with us had also not noticed this. They both said that because they were indeed surrounded by a sea of white middle-aged faces, so it had of course seemed all very normal. There is a real danger that, without external encouragement to diversify, organisations will persist in recruiting in their own image which will inevitably perpetuate the problem."***

Maggie Philbin

### *The gender imbalance in the workplace*

Although there are misconceptions among those who choose not to come into digital roles, their view of tech companies and tech jobs as male dominated is all too accurate. As of 2013, only 16% of IT specialists and just 11% of IT specialists within the IT sector are women.[xi] While this problem is not unique to the UK or a new issue, female representation has declined over the past 10 years and women's representation in tech industries and occupations is lower in the UK than the EU average.[xii] Too often this seems to have become the accepted norm within the industry.

Employers alone cannot fix this problem. They face a limited pipeline in terms of girls studying computing disciplines across education: in 2013, only 6.5% of those studying A-level computing were girls.[xiii] While not everyone working in tech roles will have studied computing at school, this is an indication of the challenge faced by employers. However, we believe there are steps that can be taken by organisations to improve the woeful current state of affairs. Contributory causes have been identified as the pay imbalance, corporate culture, the recruitment and retention policies and the limits to flexible working.

Firstly, businesses need to ensure that they are addressing the pay imbalance. The median pay for female IT specialists is 16% less than the comparative figure for men and *"the recorded level of pay for women IT roles has been consistently below that of male IT specialists in each of the past 10 years"*.[xiv] There is no excuse for this.

Secondly, it would help if employers were transparent about their own gender balance. Google, for example, recently revealed that only 17% of their employees in tech positions are women. While some businesses will be concerned about data being commercially sensitive, we need transparency to highlight the problem and showcase companies which are managing to make progress on the issue.

Whilst there have been improvements in the number of female non-executive directors, the number of women in executive directorships remains low as does the number of women in senior management positions. While the figures are low across the sector certain companies do better. For example, 28% of IT roles are women at Network Rail. Network Rail identified two factors which have helped them reach this level. Firstly, the number of senior role models within the department: not only do they have a female CIO but also half of the senior leadership team are women. Secondly, there are also a large number of women working in senior leadership positions across the business outside of IT.

We would encourage large organisations to report the number of women in IT roles. In particular, we would encourage the Government to make this obligatory for all government departments and Quangos. If one cannot measure it one cannot manage it.

***"It is time that the leaders of our industry got real about the impact of the gender pay gap on the retention of women in tech."***

Gillian Arnold, BCS Women, in E Skills report

***"Intel believes that transparency with our data is the best way to have a genuine dialogue. We are tech companies and data drives our business; we need to get beyond our fears that the numbers are a poor reflection on our individual organizations and work together to address the issue collectively."***

Intel chief diversity officer, Rosalind Hudnell, talking to CNN Money March 2013

***"Being surrounded by several successful women has made me realise that a position of seniority is not out of reach for me and other women, I aspire to emulate their successes – they have proven that it is possible."***

Katherine Thomas, an IT project manager at Network Rail.

Much emphasis is placed on mentors. However, some consider that it is not just mentors which help but sponsors. That is, people who can more actively support women who may not have the networks or social capital to take advantage of opportunities. Someone prepared to advocate on your behalf when you are not in the room, to make introductions, to act as referee, to alert you to openings. This applies not just to the teenager seeking work experience but right through to the woman looking for an executive directorship.

A perennial issue flagged up by all we have consulted are the problems of returning to work after a career break, typically following maternity/paternity care. To help ensure women can have a route back into tech roles, we would encourage companies to experiment with returnships. Returnships are schemes which offer the opportunity to return to a position in the workplace in a paid capacity for a set period of time with the possibility of a job at the end of it. It allows both the employer and employee to test whether the match is correct without making either commit when the fit might not be correct. We would encourage more employers to ensure that they offer pathways back into tech roles as one way to address the gender imbalance.

Employers should also make sure that they review their employment and recruitment policies to ensure that women have are supported. For example, we would encourage universities to sign up to the principles of the Athena SWAN charter. The Charter was developed to encourage and recognise commitment to combating underrepresentation and women in science, technology, engineering, maths and medicine employment in higher education and research. It helps to promote inclusive working practices and allows universities to join part of a national and regional peer support and practice-sharing network of members.

Altering recruitment processes have helped the BBC to tackle their gender imbalance. 40% of those on the BBC's MSc Technology Trainee Scheme are women. To redress the gender imbalance during their recruitment process, they have had: female-only panels at recruitment events; gender neutral language and photos of female engineers in their promotional material; and changed their entry requirement from maths and physics to maths and another science on account of the fact that women tend to favour biology over physics.

# THE DIGITAL CHALLENGE FOR SCHOOLS

**Frontier Developments PLC** is a computer and video games developer which has built a uniquely diverse track record comprising games that have defined genres, been critically acclaimed and sold many millions of copies.

Frontier looks for outstanding candidates who are from top schools in their field, be that computer science, animation, technical art etc. people with a broad range of skills.

The game-specific elements for all disciplines, except possibly games design, are just a small part of a rounded education. In programming the company competes for candidates with the banking and film industries, in music, sound, art and animation with film, advertising and TV. For design, a love and thorough understanding of games is vital and for art, a good portfolio of work is essential.

UK DIGITAL SKILLS TASKFORCE

## The Digital Challenge for Schools

**Recommendations:**

1. Government should invest at least an additional £20 million by 2020 to help successfully embed the new computing curriculum in schools across England. Government support will likely need to remain in place for the next decade.

2. Schools must provide time and support for computing teachers to deepen their subject knowledge and develop their teaching style. Dedicated time for Continual Professional Development (CPD) is essential for teachers and should be recognised as a core component of being a professional teacher.

3. Government should launch a 'Digital Challenge' for schools, modelled on the collaborative approach of the London Challenge to stimulate partnerships between schools, colleges, universities and industry to enhance careers advice and both the curricular and extra-curricular opportunities available to young people.

4. Government should treat computing as a fourth 'core science'. In addition, there should be a digital component to education and training opportunities for young people up to the age of 19.

5. England, Northern Ireland, Scotland and Wales should all ensure that their computing curriculum includes a balance of computer science, digital literacy and information technology.

6. The establishment of a network of school governors with expertise in computing. Those working in the digital industries should be encouraged to apply to become school governors.

7. Universities should take urgent steps to address the severe shortage of computing teachers. Every university should encourage their computer science students to consider teaching by offering the Undergraduate Ambassadors Scheme.

8. Government should provide a route for experienced professionals in the digital industries to enter the teaching profession via a fast track 'Teach Next' route, modelled on Teach First.

***"Your IT curriculum focuses on teaching how to use software, but gives no insight into how it's made. That is just throwing away your great computing heritage"***

Eric Schmidt, Google, August 2011.

Eric Schmidt's criticism of the old ICT curriculum in England in his MacTaggart Lecture was a catalyst for encouraging the Coalition Government to overhaul the old ICT curriculum. He added his voice to groups such as Computing at School (CAS), the grassroots organisation which had campaigned for change to the curriculum. In

addition, the Royal Academy of Engineering's 2009 report, *ICT for the UK's Future: the implications of the changing nature of Information and Communications Technology*, NESTA's 2011 *Next Gen.* report and the Royal Society's 2012 report, *Shut down or restart?*, all built the case for curriculum change.[xv] The Coalition Government responded and, in September 2014, England will have a new computing curriculum which will incorporate computer science, digital literacy and ICT.

In our regional meetings and submissions of evidence, it was often remarked that schools follow a Victorian model, providing an excellent preparation for a bygone industrial age but that our education system fails to meet new challenges.

The sheer diversity and fast changing nature of technology skills makes it impractical to focus on only teaching specific vocational digital skills. Instead, we need children to gain a deep fundamental understanding of computer science, a fourth core science, which will facilitate later learning. The old curriculum was overly focused on ICT software user skills. While skills remain important and we should not throw out the baby with the bathwater, they are not alone sufficient. In addition, all children need a grasp of digital literacy (or digital literacies), the web skills you need to consume, create and participate online effectively, responsibly and safely.

As Alison McKinnna, the Operations Director at Tribal Group, said at our Doncaster regional meeting, it's very important that digital skills are threaded through the entire curriculum and not just seen as an *"ICT/Computing issue".* Together, computing as a subject can mix the vocational and the academic, opening up study at university or further education or progression into digital apprenticeships. Computing could provide a helpful foundation for our children's future, whether they become a digital citizen, digital worker or digital maker. However, the curriculum change was just the first step to such a future. Considerable challenges lie ahead which need to be tackled if we are to teach the next generation to design and build the technologies of the future rather than just consume them.

***"In the longer term we need a radical re-think on curriculum structure. We are still using a 19th century curriculum structure which makes it extremely difficult (if not impossible) to enable learning of the fundamental skills required in 21st Century - collaboration, team work and multi-discipline activities."***

Martin Longley via MirandaNet

### CPD for computing

The biggest challenge in terms of the computing curriculum reform will be its implementation. To successfully teach a rigorous, creative, challenging and exciting computing curriculum in England, teachers will need support to make an unprecedented step change from ICT to what is essentially a new subject with a core of computer science. Chris Mairs, the chair of the UK Forum for Computing Education, warned at our London regional meeting that the *"big challenge now is empowering teachers to effectively deliver that curriculum"*. We need to demystify teachers' concerns about the curriculum and ensure there is adequate provision of both training and resources. Extensive continuing professional development (CPD) training of existing teachers will be essential if computing is to be a success. As two of the reports which pushed for the curriculum change noted,

***"The quality of an education system can never exceed the quality of its teachers"***

Andreas Schleicher, Deputy Director of Education and Skills, OECD

the old curriculum was only one part of the problem.

The 2011 *Next Gen.* report warned that *"the problems with ICT perhaps have less to do with the way the ICT national curriculum is defined than with the way it is implemented in most schools", noting that "at least three-quarters of ICT teachers would struggle to go beyond what they are teaching now, even if they wanted to".*[xvi]

The 2012 Royal Society report, *Shut down or restart?*, warned that alongside curriculum reform two other major problems were that *"there is a shortage of teachers who are able to teach beyond basic digital literacy"* and that *"there is a lack of continuing professional development for teachers of Computing."*[xvii]

The major priority must be CPD for existing ICT teachers. As the Royal Society warned, "in most cases Computer Science will be taught by existing staff, and they will need help". There are specific concerns about the abilities of certain secondary teachers. According to Government data, 55.1% of secondary school ICT teachers lack a post A-level qualification relevant to ICT.[xviii] In addition, the 2013 Good Teacher Training Guide found that, only 53.6% of ICT postgraduate teacher trainees have a first class or a 2:1 degree, the lowest of any subject.[xix] Primary school teachers will overwhelmingly not have a background in computing. This is not to criticise teachers. Many of those who we have met were dissatisfied with the old curriculum and agreed with the case for reform. However, teachers will need more help if they are to make an unprecedented step change to teach computing.

### Funding for CPD for teaching the new computing curriculum

There is a real risk that the new computing curriculum will fail young people and fail to meet the needs of our growing digital economy without sufficient investment. The Coalition Government has so far unveiled approximately £3.5 million of additional support for the upskilling of the existing workforce. The main investment has been to support the creation of CAS's Network of Teaching Excellence in Computer Science, with 400 master teachers to pass on their skills and subject knowledge. There has also been investment in the Barefoot Computing project for primary teachers, which will include a series of 800 workshops being run across the country by volunteer experts, and a series of matched funded initiatives to leverage support from businesses and other organisations as part of a Year of Code.

***"Computing At School have done a marvellous job of upskilling teachers via their Master Teacher and Network of Excellence programmes. This scheme needs to continue and be permitted to grow."***

Christine Swan, Director of ICT and Enterprise, The Stourport High School and VIth Form Centre

However, while the £3.5 million of funding made available so far is welcome, it compares poorly both with the investment made in other education systems trying to improve their computing education and with the sum invested in CPD for other subjects in England.

A comparison with Jersey puts England's investment in preparing for the new computing curriculum into perspective. Last year Jersey set out their intention to overhaul their computing curriculum with a move towards teaching computer theories and coding. Its ambitious

vision was set out in their October 2013 *Thinking Differently* strategy, which covered three priority areas: teaching and learning; infrastructure and technology; and business and education.[xx] A fund of £2.4 million is being invested in teaching and learning, which 38 schools and colleges will be able to bid for. Half of that £2.4 million is expected to be spent on CPD for both the computing curriculum and for specific training in the use of technologies such as interactive whiteboards and tablets. Assuming that around £600,000 will be spent on the CPD for computing, Jersey's budget provision for their new computing curriculum equates to approximately £15,750 per school. By comparison, the £3.5 million made available by the Department for Education so far is only equivalent to £175 per school across England's 20,000 state funded primary and secondary schools.[xxi]

The funding also compares poorly with other subject areas which have received specific additional funding. In recent years, the Coalition Government has invested £7 million in physics teaching, £11 million on a new maths teaching hub and £16.8 million on a Department For International Development funded programme for CPD on global issues. Physics and maths are established subjects whereas the computer science core of computing will be a largely new subject matter for many teachers at both a primary and a secondary level.

Many organisations have expressed concern that the current CPD funding is not sufficient to make the step change to computing.

London's Local Enterprise Partnership warned that not enough funding is being provided ahead of the introduction of computing in its funding bid to the Local Growth Fund, A Growth Deal for London:

*"There is a real risk that budgetary and other pressures on schools, particularly in the disadvantaged areas of east London close to where much of the new digital employment is concentrated, mean they fail to realise this opportunity and increase computer science teaching."*[xxii]

As part of their £6.3m appeal for a *"Meeting the Digital Skills Challenge"* initiative, they have called for extra funding to support efforts to teach coding and attract new teachers.

The Council of Professors and Heads of Computing warned in their submission of evidence that:

*"Constrained school training budgets and already heavy commitments on teacher time are two of the key reported tripwires… Unless there is sufficient funding given to computing initiatives they will wither or fail to have significant impact."*

The BCS, the Chartered Institute for IT, made the case for long term investment in CPD: "Only with professionally trained and well-motivated computing teachers will the new computing curriculum succeed. The government should expand existing high quality CPD schemes for computing teachers, and ensure they have mainstream funding over the next decade at least."

We are entirely aware of the fiscal position of the UK Government. However, if we really believe that our future as a country should be as a world-leading digital economy and that computing education would form the base for that ambition, we must invest a sum that is commensurate to the challenge of preparing our teachers for computing.

We have heard concerns across the country that teachers simply lack the help that they need to teach the new curriculum, a claim supported by a recent survey by TES and NESTA which found that 60% of England's teachers are not confident delivering the new computing curriculum and that 67% of teachers said they did not feel very or at all supported by the Department for Education.

Policy Exchange proposed in their Tech Manifesto that a competitive grant pot of £3 million a year should be established over the next Parliament.[xxiii] We believe that an additional investment of £20 million over the next Parliament is the absolute minimum needed to help teachers get the training they need for the new subject. This sum was recommended by the experts of the UK Forum for Computing Education, the independent committee which acts as a single voice for the computing community on computing education issues for 5 to 19 year olds in their submission of evidence to this review. We believe that this sum is the bare minimum required and that funding above this level could further help to expand the availability of CPD to ensure that the change is embedded.

In particular, we must ensure that the focus of CPD investment for computing is not just targeted at secondary schools. We must also focus on raising computing standards at primary school. It has been said that learning to program is much like learning a language - best learnt when young. The importance of primary school level attainment has been evidenced in recent research from the Institute for Fiscal Studies and the Institute of Education. That report argued that the roots of "the London effect" of improved higher attainment of disadvantaged pupils over the past decade "are likely to lie in primary schools" improving teaching at an early level.[xxiv] In addition, research from Google has also shown that it is important for school pupils, especially girls, to have computing education at a young age.[xxv] They found that *"early exposure to Computer Science is important because familiarity with a subject can generate interest and curiosity while establishing a sense of competency. Moreover, even a basic understanding of Computer Science provides insight into viable career paths within the field and how those careers can be leveraged to achieve personal goals."* By contrast, it warned that "young women unfamiliar with Computer Science and its broad applications have difficulty visualizing it outside the narrow scope often presented in popular media". If we are to tackle the gender divide in tech jobs, we need to teach computing well and from an early age. Preparing our children for their digital future will require investment and focus across every level of education.

***"Imagine we had a shortage of pianists, and Year of Piano was the proposed solution: £500,000 to train 100,000+ piano teachers - people would naturally call it absurd. You can't learn the piano in a day, certainly not well enough to teach it. Why on earth would anyone believe programming is orders of magnitude easier? I think politicians in particular underestimate the true importance of computing to the UK by orders of magnitude. Hence we get national education initiatives with soup-kitchen budgets."***

Jason Gorman, computer programmer

## The importance of CPD

In order to improve the teaching of computing in schools there needs to be a shift in culture with a greater emphasis on CPD. It is essential that schools make time available for their staff to expand their knowledge and develop their pedagogical techniques. Just as teachers have a time allowance for planning, preparation and assessment, teachers need similar provision for CPD. After all, it will be of no use if CAS develop a nationwide network of master teachers providing free or reasonably priced high quality CPD but schools do not provide teachers the time out of the classroom to attend their sessions.

In addition, there are considerable useful resources available online which teachers need time to explore and use. Without CPD, new graduates coming into teaching will find their subject knowledge out of date and lack the chance to develop their teaching style. While it is a brilliant testament to their dedication that teachers undertake CPD in their own time at their own cost in evenings or weekends, this should not be necessary. We would not expect other professionals, such as doctors, to make sure they stay up to date in their own time.

At one CPD event for 120 teachers in London, one of the teachers who had been invited to share her knowledge and experience with others had a confession. The only way she had been allowed to attend the event was by pretending her mother was in hospital. She began her presentation with: *"Please don't tweet that I'm here".*

A Design and Technology teacher in Wales told us it was so difficult to get time out for CPD that she relied on an electronics hobbyist in her village to come into her school and work with her students.

Instead, we need a new approach to CPD as an essential ongoing part of pedagogical improvement as part of being a professional. All state school teachers should need to participate in ongoing CPD in order to remain in the classroom. This could be assessed by teachers themselves, coming together in a professional body such as the Royal College of Teaching which has been proposed in recent years. Alongside such a requirement, we need support for teachers, both in terms of time and resources, to ensure that all can undertake CPD tailored to the teacher's needs. It is important too that teachers should be able to progress in their career without doing so only by entering management and thereby spending less time in the classroom.

Peer to peer sharing is of great value and the growing popularity of TeachMeets is testimony to this. They are an excellent opportunity to hear about the effective use of and teaching of technology. However, although some teachers participate and attend, we would encourage more to do so. As MirandaNet commented in their submission, *"teachers have few channels where they can publish their knowledge and expertise to a wide audience and influence policy like the doctors do in the Cochrane review".* We need an evidenced approach to what works.

Opportunities for CPD are also important to address the gender imbalance within computing. We have been told that the old IT GCSE discouraged many students, male and female, from both studying the subject at higher levels and from entering a technology career. In particular, there were concerns that the old curriculum put girls off. However, it is teachers who can make the difference and tackle this gender imbalance in the classroom. We should not be fatalistic.

*"In my own practice as a teacher, in 2010 at Key Stage 5 approximately 10% of the class was female. By 2013, this had changed to 50%. This was achieved through approaching lessons at Key Stage 3 and Key Stage 4 from a gender neutral approach to make it more inclusive and sharing these lessons plans and approaches within the department. I also used role models to support lessons at Key Stages 3 and 4. I'd ask the few sixth form girls I had in the subject to come into class and support. Also, I was the first female ICT teacher in the department, so I was also a role model. I included tasks that had a real world scenario or that would have a social impact as girls become more engaged by this approach. I'd also allow creativity and collaboration between students to work on projects in a hands-on way to engage them all. This helped to support and engage the lower ability students too. These approaches seemed to make a real impact."* Carrie Ann Philbin, Education Pioneer at Raspberry Pi, former teacher, vice chair of CAS #include and member of the UK Digital Skills Taskforce

The problems of CPD for computing teachers are part of a broader weakness across England's education system: the Institute of Education has warned that "the proportion of teacher time devoted to CPD in England is lower than in the best-performing school systems".[xxvi] The OECD's 2013 Teaching and Learning Survey revealed that English teachers work 46 hours a week, one of the highest amongst the 34 countries surveyed. David Weston, the CEO of The Teacher Development Trust, noted that the report revealed that English teachers are much less likely to engage in subject knowledge CPD than the average amongst the 34 countries surveyed. While our teachers and schools have muddled through before despite our current inadequate approach to CPD, this will not be sustainable for the new computing curriculum. The problems of our approach are apparent in many of the submissions we have received.

In 2011, Ofsted produced a report, *ICT in schools, 2008-2011*, which was highly critical of CPD provision for ICT staff in most schools. It found *"few examples of a systematic approach to auditing and meeting the ICT training needs of staff"* and warned that, *"given the continuing pace of innovation and development in ICT in education, and in technological advances in the workplace, it is clear that all schools will need to adopt a systematic planning cycle for the training and updating of ICT and other staff"*.[xxvii] If the new computing curriculum is to be a success, we will need school leaderships to recognise the importance of CPD.

***"It breaks my heart to know the opportunities I have missed to make me a better teacher"***

A secondary school computing teacher, via email.

## A 'Digital Challenge' for Schools

In order to make sure that schools appreciate the scale of the challenge ahead and the importance of taking steps to prepare for computing, the Government should undertake a sustained awareness-raising campaign targeted at schools' governors, headteachers and senior leadership. Ensuring these key individuals appreciate the scale of the change is extremely important to making sure schools prioritise computing.

In September 2014, there are considerable changes coming in to the English school system from performance related pay to curriculum reforms across the board. With an ongoing focus on core literacy and numeracy and a continual focus on the next set of assessments, the introduction of computing risks being overshadowed. Alongside such a campaign, we need Ofsted to be given clear policy guidance covering the early years of the curriculum. Ofsted must understand the scale of the challenge schools face while ensuring during inspections that schools have both taken steps to prepare for the new subject and have developed plans for introducing and preparing for computing over the medium term.

In addition, attendees at our London regional meeting emphasised the need for *"computing champions"* within schools to make the case for computing. We believe that schools could benefit from a 'London Challenge' style collaboration programme between schools to help schools make the transition to the new subjects.

London Challenge was launched in 2003 by the Government to improve outcomes in low performing schools in the capital through collaboration between schools at a regional level with an emphasis on the importance of school leadership. It has been credited as one important factor which helped to improve standards in London schools.[xxviii] We would also encourage the establishment of an independent network of governors with an interest in computing who can share best practice and exchange resources on preparing for computing. We should also encourage those working in the digital industries to apply to become school governors.

Although Government has an essential role in providing additional support to help make the step change from ICT to computing, we believe that the responsibility extends to all broader stakeholders, such as businesses and universities, which have the expertise that school teachers need. While we are aware of considerable good practice from industry and academia (for example, over 80 universities are already working with CAS), we would encourage all organisations to consider what steps they can take to help with the transition. It is also important for schools, colleges and universities to collaborate at a local level to help make the step change to computing. Below are two examples of local collaborations to prepare for the new curriculum.

Patsy Walsh, head of ICT and Computing at St Cuthbert's High School, in Newcastle, told us about the Primary Computational Thinking Project, a collaboration between St Cuthberts High School in

Newcastle, its feeder primary schools in Newcastle and Newcastle University. This has helped them to prepare for the new curriculum and develop computational skills through collaborative learning. Patsy made a successful bid for funding along with Dr Nick Cook from Newcastle University to work on aspects of computational thinking with their feeder primary schools. The bid provided funding for Raspberry Pis, Bee Bots, Lego Mindstorms and Pico Boards. The project team spending one afternoon a week in the primary schools leading workshops with primary school teachers. The team includes St Cuthbert's staff, sixth form students and final year Newcastle University Computer Science students. The lessons include computational thinking with Beebot and Lego Mindstorms for programming with Scratch with years 5 and 6. The Bee Bot work also integrates numeracy and literacy into the task through the use of mats.

Patsy explained how the project had had benefits for all involved:

*"In general students and teachers have responded very positively to the project. In one of the first schools visited Ofsted happened to be inspecting and spent 30 minutes observing the lesson. The comments made by the team were very favourable – in particular the project was seen as an excellent form of transition work with the secondary school. There seems to have been a significant acquisition of skills that could be attributed to the student lead aspect of the project. Our students enjoyed their input and learnt a considerable amount – the university students acted as excellent role models. As a result of the project a year 12 student led has been successful in obtaining an apprenticeship with Cap Gemini. Also, one of the university students was offered a place on all the PGCE Computing courses that he applied for."*

The best practice has also been shared with time set aside to reflect on the successes of the project. Teaching staff and students have created booklets for the code themes which are copied and provided to the schools. In addition, guides have also been created as support for the student leads.

The London Borough of Camden has made scaling the new Computing curriculum a key strategic priority across its 57 schools. Camden has created a *"Get Camden Coding ladder"* programme to ensure there is a pathway for Camden children to develop computing skills along each stage of their education. Camden, which has retained a strong 'middle tier' core Local Education Authority, has been in a position to scale support for the new subject in schools right across the borough. Its primary schools all subscribe to the services of the Camden City Learning Centre (CLC) which provides opportunities for all Camden pupils to have day long programming projects led by a highly skilled team using the latest technology from programmable toys to robotics.

Working with primary 'digital leaders of learning', schemes of work and materials are being developed to support the implementation of the new National Curriculum for Computing. The use of common resources identified by and tested in Camden's schools and the CLC

better enables the sharing and development of practice between schools.

Cllr. Theo Blackwell, Camden Cabinet member for Finance and Technology Policy and member of the UK Digital Skills Taskforce said:

*"We need to start children early to get them excited by the new computing curriculum. We are doing that here in Camden by enabling children in primary and secondary schools to experiment with coding, manipulating robots and mini-computers, as well as multi-media applications, so they can see the practical uses of computer programming in daily life. Because of our partnership between schools, the council and the CLC, all primary pupils in Camden will enjoy have a broader more innovative programming experience, that starts earlier and goes deeper, than in any other London borough. Camden is home to very many creative industries at the cutting-edge of technology, from games to video special effects. We want young people here to be able to work in those industries, not just use their products."*

To make the step change in provision, the council's culture and environment department has backed the development of innovative new courses in robotics and support for teachers with a £250,000 investment from its 2013 budget. The council has also enabled an innovative programme of sessions to promote coding and computing to students in Camden maintained secondary schools. Provided by the specialist provider Film & Video Workshop, it includes programming a robot and the Engduino, a computer on a board designed and produced at University College London's (UCL) Department of Computer Science. 1,000 secondary students will participate each academic year.

Camden is also investing in CPD to support teachers for the new curriculum. Amongst the CPD initiatives is the creation of a special interest group to share work from the undergraduate programmes at UCL with school teaching teams. In the next academic year, members of the group will be supporting a computing club at the CLC. The partnership provides teachers with unique opportunities to learn about world leading developments in computing and leading thinking in pedagogy and curriculum a summer school will provide an opportunity for post 16 students to work with Dyson designers on programming projects.

Many experts we have met think that it will take at least a decade to successfully embed the new curriculum. We will need collaborations like these at a local level to help make the transition. In addition, we will need the support of industry for teachers. People in business can help through a variety of ways, such as by signing up with CAS or by getting involved via grassroots communities such as the Raspberry Pi community. Larger businesses can help fund CPD. So far companies including Microsoft, Google, IBM and ARM have all made major financial contributions to teacher CPD programmes such as CAS and Code Club Pro. Samsung is working with Birmingham Metropolitan College's Harborne Academy, a secondary school for 11-18 year olds, to build a professional development centre for teachers. Starting with

teachers at Harborne's 11 feeder primary schools, the new Samsung Digital Academy for Teachers will provide three levels of training programmes to equip teachers with the knowledge and skills in technology and coding using Samsung products. The Academy will provide over 500 teachers over the next three years with training in using technology in the classroom and an introduction to programming in line with the new curriculum.

Another way for businesses to help teachers is by offering opportunities for teachers to gain experience of industry. Many individuals and organisations who we spoke to were keen on such an idea. For example, the Institution of Engineering and Technology (IET) stated in their submission that:

*"Teacher secondments to the business and commercial world would provide great benefit to both the teaching staff and students".*

We would like to see more schemes to encourage teachers to gain insight of the business world. While it would help all teachers to appreciate the possible digital jobs that their pupils could aspire to, such links are especially important for vocational elements of education where we need teachers to be aware of the latest developments. Inviting people from industry into the classroom to provide insight into how they are using digital technologies would also help to provide students with some context for their work

### Teacher recruitment

Beyond the immediate need for CPD, computing also faces a longer term challenge of expanding the pipeline of new teachers coming into the profession. The latest data shows that the Government has only hit 57% of its target for computer science teacher recruitment for 2013/14 against a cross-subject average of 96%. [xxix] The Government has introduced extremely generous bursaries to encourage graduates to consider teaching which need to be maintained at levels comparable to other priority subjects. In addition, the Government could have a drive to encourage IT professionals to consider retraining as a teacher. There have been calls previously for a 'Teach Next' initiative, modelled on Teach First, to provide experienced professionals a pathway into teaching. Industry has much of the expertise that we need in schools.

University computer science departments should take a lead on encouraging their students to consider teaching. It is in universities' enlightened self-interest for schools to teach computing as well as they possibly can. All university computer science departments should offer the Undergraduate Ambassadors Scheme. The scheme provides universities a way to develop a module which provides STEM undergraduates with an opportunity to gain academic credit by working as teaching assistants and acting as role-models in local schools. It encourages undergraduates to consider teaching as a career whilst also giving them useful, transferable skills which will benefit them in whatever career path they choose to follow. First

established in 2002/03, the scheme has grown but it has had limited uptake from computing departments so far: fewer than 80 computer science students took part in the scheme in 2012/13, with only 13 departments having any involvement.

The University of Glasgow's School of Computing Science has found the Undergraduate Ambassadors Scheme to be extremely worthwhile. They first ran the scheme in 2007/8 and have had 10 students on average participate each year. Each ambassador will have contact with around 4 different class groups with the result that approximately 800 school pupils a year gain significant novel exposure to the subject. After participating in the scheme, typically between 1-3 students each year continue onto teacher training.

Dr Quintin Cutts said: *"This course is a win-win for everyone concerned. The ambassadors get to 'give something back' (often a phrase they use) as well as to get experience of teaching and improved communication skills: it is one of the few times where they need to be really professional. Having to explain computer science and programming concepts to pupils requires the ambassadors themselves to develop their own understanding, and many have said that their understanding of programming concepts has deepened as a result. Teachers benefit from the infusion of ideas which comes from our students. School pupils learn from ambassadors who are only a few years older than themselves which can help to switch them on to the subject. In fact, one of our Ambassador students this year said that he only went on to study computing because he had had one of our ambassadors at his school a few years before who had taken away much of the mystery and confusion of the subject. Lastly, the scheme is really useful for the academic staff involved. The ambassadors' reports on their visits give us great insights into what goes on in classrooms, something that academics have difficulty accessing otherwise. We have really rich discussions in the university sessions about the nature of computer sciences and education generally, and working with the ambassadors on their own teaching materials is very rewarding."*

## Curriculum reform

We believe that all education systems in the UK need to ensure that their computing curriculum includes a balanced mix of computer science, ICT and digital literacy as advocated by the Royal Society in 2012. While England is making the change to computing from September 2014, we need all of the devolved education systems to ensure that their curriculum provides the rounded computing education that we need. The Royal Academy of Engineering highlighted the importance of computing education in their 2009 report, *ICT for the UK's Future: the implications of the changing nature of Information and Communications Technology*:

*"It is essential that a significant proportion of the 14-19 age group understands computing concepts – programming, design, problem solving, usability, communications and hardware. It is of particular*

*importance to reform the teaching curriculum in schools to differentiate between the learning of genuine IT and the use of IT. Understanding the basis of the subject is fundamental – understanding of applications can build on this and can be delivered either through higher qualifications or training in employment."*[xxx]

We need young people to both understand and apply fundamental principles and concepts of computer science, including abstraction, logic, algorithms and data representation. An ability to analyse problems in computational terms and experience writing computer programs will be a useful education for all. Of course, not all students will become digital makers. However, a foundational understanding of computer science will be useful for those who go on to become digital citizens and digital workers. Curriculum change must not throw out the baby with the bathwater: we will continue to need to teach children how to use information technology and how to be responsible, competent, confident and creative users of information. It will remain important to teach software user skills for word processing, spreadsheets and presentation software skills given their wide relevance. However, we should not confine such skills to computing or ICT. Instead, they can and should be developed across all subject areas. Digital skills are fundamental life skills, a basic literacy required by all. We do not teach literacy only as part of English lessons and nor should we teach digital literacy only within computing classes.

### Schools' approaches to technology

Much has been made of the irony of students walking into school and being asked to leave their technology behind or turn it off. Kingston University in their submission suggest schools should:

*"review school policies towards personal technologies and environments, and identify situations where personal technologies and social media can be integrated positively into the school environment. Some work has shown, for example, that by a school engaging in this way, it has helped with cyber bullying as pupils feel that schools understand the technology and therefore are then prepared to disclose problem issues."*

***"No technology has an impact on learning on its own; it all depends on how it is used."***

NESTA

At many schools, a real focus to ensure technology is well integrated into teaching and learning has been made. For example, on a tour of Barclay primary school in Leyton we saw how use of the latest technology had been successfully integrated throughout classrooms. Following piloting of hardware, technology had been rolled out following extensive planning and the provision of training for teachers. While our focus has been on the need for CPD for teachers, we have heard about how poor equipment can hold back learning. The contrast between the quality of kit in schools can be shocking. One teacher from a junior school in Manchester said she was frustrated to hear about exciting lessons she could be leading in the classroom when she had to make do with 20 ancient laptops across

220 students.

We support the need for an evidence-based approach and applaud initiatives that help schools to know what is effective. There is good research being done in this respect. For example, the Education Endowment Foundation is undertaking 11 trials into the effects of digital technology, ranging from an investigation of flipped learning through to the impact of online maths tutoring.

It is essential to develop a school culture and plan for implementation of technology.

In their submission NESTA proposed *"the development of a 'testbed' that brings together teachers and the edtech industry, informed by the growing research into evidence in education."*

It is a sensible approach that we endorse.

### Cross curricular and project-based learning

Computing is extremely important as a subject but we have concerns about the extent to which most learning at school happens in silos. Attendees at our meetings across the country, members of the Young Digital Taskforce and many submissions emphasised the benefits of both project-based learning and cross curricular work.

We need an education system that encourages and recognises such an approach and the skills that it develops. This has been consistently emphasised in both submissions of evidence and by attendees at our regional meetings:

*"It is critical to recognise that digital skills need to be applied cross-curriculum as they do not sit within any single specific area. The education environment should have greater links to the world of work that students will experience, there are few if any careers that do not interact with digital technologies in some capacity. By encouraging cross curricular delivery, learners will come to understand and expect digital skills in each area of the curriculum."* OCR

*"There is also need to acknowledge the cross curricular nature of technology – it isn't just something that should be used in ICT lessons. All manner of subjects can benefit from technology (for example, research in history, filming and production in drama, geocaching in geography, social media in English) if teachers feel supported in using technology in lessons. There are positive moves by OFSTED on this front that are encouraging but at present viewing digital skills as an "ICT" issue is seriously hampering the potential positive impact of technology in schools."* Professor Andy Phippen, University of Plymouth .

*"A most important signal to send out is that practical technological competences are valued as much as academic attainment in exams. This means providing real incentives to teachers and their pupils to undertake really useful practical digital projects. Not just those pupils*

***"Cross-curriculum activities which involve computing, maths, science, art and design would be beneficial as it would provide the basis for a systems thinking approach."***

IET

*that can't achieve a C grade, but the A*s too. Such projects will make the breadth of opportunity self-evident and might even stimulate a few more entrepreneurs. This is not going to happen while virtually all the credit is accrued from academic end of course exams."* MirandaNet

The value of applied learning was emphasised by Deborah Eagen, from the Sheffield City Region Local Enterprise Partnership, at our Doncaster meeting and by many others including Debbie Forster of Apps For Good.

Avoiding a siloed approach to the subject is essential as digital technological advances also massively affect subjects beyond computing. For example, Graeme Lawrie, Head of Science and Technology, Sevenoaks School, explained to us how Design and Technology has changed:

*"As Design and Technology evolves as an academic subject we find that the technology push has enhanced our curriculum through new and exciting hardware and software. It is not uncommon now for D&T to teach a variety of digital skills within the context of 'Design and make' related activities. Desktop publishing, computer aided design and manufacture, advanced electronics, programming/coding websites and apps as well as computer control through mediums such as Arduino or Raspberry Pi. Most research for the subject is also completed through IT Tools such as the Internet, finite element analysis and advanced computer simulation. The divide between 'Computing' and 'Design and Technology' grows smaller each year."*

Many of the challenges facing computing, including the urgent need for CPD for teachers, the importance of up to date resources and the shortfall of new teachers, also confront Design and Technology. Russell Bramhill, a Design and Technology teacher from the Hayfield School, explained the implications of technological advance for him and his students.

In their submission, the Royal Statistical Society (RSS) highlighted that:

*"Digital technology has made it possible to collect and process data on a scale that was unimaginable just a few decades ago. Software is a hugely powerful tool for data analysis, and the use of it should be coupled with critical understanding."*

Their *World Full of Data* report warned that changes in technology have had an extremely limited impact on the way in which subjects are designed, taught and assessed.[xxxi] The skills needed for "big data" analysis do not simply belong as part of either maths or computing. Instead, as the RSS put it in their submission:

*"There is a strong case for data-related skills to be allied with digital skills".*

***"If the key skill in a digital world is working creatively in collaboration with others, multimodally, on real tasks informed by massive amounts of information and using computer tools and computing techniques, we have to ask first how the education system is going to assess and accredit this, and then how the curriculum and organisation of schools should be constructed to enable young people to successfully achieve what is being accredited. Without grappling with the big black cloud of how schools and individual pupils will be assessed, there is little chance of meaningful change. What you get is what you measure."***

MirandaNet

## The case for wider curriculum reform

It's clear that our education system needs to change to give young people the foundations they need to succeed in the new digital economy. While the new computing curriculum is welcome, there was some concern about the readiness of our schools to teach it effectively from this September.

Tech companies have told us that creativity, critical thinking and communication skills are just as, if not more, important to them that technical knowledge and teachers have complained that the constraints of the existing schooling system provides limited scope for creativity in the curriculum. Rethinking what we teach, how we teach and why are big questions beyond the scope of this review, but we nonetheless found wide-ranging support for curriculum reform that our political leaders may wish to consider.

# THE TECH THIRD SECTOR

UK DIGITAL SKILLS TASKFORCE

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# The Tech Third Sector

### Recommendations:

1. The Tech Third Sector should embrace its potential to act as a 'petri dish' for schools, providing the space to experiment with how we teach computing and learn digital skills. Collaborative research across programmes could expand our understanding of the impact of different approaches. This learning could then inform and help teachers within formal education.

2. Tech Third Sector initiatives should be mapped and signposted online to allow students, companies and communities to easily find and get involved with schemes in their local area.

3. Businesses and major trusts and foundations should promote the growth of the Tech Third Sector by providing seed funding to stimulate new initiatives and larger grants to allow successful initiatives to scale up.

4. Efforts to recognise informal learning via online portfolios or digital badges should be encouraged.

### The Tech Third Sector

An ever growing number organisations and grassroots networks have understood the need to help people gain and develop digital skills above and beyond what is taught in school, groups which together can be described as the Tech Third Sector. These organisations have taken the lead in pioneering a rich variety of local, regional, national and international programmes which enrich learning. They often collaborate, cross-promote and have created a lively ecosystem focused on the needs of young people of all ages not currently met by restrictive curriculums.

The Tech Third Sector provides opportunities to explore digital making and creating. Their programmes encourage creativity, hands on learning, problem solving, teamwork, collaborative work, communication and leadership. Schools and teachers have told us that the development of these important attributes and skills is neither appreciated nor encouraged by the accountability measures which weigh down on them. As Rachel Mason from STEMNET put it at our regional event in Wrexham, teachers are caught in a "strict timetable" that limits their ability to be creative. So, the Tech Third Sector offers teachers the space to escape those and teach in a different way, one which they are often keen to seize. For example, 45% of Code Club volunteers are primary school teachers. One of the most watched TED lectures is Ken Robinson's beautifully put case for creativity in the classroom, titled How Schools Kill Creativity. We would like to see more time made available within the school

***"Teachers are driven by the curriculum and the framework and applied learning gets lost amongst it. Responsive teachers may find it all too restrictive. One table member gave an example of a 28 year old leaving the profession because of this. Students also disengage because they can't see the point of what they're learning"***

Gillian Arnold, Chair, BCSWomen, and UK Digital Skills Taskforce member, feeding back from her table at our Doncaster regional meeting

timetable for cross curricular project based activities but until that step is taken, organisations which enable students to value and develop their own ideas outside the curriculum have a very important place.

These organisations offer projects which encourage students to develop their digital skills on real world projects and to forge direct contact with people from industry. Emma Mulqueeny explained to us how Young Rewired State (YRS) offers young people the opportunity to work on real life projects:

*"Our work in this field has led to some great experiences for young people, as they are given specific problems to help out with, such as Refugees United: finding new ways for Somalian refugees in camps across the Kenyan border to identify themselves and reconnect with their families and friends in other camps, and a wealth of other hack events open to them through Rewired State. Young people across borders are now connecting, with the young coders from Berlin being invited to take part in the upcoming YRS event in Kosovo - as one of the apps they built at YRS Berlin addressed the issue of finding people missing through war. That is an historical problem for Germany, and a current challenge facing Kosovo. Community is at the forefront of everything we do, and everything we do has a point! The challenges are tangible, their solutions are relevant."*

The real life contact helps change young people's views of the sector. As Debbie Forster from Apps For Good says, they can *"help to dispel some of those myths that technology and digital is only about smelly boys coding in basements somewhere"*. The skills that they develop in organisations like this, or on the many resources available online, can feed back into their work within the classroom. TeenTech has heard from teachers who have found that it has had a powerful impact on learning within schools. Russell Bramhill, a Design and Technology teacher from The Hayfield School, said that students had gained a new passion, creativity and a depth of knowledge and understanding about the design and manufacturing industry by participating in the TeenTech Awards which "might not be on the assessment criteria" but which is extremely important and now "shines through in their work". Most of all, these organisations offer an extremely engaging way to get excited with computing through making and doing.

***"Encouraging children to see the link between learning Blender at home and their lessons in maths at school is a really important way parents can help develop that informal learning into something more meaningful"***

Leading visual effects studio, Framestore

*"Humans are curious animals - we love solving problems and figuring out how the world works. And we're compulsively creative: stick a ball of Plasticine into anyone's hands and they will instinctively start to shape it into something. In fact, it's very hard not to make it into something! These two things together - problem solving and creativity - are very empowering. You can change the world around you and make your ideas come to life. This obviously has practical applications, from medicine to engineering, but it's also great fun. You see this at maker fairs and tech events: there are lots of serious applications on show but the biggest crowd is always around the giant dancing robot made out of scrap. Or anything that shoots huge flames.*

*So making stuff is fundamentally satisfying, fun and it scratches an*

*evolutionary itch. But it's also a powerful educational tool because making requires deep thinking. If you want to build something you have to: break the problem down; work out the best way to do it; decide what's important and what's not; and reuse things that work and reject things that don't. These skills are essentially analogues of computational thinking concepts such as decomposition, algorithmic thinking, abstraction and generalisation. It's a very powerful way of thinking about the world that is transferrable to all school subjects and beyond. They are essential real-world skills. By making and building things, young people (and adults!) learn while they are doing something that they think is fun and cool. It's learning by stealth.*

*Of course, computing complements the "traditional" making process. It takes it so much further. You can bring your ideas to life much more easily, starting off with simple games or proof of concepts on the screen; moving on to something like building a small, single motor robot or wearable tech; then tackling more complex projects including network-enabled devices. This is why I love physical computing: it's empowering, exciting, useful, accessible and challenging. It's a beautiful thing."* Clive Beale, Director of Educational Development, Raspberry Pi Foundation

Tech Third Sector organisations operating nationally include Apps For Good, Code Club, CoderDojo, Stemettes, Technology Will Save Us, TeenTech and Young Rewired State. This is certainly not a comprehensive list and there are many other excellent initiatives running regionally and locally. These organisations sit alongside Maker Faires, Raspberry Jams, CSR initiatives run by large corporates, outreach work led by universities and programmes run by institutions such as the Royal Academy of Engineering, British Science Association, STEMNET, e-skills UK and Engineering UK. Together they provide what can either be viewed as a rich tapestry or a bewildering confusion of opportunity. We believe that this diversity is a strength. *"Businesses can also collaborate with expert Tech Third Sector organisations, as O2 have with Appshed and Mozilla Foundation to run their Think Big School."*

Think Big School is designed to engage secondary school students, giving them the opportunity to practice the principles of entrepreneurship and use digital technology to bring their ideas to life. Students are encouraged to consider how technology can help to solve everyday problems, using the latest digital making tools to start prototyping and building their ideas online. The programme gives students the chance to interact with O2 business mentors, who bring their skills and knowledge to the table to help the young people to translate their ideas into viable products or services.

Telefonica believes that the possibilities of technology should be open to everyone and that young people should have the knowledge, skills and confidence to learn the building blocks of the internet. Together, this can help young people to consider how they might create and shape the digital future of their lives, their communities, the UK and the world later in life. It is not just about use of technology; instead, it is about unlocking the potential of young people to learn how to make and create products and services that

***"As the generation to have grown up with the internet, young people are uniquely placed to capitalise on the opportunities offered by the digital economy. I believe that young people hold the skills and ideas to help create a prosperous future. But they need the tools, support and self-belief to do so. Think Big is how we help, through funding youth-led local community projects, Think Big Schools and GoThinkBig. We support young people to develop enterprise skills, web-making and digital skills using the latest technology, and employability skills to prepare them for the world of work."***

Ronan Dunne, CEO Telefonica UK

will transform lives, make the world more sustainable and ultimately, change our future for the better.

Think Big School is a collaboration between O2 Telefonica with expert partners, such as Appshed and the Mozilla Foundation, to create and deliver the ThinkBig experience to young people and schools across the country. Think Big Schools has reached 6000 students so far and aims to double this by 2015. Of those who have taken part, 80% felt that Think big School provided them with an opportunity to learn and achieve new things, 70% felt more confident about starting work and felt their digital skills had improved and 55% expressed they'd consider working for a digital company in the future.

*"Beyond the formal curriculum, many businesses, including TATA Consultancy Services, have outreach schemes directly aimed at young people. Whilst there is the temptation to rationalise, reduce duplication and bring scale, we would argue that the existing 'many flowers bloom' approach brings creativity, innovation and allows businesses of all sizes to develop individual and meaningful local relationships. TCS's own IT Futures programme, whilst annually reaching over 10,000 young people is nonetheless adaptable to differing circumstances such as geographical locations, age profile of young people and the skills set of our employee who choose to volunteer."* TATA Consultancy Services

However, while the Tech Third Sector is better off for its diversity, there is scope for collaboration and learning between the organisations operating in this space, which could help to share best practice. In particular, we believe the informal sector can adopt a new approach. These organizations can innovate, can experiment, can afford to take risks and occasionally get things wrong. Consequently, the Tech Third Sector can act as a petri dish for the formal education sector to test different and complementary approaches to learning.

*"One of the reasons we occupy space in the informal learning arena is not because we don't consider formal learning important but because we're aware of how long it takes to bring about change. We need to influence and encourage young people as soon as possible and it's easiest to do that in the informal space. The challenge is that the formal learning space is very risk averse (down to teacher level); if they get it wrong, the personal cost to them is enormous; so teachers are not incentivised to go off piste. We look upon informal learning as a way of modelling new approaches, a lab for formal environments. It's an opportunity to build a body of evidence to reduce that sense of risk. Because the only way to really scale will be by having some of these new teaching models embedded in the curriculum."* Paula le Dieu, Mozilla Foundation

Currently, some funders of Tech Third Sector organisations not only gather information from projects but also bring them together to share best practice. The Google RISE Awards winners have the opportunity to attend a Summit which brings together representatives from initiatives across the world currently being funded by the company. The stimulating three day event gives

organisations the opportunity to share ideas, benefit from the latest research on outreach and receive quality advice on crowd funding, gathering feedback and scaling to help make their organisations more sustainable. Google actively encourage RISE partners to collaborate to develop and scale their offerings. We think this is a highly intelligent approach.

## Mapping and scaling initiatives

While the diversity of provision within the Tech Third Sector is a positive, all too often schools, students, parents and prospective volunteers are unaware of what exists. Consequently, we believe that there is a real need to map the opportunities to make it easier for all to identify and get involved with the programmes that running in their area which are age/ability relevant.

Centre for London's Connecting Tech City project is going to build a website which will help map out the different programmes delivered in schools, after school clubs and as drop-ins and structured courses in and around Tech City in East London. We think we need a similar initiative which might cover programmes across the UK with an explicit focus on informal learning. We believe that with corporate support and Tech Third Sector collaboration, such a platform could be established. It would help to boost the numbers involved with these schemes.

Many people we have met across the country have appreciated the importance of lending support to these organisations. Businesses and other organisations can take steps to help increase opportunities for young people to learn outside of the curriculum. Councils, with the benefit of local knowledge, can help steer activity to schools, students and families who most need support. Camden Council has the intention to be the first Local Authority nationally to have a Code Club in all of its 43 primary schools by July 2014. Camden's City Learning Centre (CLC) has helped bring together staff from Google UK, University College London's Department of Engineering and Dentsu Aegis Network to provide volunteers for after school Code Clubs. 75% of schools in Camden now either have an active club or are seeking volunteer partners.

*"This innovative partnership between UCL, Google and Code Club is part of our pioneering work to provide our young people with a range of opportunities to develop their ICT skills and qualifications. This forms part of the wider objectives of Camden Council and its partners to create the conditions for and harness the benefits of economic growth, and make Camden a place where everyone has a chance to succeed."*

Cllr. Theo Blackwell, Camden Cabinet member for Finance and Technology Policy and member of the UK Digital Skills Taskforce

Supporting such efforts should be seen as an important part of corporate social responsibility for businesses. Larger employers in particular are able to make a huge difference by adopting scalable,

clever approaches. One suggestion at our Reading regional roundtable was that these companies could encourage and support their suppliers to get involved, be it in helping with Tech Third Sector initiatives or in providing careers talks in schools. It was described as a way in which large companies could "feed corporate social responsibility down the supply chain". An idea mooted at our Newcastle idea was that large employers might commit their entry level employees to volunteer with a Code Club as part of their scheme for their apprentices and graduates. We need approaches like these to help boost the Tech Third Sector.

In particular, we need to expand the reach of Tech Third Sector organisations so that all young people join in, have fun and learn. While the informal sector will never have a universal reach, it is important that we the organisations reflect the society we live in.

We do not want these organisations to compound existing inequalities in our society. We need them to reach across the whole of the UK, in cities and in the country, for girls and boys, rich and poor. Everyone has a part in making sure that there are opportunities for all in the Tech Third Sector.

We would encourage businesses and charitable trusts and foundations to make a range of funding pots available to encourage innovation and the growth of new initiative, as well as larger funding streams to allow initiatives that have demonstrated high impact to scale up.

***"After school clubs / weekend clubs which require a level of participation from parents tend to be supported by parents (often middle class) who value skill acquisition. What we've built is an acceleration programme for the better off. We need to connect to a broader spectrum – we still suck at it."***

Paula Le Dieu, Mozilla Foundation

### Recognition of informal learning

It could be helpful for the skills and knowledge which young people may be developing outside formal education to be better recognised, so that when they apply for further education, training or employment, they can be considered alongside formal qualifications. Students also need to understand some of the things they may take for granted or are doing for fun are in fact valuable skills. For example, at our Plymouth regional event Paul Coles from BT said that he needed people who are "good at World of Warcraft", people who could strategise.

Often, industry warns that CVs do not provide the granular evidence for what they really need to know about a candidate. It can be hard to distinguish between people with identical sets of exam results and there is often a sense that good people have been missed. Mozilla believe it is important to find ways of surfacing that learning, for the evidence of projects completed which is why they set up open badges as a platform for people to manifest their learning outside traditional exams.

Digital badges enable students to keep a portfolio of their achievements. DigitalMe who are supported by the Nominet Trust, run the Badge the UK initiative so teachers, employers and social enterprises can badge their learning programmes. There is growing interest. Between November 2012 and November 2013, the number

of digital badges issued grew by more than 1400%. 60,000 students are now collecting badges in their 'backpacks' with over 300,000 badges issued. We would also encourage such efforts to help make sure that the benefits and outcomes of informal learning are recognized.

### Existing Tech Third Sector organisations and their needs

We asked some leading Tech Third Sector organisations to provide a short summary of their activities and for their 'ask' for help:

Apps For Good offers students the opportunity to learn to create their own mobile, web and social applications to solve problems within their communities. This year alone, Apps for Good has partnered with 213 schools who delivered their course to 17,000 students in classrooms from Wick, Scotland to Bude, Cornwall. Apps for Good provide the course content and training, and then let teachers do what they are best at – inspiring and guiding young people. In the course, students learn all key aspects of product development from technical feasibility to coding to business models, gaining core skills such as problem solving, teamwork and communication.

Corporate partners are critical to Apps for Good, not least because of the employees they provide to act as expert volunteers. They are a key element of the programme, adding an exciting, real world element to the course. Apps for Good Experts need enthusiasm and the skills to help students bring their app ideas to life, whether by fostering their public speaking skills, helping them understand end users or by giving more technical guidance. Sessions can be conducted via Skype or in-person, and the commitment is as little as 1 hour per year. You can register as an Expert here.

Code Club is a nationwide network of free volunteer-led after-school coding clubs for children aged 9-11. They create coding projects which volunteers teach in extra-curricular clubs, after school or at public venues such as libraries. Their projects teach children how to program through making computer games, animations and websites, and help them develop the skills to be creative, confident digital makers.

Most Code Club volunteers teach one project a week at their club for about an hour (though some give more time and others group together to support one club). Code Club is aiming to have a club in every single primary school in the UK: to do that they need lots more people who can give a little of their time to help the next generation of coders. So far, over 2,500 clubs have been established over the last 3 years but another 750 schools are currently looking to run a club but need a volunteer to do so.

CoderDojo is a global, volunteer-led community of free programming clubs for young people. At a Dojo, young people between 7 and 17 learn how to code, develop websites, apps, programs, games and explore technology. Dojos are set up, run and taught by volunteer

champions who drive the movement. All Dojos subscribe to a common ethos focused on community, peer learning, mentoring and self-led learning with an emphasis on openness and inclusiveness. As of July 2014 there are over 450 Dojos spread across 46 countries.

There are a number of ways that industry can get involved with CoderDojo. Their specific ask of corporates is to throw open their doors and run a Dojo in their office. This will give companies' employees the opportunity to volunteer their time and mentor at a Dojo enabling them to experience the magic of showing the next generation how coding can be a force for change in the world. Click here to mentor at an existing Dojo.

TeenTech run large scale, sharply focused events across the UK with a supporting Awards scheme to help young people, their parents and teachers understand contemporary opportunities in science, technology and engineering. The TeenTech Awards programme invites students to develop their own ideas for technology which could make life "better, simpler or easier" and provides industry contacts and dedicated innovation workshops to give students both feedback and encouragement, supporting schools which might not normally consider entering a national competition and students who might never have seen themselves as digital creators.

Events are always run with strong regional partnerships to ensure the excitement and interest generated on the day is taken forward by industry and education partners. TeenTech welcome companies who would like to join us to provide activities or ambassadors for our events or mentors for the TeenTech Awards. You can register your interest here.

Stemettes was started as a response to the declining number of women working across STEM careers in the UK. It aims to inspire the next generation of females into STEM by showing them women already in STEM via a series of public events (like panels & hackathons), workshops and exciting opportunities - which centre on passion, fun and real industry settings. Stemettes are asking for STEM businesses based outside of London to offer them venues and employee time to run public events and workshops for girls around the UK. In particular, they are lacking good STEM employer hosts in Wales and Scotland.

Technology Will Save Us (TWSU) is a design-led, technology start-up focused on learning. It is on a mission to provide everyone new opportunities to learn and create using technology. Based in East London, it designs DIY technology kits, useful resources and tools to instigate learning in the 21st century. All of its products are vehicles for education that encourage everyone to make, play, code and invent with technology. Using everyday life as inspiration, the kits tap into the hobbies and passions that they love - music, gardening, cycling and gaming.

This year TWSU have been building a pool of great teachers to become TWSU Ambassadors. They would love more of them, especially beyond London. TWSU are looking for teachers from

primary, secondary, academies, independents, free schools, home educators and colleges across the UK to work with them to use their kits in the classroom as a tool for teaching STEAM skills.

Young Rewired State (YRS) is an independent global network of kids aged 18 and under who have taught themselves to program computers. They introduce these children to like-minded peers at events around the world, where they use freely available open data to make websites, apps and algorithms to solve real world challenges. The main objective is to build a community of independent learners where they can develop their skills through peer-to-peer engagement.

YRS would like businesses to participate in the Festival of Code by signing up to be a local centre and providing their staff with an opportunity to mentor the kids. YRS want them to do this so that they can uncover the young tech talent in their local communities, and demonstrate to the kids in our network that their independently developed skills have a valuable place in the real world!

# APPRENTICESHIPS FOR A DIGITAL ECONOMY

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UK DIGITAL SKILLS TASKFORCE

# Apprenticeships for a Digital Economy

### Recommendations:

1. Progression onto apprenticeships should be recognised as a good outcome for school students. At present, the system focuses overwhelmingly on university, irrespective of whether that route necessarily suits the student. Additionally, there is a need to educate the educators and the influencers about apprenticeships, helping teachers and parents to understand the benefits of apprenticeships.

2. Government should radically simplify the apprenticeship system to ensure that more digital businesses, especially SMEs, invest in apprentices. The process remains too opaque for businesses of all sizes.

3. Government must champion models which allow microbusinesses and SMEs to either share digital apprentices or to collaborate with other businesses in digital apprenticeship training.

4. All employers should ensure that their training providers are developing their apprentices' digital skills. Also, all apprentices should be offered remedial digital skills training if they have limited digital skills.

Apprenticeships have cross-party support amongst politicians with an increasingly positive view amongst students, businesses and members of the public. However, it is clear from what we have heard that we need to make apprenticeships work as well for the digital age as they did for the industrial era. For example, attendees at our Doncaster roundtable were especially focused on making sure that a system which works for manufacturing in the region is just as effective for digital. Our recommendations do not focus on what the exact digital content of apprenticeships should be – that is best guided by employer demand. Instead, we make suggestions for how the process can be improved both for prospective employers of apprentices and for prospective apprentices.

### Why apprenticeships?

We believe there is a strong case for why the apprenticeship approach is well suited to both prospective employers and apprentices.

Apprenticeships suit those who prefer competency and employment based learning rather than the A-level to university route. It is a myth that apprenticeships are for low-achievers or for those not bright enough for university. As one group at our Plymouth regional

meeting put it, *"there's a certain elitism"* about apprenticeships. Instead, we have consistently heard that apprenticeships offer a good pathway for those who do not want to study full time for three years at university but who will need training and further education above and beyond what they learned at school, with components focused on both job specific training and broader understanding.

There is an excellent business case for apprenticeships. They offer a way to improve productivity, a good way to scale up businesses at reasonable cost and a means by which to secure Government support for training staff for a new role. Employers have emphasised to us that apprentices are loyal employees who generally remain with the company after completing their apprenticeship.

Apprenticeships provide a means by which businesses can ensure that the education and training of new staff meets their needs. Employer-led learning can ensure that the digital skills apprentices learn remains up-to-date given fast-moving and extremely diverse business requirements. For instance, the third year of the curriculum for the BBC's Technology Apprenticeship was not written when it was launched so that it could be kept completely up to date.

A survey of over 4000 businesses employing apprentices for the Department for Business, Innovation and Skills found that:

- 68% of employers felt taking on apprentices had improved productivity
- 67% that it had improved staff morale
- 60% of all employers felt taking on an apprentice had improved staff retention
- 80% of employers (both across all sectors and specifically in the ICT sector) planned to offer apprenticeships again in the future[xxxii]

Apprentices can fill skills gaps in companies at all levels, not only in technician roles. Digital companies can learn from the modern approach taken to apprenticeships in other sectors. One example is the automotive company Jaguar Land Rover, which uses apprentices to fill high level skills gaps. While the company used to only take on apprentices to fill trade positions, such as car mechanic roles, apprenticeships can now go to a much higher level in the company. Jaguar Land Rover has a Level 6 Higher Apprenticeship scheme with 150 places for its 2014 intake. This is a 6 year programme which will include study for a fully funded engineering degree from The University of Warwick. Their programme is one example of the growing expansion of higher level apprenticeships which can offer the opportunity to gain a level 4 or 5 qualification at a foundation degree level study through to a level 6 degree equivalent qualification. Apprenticeships thus offer the opportunity to learn to post A-level debt free. Employers at our Plymouth regional meeting thought that it might be easier for them to keep talented apprentices than graduates as their university debts could force them to seek higher wages outside the region.

Taking on an apprentice offers benefits to the whole business. It can

help to develop mentoring and communication skills amongst the rest of the team. Apprenticeships can be built into career progression, from entry standard apprenticeships onto higher level schemes. This can provide a means for businesses to retrain existing staff into new roles.

Apprenticeships also have excellent broader benefits to society. They offer a pathway into the world of work for those who do not study at university and present an excellent way to connect vocational education with local needs. For example, Hackney Community College's Tech City Apprenticeships programme is helping businesses in London's Tech City to make the most of local talent and to bridge the disconnect between a booming tech sector alongside a high local youth unemployment. However, it is important to highlight to employers that taking on apprentices is first and foremost a good business decision with corporate social responsibility style benefits as a welcome extra.

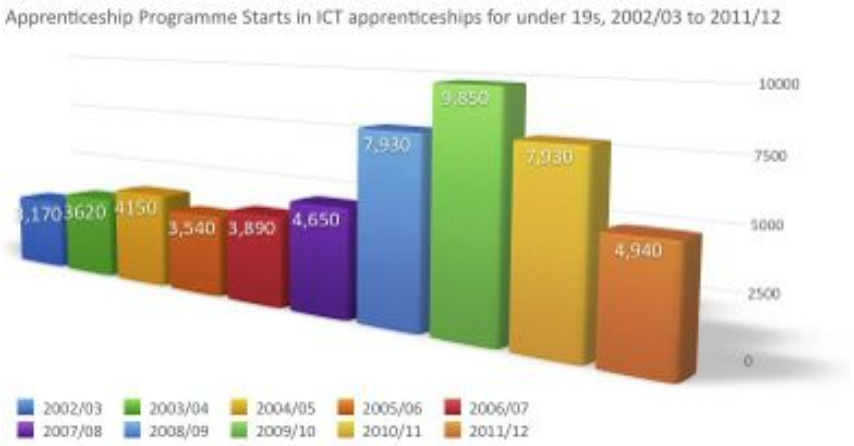
Apprenticeships can work well for companies of all sizes. Taking on an apprentice has worked well for POKE, a digital creative agency based in Tech City in London. The company took on Kofi Adu-Boahen, from Hackney, as their apprentice as part of the Tech City Apprenticeship programme established in collaboration with Hackney Community College. Nick Farnhill, one of POKE's partners, explained their interview process to find their apprentice. *"After the shortlisting process, we interviewed seven people from across the country but it was Kofi Adu-Boahen, who just happened to come from Hackney, who stood out,"* said Nick. *"He had dropped out of university as it wasn't fulfilling what he hoped to gain from that route. It's a strong argument for apprenticeships to have someone actively working on creative ideas who has an insight into how to engage with the youth audience we often try and reach. We are getting more benefits than we imagined as our team have enjoyed being taught how to mentor. Kofi is an all-rounder, a great character and is a committed and invaluable member of our team."*

Apprenticeships also work well for large multinationals. With more than 130,000 people in over 40 countries, Capgemini is a leading provider of consulting, technology and outsourcing services. Their Higher Apprenticeship Programme in the UK has grown rapidly since it began in 2011 and is becoming increasingly important to their pipeline of skilled IT professionals. Last year, they recruited 109 higher apprentices, up from 35 in their pilot scheme in 2011. By the end of 2014, Capgemini will have almost 240 apprentices on programme, demonstrating how positively apprentices are viewed by the company and their clients: they bring energy, flexibility and innovation and they are cost effective. The apprenticeship also adds value to the apprentice as it allows them to develop technical career paths by partaking in real technology innovation and business interaction, with the additional wrap around of personal development support and the ability to gain a fully funded degree that will enhance their skills.

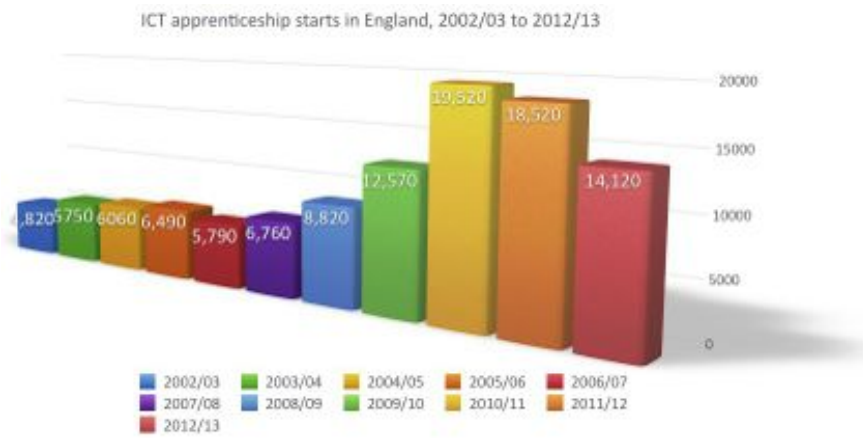
Capgemini UK Executive Chairman Christine Hodgson said: *"All our apprentices will gain professional IT qualifications. We've created a*

*unique training approach, so that within four months of joining they are contributing to the business, progressing and adding real value to Capgemini. As part of the programme all our apprentices have the opportunity to study for a full degree with Aston University, a first for the industry."*

There have been recent additions to the digital apprenticeships which are available. WANdisco unveiled a Big Data Apprenticeship scheme during this year's London Technology Week. Google have taken on digital marketing apprentices. In addition, employers including Atos, BT, Capgemini, Cassidian, CGI, IBM have worked with the sectors skills council, e-Skills UK, to establish new specialist cyber security apprentices - over 100 are set to be created this summer.



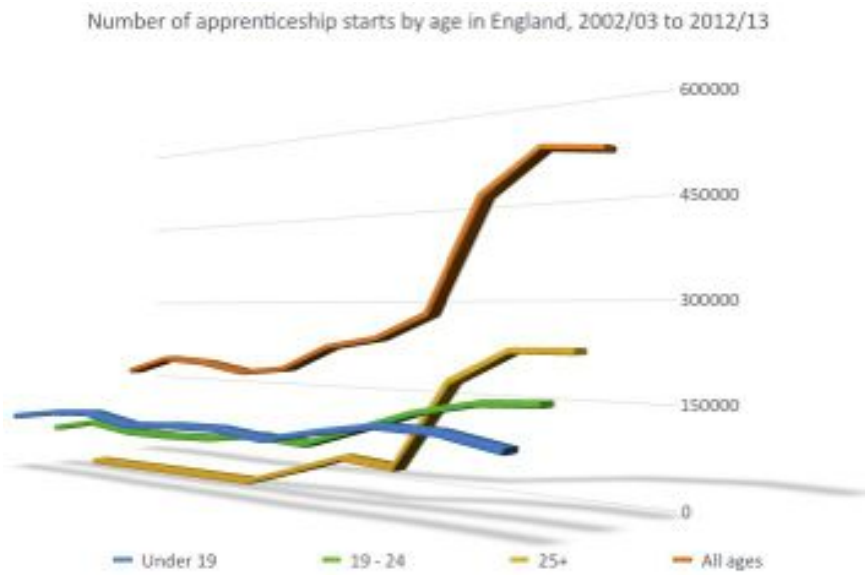

However, despite the strong benefits of apprenticeships to businesses and their appeal to school students, they are not a major route into digital careers. In fact, the numbers of Information and Communication Technology apprenticeship starts have actually fallen by 28% in England between 2010/11 and 2012/13, from 19,520 down to 14,120. The number of starts among those aged under 19 has fallen by 50% over that period. ICT apprenticeships also represent only a tiny fraction of all apprenticeship starts in England, 2.8% of the total in 2012/13.[xxxiii]



## Increasing progression onto apprenticeships

If apprenticeships are to become a greater route into digital careers, it is necessary for schools' incentives to be aligned appropriately and to improve teachers and parents' understanding of their potential. We have repeatedly been told that schools are not encouraged to support progression into apprenticeships given the overwhelming focus instead on university within accountability systems. School teachers are one of the major sources of careers advice yet lack familiarity with the apprenticeship system. The result is that school pupils have limited awareness of this pathway. TeenTech surveyed 5500 teenagers aged 12 to 13 during 2012/13. They found that 74% of them were thinking of going to university while only 9% were considering apprenticeships.

In addition, schools in England have now been made responsible for independent careers advice but are essentially financially incentivised not to advise students aged from 16 to 18 to move onto an apprenticeship as they will lose their funding. The recent growth in apprenticeship numbers has been concentrated amongst those aged 25 and over. By contrast, the number of apprentices aged under 19 has been flat static for almost a decade up to 2011/12.[xxxiv]




This problem has been noted by *The Richard Review of Apprenticeships* which warned that:

*"Learner demand is currently being artificially held back. When quality is consistently higher, we will need our schools, our teachers, and all those who inform and guide young people, to do a better job at providing them with the information they need to seriously consider apprenticeships."*[xxxv]

We have heard similar complaints from employers. For example, in

their submission, Virgin Media warned:

*"Efforts to promote apprenticeships are often undermined by how schools track 'destination' or success rates for school leavers. Work-place learning is consistently ranked below university attendance, thus lessening its appeal. We urge policy makers to encourage schools to give work-place learning and apprenticeships schemes an equal weighting to academic routes."*

The experience described by James Callender, an O2 higher apprentice, at our apprenticeship roundtable seems all too typical of our current dysfunctional approach to the apprenticeship pipeline.

*"At sixth form it was widely perceived that most of the 100 students in my year would move on to study at university next. Teachers would actively promote university (but no other routes into the world of work); everyone was required to undertake the UCAS admissions process; the school reported widely on the university destinations of students and a large number of open days at universities were arranged.*

*Over the summer of my A-Levels, I set up a small business with a friend. After getting my results, I decided to defer my entry to university, work on my business before then deciding to go travelling whilst working out what my next move would be. It was then that I stumbled across the O2 apprenticeship programme. I only found out about it whilst checking some details about my mobile account on the O2 website.*

*The apprenticeship caught my interest as I wanted to learn something new and, with the opportunity to earn money at the same time I thought it looked great. After attending an open evening at the O2 office in Leeds I applied immediately for the role. Eventually after the long and challenging recruitment process I was offered a place on the programme. I started in September 2009 age 20. After 2 years as an advanced apprentice I was offered a role as a technical analyst. I have subsequently applied successfully for the newly designed higher apprenticeship programme.*

*I think that if I was better informed as a sixth form student about the various apprenticeship opportunities available to me I may have applied for a higher apprenticeship programme much earlier in my career."*

We cannot have a system where people only discover apprenticeships by chance when looking at their phone plan online. The problem of a lack of information about apprenticeships has been raised to us a problem by people across the country. Alex Jackson, an apprentice at Cosmic, an IT and consultancy business, told us at our Plymouth regional meeting that he had found it *"very difficult to find out about apprenticeships".* If politicians are serious about expanding apprenticeships, they will set a framework which recognises their merit and encourages schools to provide adequate information, advice and guidance about the opportunities which exist in apprenticeships.

Part of the solution must be for school incentives to be rebalanced. In a paper for think tank Demos, Jonathan Todd wrote advocated reforming Ofsted assessment of schools *"to give some weight to the number and quality of apprenticeship places secured by school for their pupils – creating 'skin in the game' for schools in the careers of their pupils"*.[xxxvi] Just as schools should not encourage students to progress onto university irrespective of the suitability of the course or institution, there should of course remain scope for schools to be discerning in which apprenticeships they support. However, we cannot maintain the status quo where schools are encouraged to treat apprenticeships as an entirely second class route to university.

Secondly, the problem is one of lack of awareness amongst both parents and teachers. This is not surprising given most teachers' personal experience is with the university route of progression, the heavy emphasis on university entry as an aspiration for young people and the sheer number of apprenticeship frameworks. Research from PwC in 2012 found that 52% of teachers "were not at all confident" about advising young people on apprenticeships.[xxxvii] To help address this, we need to educate the educators about apprenticeships. We need businesses to engage with local schools to highlight the opportunities available. We recommend that apprentices should return to their schools to provide careers advice and guidance to their former fellow students. Providing opportunities for apprentices to talk to school governors and school leaders is a powerful way of showing not only the knowledge but the self-confidence of young people who take this route.

In a better system, it would be just as normal for schools to be encouraging their pupils to attend company's apprenticeship open days, such as the one run by the BBC for its technology apprenticeship scheme, as it would for them to be encouraging them to attend university open days. It is important that young people are not offered a binary choice between studying at university and becoming an apprentice. Instead, a higher apprenticeship leads to a qualification at level 4, equivalent to a higher education certificate, higher education diploma or a foundation degree. This should be emphasised when making the case for apprenticeships – after all, 98% of mothers of children born in the UK in 2000 wanted their children to go to university.[xxxviii] It should be highlighted how apprenticeships can potentially offer university-level education alongside employment.

In the longer term, companies taking on digital apprentices should aim to ensure progression through into higher level apprenticeships. This is especially the case for higher level roles in the digital sector. A September 2013 report by e-Skills UK and UKCES highlighted that *"digital sector workers are amongst the highest qualified members of the UK workforce",* with approximately 63% holding a Higher Education level qualification in 2012.[xxxix] A level 2 apprenticeship will need to be the start, not the end, of the learning and earning pathway in a digital economy. We support the Coalition Government's intention to expand the provision of apprenticeships beyond level 3 and would encourage the next Government to

accelerate this progress.

## Simplification

The complexity surrounding apprenticeships must be tackled if more are to be created. There are both unfounded perceptions of complexity as well as the reality of complexity. Both need to be addressed. The system itself remains far too complicated. We have met employers dissatisfied with the level of bureaucracy involved for companies of every size, from SMEs through to multinationals. An excessive number of frameworks, the different levels, complexity within funding arrangements and a lack of clear information about training providers all mean that there confusion about the process remains common. Bob Paton, Managing Director at Accenture's Newcastle Delivery Centre, told us he frequently reflected during the painstaking 8 months it took him to set up the apprenticeship scheme, that were he in charge of a small software company rather than part of a multinational corporate firm, he would have *"packed it in"*. Julie Hawker, the CEO of Cosmic, said that taking on apprentices had been an "absolutely brilliant experience" for their small company but complained that taking on an apprentice had been *"very, very time-consuming"*.

People have consistently criticised the National Apprenticeship Service's website. Attendees at our Plymouth regional event complained that it is *"just not working"* at the moment. At our Newcastle regional event, Bob Paton asked: *"Is there anybody who has looked at the national apprenticeship service website who can understand it? It's just far too complicated."* We need a clearer website that can bring together and explain all elements of the process, including recruitment, funding and information about training providers at a local level. Attendees at our regional meetings have repeatedly called for a website which has the simplicity of Google or Amazon to be the portal to all information about apprenticeships.

## Making apprenticeships work for SMEs

Simplification is especially important for smaller employers. SMEs lack either the time or resources to negotiate the system. This has consistently been raised at all of our regional meetings and at our apprenticeship roundtable. Research also demonstrates that SMEs find the process more difficult. For example, the Department for Business, Innovation and Skills survey of apprentice employers showed that 62% of organisations with 1-24 employees which had employed an apprentice felt that they had had sufficient information, support and guidance available to them. By comparison, 75% of organisations with 100 employees or more had felt happy negotiating the apprenticeship system.[xl]

A key point made in Professor Alison Wolf's influential report on vocational education was that the vocational system must reflect the

nature of the labour market. Professor Wolf warned that: “If we are going to do better in the future, we need to be aware of, and responsive to, the labour market realities of today.”[xli]

Similarly, the vocational education system must be more responsive to the reality of the digital labour market today if it is to thrive. According to the Coalition Government's *Information Economy Strategy*, *"the overwhelming majority of information economy businesses – 95 per cent of the 120,000 enterprises in the sector – employ fewer than ten people".*[xlii] Throughout our consultation with students, businesses and training providers we have heard that the system does not work well enough for SMEs, let alone businesses with nine employees or fewer. So long as we have an apprenticeship system that does not work well for microbusinesses, we will not have an apprenticeship system which works for a digital economy.

These criticisms are not new yet they need repeating. The Coalition Government commissioned Holt Review, *Making Apprenticeships more accessible to small and medium-sized enterprises*, highlighted in 2012 that *“the main barriers to SMEs taking on apprentices are lack of awareness, insufficient SME empowerment and poor process”.*[xliii] In the eyes of those we have met, all of these problems remain.

Andrew Corbett, from the UK IT Association (which represents approximately 700 IT businesses, mostly SMEs), contributed to a roundtable event on apprenticeships which Hackney Community College hosted for us. He was clear that unless the apprenticeship process is simple, small businesses will not engage in the process. Here are his strong views on the issue:

*"The current apprenticeship system does not work for small IT companies. In conversations with our SME IT employer members, we repeatedly encounter the same problems. All too often, providers seem to be playing a numbers game, just wanting to shift bodies rather than meeting the needs of the customer. As a result, employers feel that they lack any flexibility or control over what apprentices are taught. Small employers need to achieve extra productivity as soon as possible and cannot afford to train people up from scratch and so are often reluctant to commit to taking an apprentice on for a year or longer in case they have made the wrong choice.*

*From UKITA's point of view, we think that the underlying problem is that the people who are designing the system do not understand the world that owners of IT SMEs live in and how their heads work. What the establishment needs to realise is that of the 4 audiences they are talking to – training providers, corporates, politicians and SME employers - only the SMEs are not a captive audience that needs to engage and try to make it work. SMEs have the option to simply ignore the existing schemes, an option they are not slow in exercising."*

In addition to simplification, there is a need for further research into the experiences of SMEs taking on apprentices. Hard facts and expected timeline for when businesses can expect an apprentice to be producing billable work and contributing would help employers

assess whether taking on an apprentice is viable for them. Upfront information about likely costs could help companies to assess whether taking on an apprentice would work for them. In addition, the messaging for why businesses should consider taking on apprentices should focus on the business case for doing so.

### Collaborative approaches to provide apprenticeships for SMEs

In addition to simplification, another way of making the apprenticeship system work better for microbusinesses and SMEs is to highlight how umbrella organisations can help them to take on apprentices more easily. At our Doncaster regional meeting, one table had the idea that should be a way to bring "together small groups of SMEs to share the apprentice training" where the apprentices had similar skill training needs. In fact, such an approach already exists but uptake and awareness of it is limited. Group Training Associations (GTAs) bring together groups of employers to share training, facilities and costs to make apprenticeships a realistic route for their members. They are employer-led and specialise in a particular field. There is a good case for them to expand into providing training for apprentices into digital industries.

There is also a model which lets SMEs share apprentices. In this model, Apprenticeship Training Agencies (ATAs) employ apprentices, taking on responsibility for dealing with the administration, supervision and training of the apprentice. They assist with the recruitment and offer a route for small employers to take on an apprentice if they are uncertain of whether an apprentice will work for their business or if they do not feel able to commit to taking someone on for a full framework for whatever reason. For the apprentice, it offers the same wage and training opportunities as a regular apprenticeship but with the variety offered by working for a range of employers.

While such approaches might not suit every business or apprentice, the benefits of such approaches are widely recognised. The ATA model in particular was highlighted by attendees at our Doncaster, Newcastle and London regional meetings.

The CBI has said that: *"strengthening collaborative models will support SMEs access externally delivered training… ATAs support SMEs with the employment costs of taking on apprentices by acting as the 'apprentice employer', and add value by supporting SMEs with the recruitment and selection of candidates*."[xliv]

In his review of apprenticeships for smaller businesses, Jason Holt wrote: "I firmly believe that ATAs have a role to play in enabling more SMEs to take on apprentices."[xlv]

The merits of such a collaborative approach have even been recognised in a research paper written for the Department of Business, Innovation and Skills which recommended in March 2014 that:

*"Consideration could be given to encouraging employers in sectors such as digital and creative, or relatively small organisations, to become part of group training approaches. It is likely, given the lack of knowledge some employers have in these sectors of how Apprenticeships are delivered and funded, that there will need to be a third party which, in the initial stages, establishes a group training approach."*[xlvi]

However, these approaches seem to scarcely be on the radar or most businesses despite their benefits. Marianne Whitfield, Managing Director at Cobweb Information Ltd and an attendee at our Newcastle regional event, said that the ATA model worked really well because "the process is a lot more simple and less risky from a small business point of view". Below are further examples of collaborative schemes working well:

Decoded is a company which works with businesses to help them better understand technology. It employs 34 people across London and New York and in August 2013 it decided to take on an apprentice from an ATA, Tech City Stars. The ATA made it easy for Decoded to take on a bright young doer and offered the apprentice, Waffah Shah, an opportunity to develop from a shy college-leaver into a confident professional.

The Institute of Telecommunications Professionals (ITP) is the UK's leading independent institution for people who work in telecommunications. In 2012, it ran a workshop with large and small employers which found that companies thought that the overheads involved in apprenticeships made them unfeasible as they lacked the manpower, training resources or finances to make them viable. However, the companies were interested in a telecoms specific apprenticeship where the ITP organised the training and dealt with the administration. The ITP used the GTA model to do so, advertising and recruiting apprentices, running the training and providing support to both the clients and apprentices for the duration of the apprenticeship. The ITP GTA has recruited 28 apprentices across 16 companies with their first cohort due to graduate in September.

Adam Oliver, Chief Executive Officer of the ITP said: *"The GTA has been a great success and companies have given us great feedback. The scheme enables SMEs to grow whilst they retain their focus on delivering their business objectives and three of our apprentices who are graduating in September are going on to start their Level 4 in October."*

Alan Tompkins from Horizon, an employer on the ITP GTA scheme, said: *"Unlike other Apprenticeship schemes we have tried in past years I can honestly say the ITP Apprenticeship offering is by far the best organised and most comprehensive telecommunications engineering training scheme we have ever encountered with all the help and practical assistance we could have hoped for from the very start and continuing throughout. This has made the recruitment and training of young people very easy and successful for us."*

These collaborative group structures also offer a way of

***"It's been a doddle for us with the ATA model. All the educational side is taken care of by the ATA – I really can't imagine having to do all that ourselves. The ATA model enabled us to take on an apprentice; without it, we probably wouldn't. It has gone so well with our first apprentice Waffah that we've offered her a job when her apprenticeship ends. We'll also be taking on two more apprentices this year."***

Alasdair Blackwell, Co-founder & Head of Innovation at Decoded

collaborations between primarily digital companies and other businesses which need digital skills. However, awareness of these routes remains low. It would be helpful if the National Apprenticeship Service (NAS) offered a service to help advise those interested in establishing or joining an ATA or GTA. At present, the NAS website does not even have a section for GTAs. Indeed, the relevant page promises that the GTA section is *"coming soon",* on a section last updated on the 29th August 2013. We cannot maintain such a poor provision of information about such collaborative approaches for businesses taking on apprentices.

Smaller employers can also collaborate in other ways to develop apprenticeships for their industry. For example, in Hackney, the Tech City Apprenticeship (TCA) programme was developed in collaboration between Hackney Community College (HCC) and local businesses. Ian Ashman, Principal of HCC, had identified that his students were not getting employment in the local area despite Tech City being right on their doorstep. *"In January 2012, we hosted a dinner for Tech City employers supported by His Royal Highness the Duke of York'"* said Ian. *"This gave us the opportunity to show business how a local education provider can work with them to provide the skilled staff they need and how businesses can get a real business benefit from recruiting local people and reducing unemployment rates in areas like Hackney."*

Nick Farnhill and Tom Hostler, partners at digital creative agency, POKE, were fundamental to TCA's development. *"From the early stages, the Tech City Apprenticeships rapidly gained interest,"* said Nick*. "The current framework for apprenticeships didn't fully support the digital agency or digital world. There was nothing around social media or production skills to create content for online users. We met with nine different agencies each with a different background and they all fed back on the different modules in the existing framework most appropriate to them, so the curriculum is truly employer-led."*

Creative Skillset, the industry body for the Creative Industries, helped to develop the new Level 4 Interactive Design and Development apprenticeship adopted by TCA. Glenn Bascombe, Creative Skillset's Training Network Manager, explained: *"We developed the Level 4 Interactive Digital Design apprenticeship in response to calls for new entrant staff to have a more practical grasp of both creative and coding skills. It was built by employers for employers. By involving Tech City businesses in the delivery, this has enabled them to take greater control in growing their next generation of talent."* Supporters of the TCA development programme from January 2013 included POKE, Moo, Mother, UsTwo, Infinity, The Trampery, Thompson Reuters, Avanti, iCity London and Lean Mean Fighting Machine. The first four companies recruited apprenticeships for the first cohort in October 2013, with others following.

## Digital training for all apprentices

Given that all jobs increasingly need digital skills, it is important that digital skill training forms part of apprentices' education. We would encourage all employers to ensure that their training providers are developing their apprentices' digital skills. The exact nature of these skills will be apprenticeship dependent and best guided by the employer. In addition, the taskforce believes that all apprentices should be offered remedial digital skills training if they have limited digital skills. Just as basic attainment in English and maths is important for future employment prospects, so too are digital skills. For those who have had limited access to technology or failed to develop basic digital skills for whatever reason, we ought to ensure that they have the opportunity to gain those basic skills. This could also provide a broader benefit to the companies taking on apprentices, using the training provider to help ensure that their existing workforce is also kept up to speed with the changing digital skills.

BT emphasised the importance of digital training for everyone in their submission:

*"Apprenticeships in a wide range of industries should include digital skills as part of apprenticeship schemes. Whether technology apprenticeships or not, digital skills have become a fundamental part of the workplace and must become a core part of training."*

The IET also made this point:

*"Traditional non-technology apprenticeships need to be updated for this high technology world. As an example, some companies are working with the construction industry training council and key colleges to update the steel workers apprenticeships so that these apprentices are trained in using building information modelling and are able to use digital computer aided design models rather than traditional paper designs. This therefore increases the skills level and efficiency of these individuals for UK plc."*

## Funding to go via employer

The Coalition Government is proposing to reroute funding for the training of apprentices via employers. This change follows from the Richard Review, which recommended in November 2012 that "the purchasing power for training must lie firmly in the hands of employers".[xlvii] It is important that employers do shape the training their apprentices receive as they are the customers, as Andrew Corbett of UKITA highlighted. However, we have heard concerns about the possible effects of this proposed change to funding on SMEs from companies of all sizes and from training providers. Research conducted for the Department for Business, Innovation and Skills suggests that routing apprentice funding via employers may lead to companies taking on fewer apprentices.[xlviii]

While the change will likely well work for larger businesses, there is concern that proposed process of funding going via the employer could put SMEs off taking on apprentices, companies often set up by people wanting to avoid bureaucracy. It is vital for the next Government to recognise that smaller businesses are often put off by the administration and cost involved as it is. At present, colleges and training providers do a lot of the groundwork for SMEs. It is not clear that SMEs would be able to do the groundwork themselves or that they will have time for in depth research and negotiation with training providers. In addition, it is essential that interim bodies, such as the ATA and GTA models, remain viable in a reformed system. We recommend that the funding change keeps apprenticeships viable for SMEs and that a close eye must be kept upon SME apprenticeship take up once the change comes into effect.

### Large employers helping SMEs

We also think that there is a role for larger businesses can support smaller businesses with apprentices. One way is for larger businesses to help give guidance on training providers. For example, larger employers including IBM, Visa, Fujitsu and BT have helped e-Skills UK with the accreditation of the Tech Industry Gold apprenticeship standard, helping with the process of quality assurance by flagging up providers approved by industry. Another way for large companies to help SMEs is to give them practical support with negotiating the bureaucracy involved in taking on an apprentice by, for example, giving them support with apprenticeship recruitment. Accenture's Bob Paton has been especially enthusiastic about the importance of bigger companies helping SMEs to take on apprentices, an initiative which he is currently pushing in the North East.

There have been specific initiatives to boost SME engagement with apprenticeships with large employer involvement. For example, from autumn 2012 to August 2013, BT were in a partnership with e-Skills and the National Skills Academy for IT. Funded by the Growth Innovation Fund, the scheme boosted IT apprenticeship take up in the sector. BT's role was to give employer engagement and to provide confidence in IT apprenticeships. BT helped SMEs by quality assuring training provided at further education colleges in 11 towns and cities across England.

550 new apprenticeship jobs were created through the sector managed model in Level 3 apprentice high demand entry level jobs in Software Developer, IT Technician and Database Developer positions. Over 60% of the companies involved with the project were SMEs, and 89% of them remaining involved over the entire lifetime of the project. The completion rate for the apprentices was greater than the sector average of 80%.

The support BT supplied throughout the programme exceeded what was originally conceived, with the company continuing to offer both

support with quality assurance and professional development activities for the apprentices even after the project was completed. The scheme helped to pilot the Tech Industry Gold apprenticeship standard and highlights the beneficial role larger companies can play in providing guidance to SMEs as to the quality of apprenticeship training providers.

With links to 30,000 IT companies across the UK, Microsoft has a wide reach across the IT industry. Around six years ago, it found that its Partners, especially SMEs, were struggling to find people to fill skills gaps with people exiting education lacking the skills they needed. Consequently, Microsoft launched its partner apprenticeship programme in 2010 to help address this problem among the companies in its supply chain. So far, it has helped companies to take on 5800 apprentices across 4000 companies. Microsoft has principally supported SMEs, which have represented 85% of the employers involved in the programme.

Microsoft has helped by supporting the programme design and delivery. It worked with training providers to ensure that its own vendor certifications fitted with existing apprenticeship frameworks, be they focused on developer, IT support, admin or sales roles. Working with 7 training providers across the UK, Microsoft has also made sure that the apprenticeships are accessible wherever the companies are based. A range of training providers offer the programme's training in traditional classroom settings or residential bootcamps. In addition, a fully 'remote' model is also available utilising online technologies for companies which would not find either of those options viable. To boost the uptake of the scheme, Microsoft championed the benefits of this apprenticeship scheme to both young people and IT companies.

Dominic Gill, Apprenticeship Lead, Microsoft explained why the programme helped all involved:

*"Apprenticeships offer employers an excellent way to address skills gaps. Apprenticeships also provide young people a brilliant route into a career in the IT sector. The combination of work and study as part of a Level 3 or 4 apprenticeship helps them to gain the skills employers value. So far, over 90% of apprentices stay with the company which took them on as apprentices. We are currently supporting companies to take on 2000 apprentices a year and aim to double that within two years."*

Larger employer support for SMEs to take on apprentices is in their enlightened self-interest and we would encourage more of these initiatives in the future.

# DIGITAL BY DEGREE

**ALERTME**

AlertMe provides a platform for connected home services, powering Hive by British Gas and Iris from Lowe's in the USA.

It has developed a significant skill base in cloud deployment, mobile UI, embedded software and emerging wireless technologies for the Internet of Things.

UK DIGITAL SKILLS TASKFORCE

# Digital by Degree

### Recommendations:

1. Universities should ensure widening participation funding is used to both improve academic attainment and reduce unemployment levels amongst ethnic minority computer science graduates.

2. Government should fund the National Centre for Universities and Business (NCUB) to work with other sector bodies to establish a matching website to connect students with tech businesses across the UK.

3. Government should work with universities and industry to expand the number of tech sandwich years and summer placements undertaken by students.

4. Universities should offer students of all disciplines the opportunity to develop their digital skills outside of their core subject through employability awards and other schemes.

5. University computer science departments should have active Industrial Advisory Boards to help keep them updated with industry developments.

***"Universities are key drivers of economic growth and a vital part of the innovation system, providing world leading research, technological innovation, business support, and highly skilled graduates."***

Universities UK

Britain is blessed with a strong, diverse, higher education sector that makes our country well-placed to compete in the global knowledge economy of the 21st century. According to Universities UK's latest UK-wide study on the impact of the higher education sector on the UK economy, universities now generate £73 billion in output through both direct and multiplier effects.[xlix] It is increasingly important that graduates leaving universities are equipped with the digital skills needed for a range of roles across the modern economy.

### Computer science at university

The UK needs professionals who can invent new digital technologies, create software applications and keep our online economy safe and secure. Although other graduates also become digital makers in the workforce, computer science graduates are a major source of the highest level skills our businesses need. A computer science degree can give students a deep understanding of the subject and equip them with the ability to learn and acquire new skills as technology evolves. The computer science disciplines studied at an undergraduate level include computer science, information systems, software engineering and artificial intelligence.

The BCS warned in their submission that based on conversations with global companies with offices in London, the UK is only producing

half of the high quality computer scientist graduates that are needed. Despite this, computer science has been criticized for having a higher unemployment rate than other subject groups. An analysis of the Destination of Leavers from Higher Education (DLHE) survey data can help to clarify the issue. Computer science graduates actually perform well in terms of the numbers who go on into employment. 73% of English computer science graduates in 2012/13 were in work 6 months after graduating, compared to 67% of all graduates. However, a far smaller section of the cohort goes onto further study, 8% as opposed to 14% of all graduates. 13% of all computer science graduates were unemployed after 6 months, which is higher than the 9% average for all graduates.[l]

In light of the skills gaps in IT roles, this problem would seem surprising. The issue was analysed by the Council of Professors and Heads of Computing in a 2012 report on computer science graduate unemployment. [li] The findings suggested that the higher unemployment rate was influenced by factors which extended beyond the subject and what was being taught. Computer science has successfully widened participation to higher education, attracting a higher proportion of Black and Minority Ethnic (BME) students than other subjects. Only 72.4% of computer science graduates are white, as opposed to 81.8% for all subjects.[lii] BME computer science students tend to perform less well academically at university. The CPHC report highlighted that "fewer than half of BME CS graduates" obtain a 1st or 2:1 degree as compared with 63% of white CS graduates. This is not a unique problem for computer science. According to the Higher Education Funding Council for England, "72 per cent of White students who entered higher education with BBB gained a first or upper second. This compares with 56 per cent for Asian students, and 53 per cent for Black students, entering with the same A-level grades."[liii] In addition, the CPHC found that computer science students tend to study at newer universities. 64.4% of computer science students study at post-92 institutions, as opposed to 49.9% across all subjects. Fewer study computer science subject degrees at the elite Russell Group institutions.

These factors together explain how computer science's unemployment rate is linked to factors that go well beyond curriculum content or links with industry. As the CPHC report summarised:

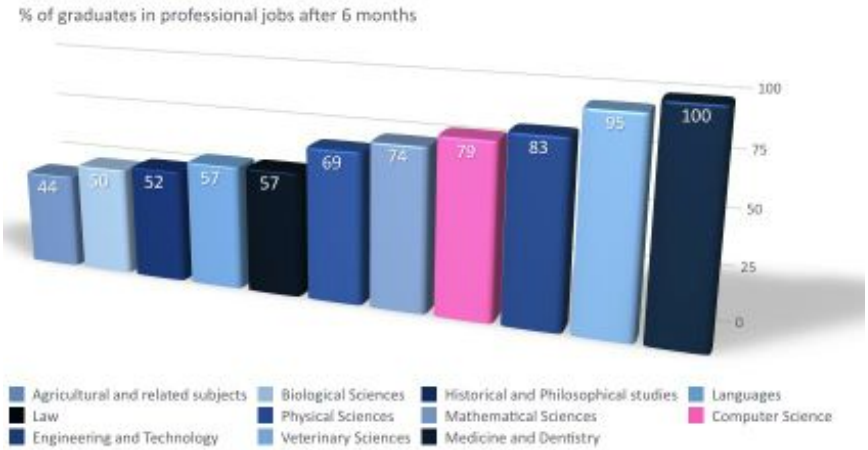
*"Compared with all CS graduates, a greater proportion of unemployed CS graduates are of ethnic minority background, attended broadly 'lower tier' universities and obtained lower degree classes".*[liv]

The high unemployment rate does not tally with the experience of many academics we have spoken to. Many of the best courses have extremely high employment rates with graduates going into well-paid professional jobs. As the BCS said in their submission:

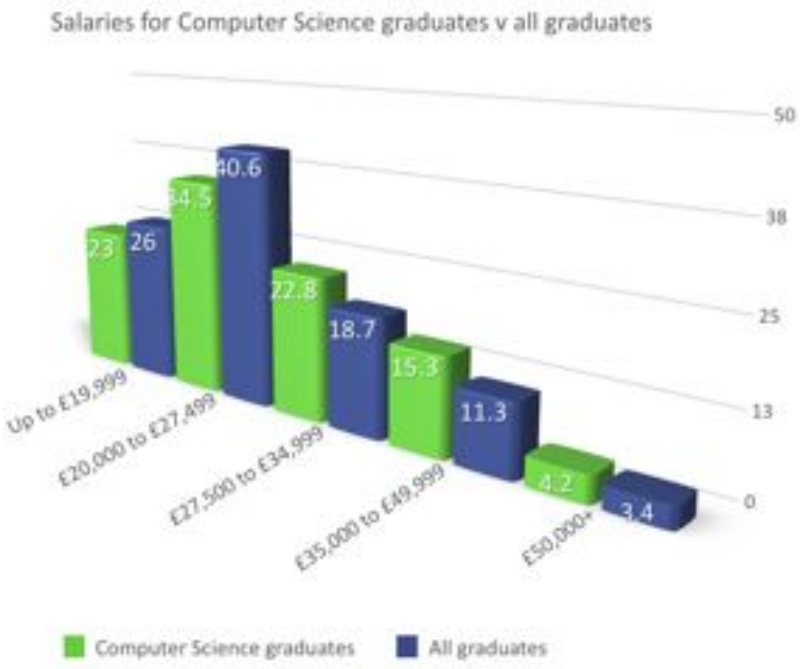
*"Computer science graduates from research intensive universities are highly sought after by employers."*

The CPHC's research supports that view: 4.6% of computer science graduates with a 1st from a Russell Group university are unemployed, lower than the 5.1% for Russell group graduates with a 1st.

In addition, while the unemployment level is higher, computer science performs very well in other respects. 79% of computer science graduates are in professional jobs 6 months after graduating, one of the higher levels amongst the subjects offered at universities. By contrast, only 65% of all graduates are in professional roles after 6 months.[lv] Computer science students tend to earn higher salaries in comparison to the average for all graduates. We have heard concerns that DLHE data does not always accurately capture those who start their own businesses or work as contract developers, a route which seems more likely for computer science graduates than other disciplines.




HEFCE analysis of the HESA standard registration population, 2007-08 to 2012-13



## Widening participation policy

Although the higher unemployment rate can be explained, it cannot be excused or accepted. In light of the research from the Council of Professors and Heads of Computing (CPHC), universities must take action to address the problems faced by students of BME students to improve graduate employment rates. Computer science academics should urge their university's management to take steps which could help extend computer science's success of widening participation to BME students into corresponding improved academic results at university and better subsequent employment prospects. Universities ought to experiment in an attempt to address the problem, be it through additional academic support, tailored careers guidance or subsidised placements with businesses.

The problem is part of a broader narrow conception of what widening participation should focus on. The former Vice-Chancellor of Liverpool John Moores University, John Brown, wrote a paper for the think tank CentreForum in which he argued that *"Government policy has been too narrowly focused on encouraging universities to recruit more students from disadvantaged backgrounds rather than on the outcomes they achieve."*[lvi] Universities invest in bursaries to attract students but do not give commensurate attention to helping those students in to succeed in either their university academic studies or life after university.

According to the Office for Fair Access, in 2011-12, £444.1 million was spent by English universities as part of their widening participation access agreements.[lvii] Of this £386.5m was spent in bursaries and scholarships and only £57.6m on outreach. None was specifically spent on additional student success measures. Despite this focus of funding, there is concern that bursary spending is not effective. Research from the Office for Fair Access found that there was no evidence that bursaries have a positive effect on whether students will continue their studies.[lviii] Consequently, OFFA has urged universities to rebalance the focus of their spending on raising attainment and aspirations among students at school as well as activities which support universities in successfully completing their study and going on to either employment or postgraduate study. According to their access agreements, universities do plan to target widening participation funds on student success in the future. It is important too that such funding is used to tackle computer science's student retention levels. One report from HEFCE found that, in 2010-11, a higher percentage of computer science entrants were no longer in higher education after their first year of study than in any other subject grouping, 12.2% and 17.1% for young and mature students respectively.[lix] One partial explanation for this problem may be that the different courses under the computer science category are extremely varied and that some students arrive at university to find that the courses do not match their expectations. It is important now that computer science departments should make the case for why their institutions ought to prioritise funding on outreach and student support.

## A matching website to connect students with businesses

The benefits of students gaining work experience as part of their university education has been consistently emphasised to us by attendees at our regional meetings and submissions of evidence from both businesses and professional bodies. In a fast changing and diverse digital economy, the specific technical needs of companies will always evolve faster than universities' curriculums can keep pace. Universities should educate their students with a deep understanding of their subject and help them to develop the character and aptitudes needed for their future careers, the core skills of problem-solving, teamwork, creativity and communication. However, acquiring vocational skills is an important element of a university education. We believe that genuine industry experience can offer students an excellent way to both develop these skills and improve their academic education.

Placements can have considerable benefits for both businesses and students. For businesses, students can bring new ideas from with up-to-date knowledge acquired during their studies. They will come at a modest cost but provide the chance to assess possible future talent without having to commit to taking on a full member of staff: High Fliers Research estimates that 37% of entry-level graduate positions with 100 of the UK's largest employers in 2014 are to be filled by graduates who had already worked for their organisations.[lx] For students, placements offer the opportunity to apply their theoretical learning in a practical setting, with benefits to both their education and their employment prospects. Business experience also helps students to reflect on their future career options in a more informed manner.

Taking students on placement can offer considerable benefits to companies of all sizes. One small company enthusiastic about taking students on placements is Lokku, the parent company of a selection of digital companies, including the property search engine Nestoria, launched in 2006. Nestoria tracks markets across the UK, Europe, Brazil and India. Despite only having 20 employees, the company has consistently taken on students for placements. Alex Balhatchet, Nestoria's Chief Technology Officer, said:

*"I am very enthusiastic about student placements - I started as a summer intern myself and then joined full time after graduation, and we really wouldn't be the company we are today without the many interns we've had over the years.*

*As you can imagine when we started in 2006 we needed to get a lot done with very little resources, and student placements were one of the best ways we found to do that. The first few we hired worked out so well we turned it into a regular programme. I would say that 50% of our interns are with us for 3-6 months and 50% are with us for 12 or more months. All of our engineering internships have been full time; we've not tried work alongside term study. The advantages of taking on a student are numerous: they are cost effective,*

*enthusiastic, come with fresh ideas and fresh eyes, and they turn into permanent hires. They are also a great way to "practice" hiring and management in a lower risk setting. Three of our current permanent team members started as interns and we currently have three interns in the team.*

*The advantages for the student are also numerous: they get real work experience, to ask all the questions they have, to learn a lot of really useful skills, and all of our internship positions are paid. We put them to work on real world projects - there is no fetching coffee - and we expect them to be curious, hardworking, and integrate into the team quickly."*

We also received many submissions emphasising the importance and value of student placements. The BCS stated: *"We believe that providing students with industrial experience is of significant benefit both to their education as well as their employability. Direct experience of solving real-work industry problems is an excellent way for students to develop a proper understanding of the theoretical underpinnings of their education whilst at the same time developing transferable skills that will make them more effective in the workplace."* The Institution of Engineering and Technology advised that: "Industry experience is vitally important for students."

This taskforce believes it is important that more is done by both universities and Governments to facilitate student placements in digital roles. A regular suggestion at our regional meetings was that there could be a benefit in establishing a website which might connect education and businesses on a larger scale than those that currently exist. One variation of this idea was that a matching website, styled on a dating website model, could help to connect students with businesses. On such a website, students would set out their skills and experience while businesses would set out their needs. The website would allow both groups to explore a wide range of possible options and let them decide what length and type of work placement would be the right match for them in terms of the work required. While the full year sandwich course may work well for certain students and businesses, both groups can prefer placements of different lengths, such as summer placements, regular part-time work during university term time or ad hoc project work. As the organisation which promotes collaboration between universities and business across the UK, we would advocate that the NCUB is the organisation with the expertise to work with other sector bodies to establish such a website.

A matching website could provide real scope for scale which would help SMEs in particular. These businesses often struggle to connect beyond the silo of each university careers service, lacking the time to attend careers fairs and campus events. Consequently, only 19% of students actively look at SMEs and start ups when applying for post-graduation jobs.[lxi] The benefits of a national scheme were noted by the Council of Professors and Heads of Computing (CPHC) in their submission of evidence: *"National projects have the means to reach out to SMEs in particular and many SMEs employers talk of using placements to both undertake specific project work and secure a*

*pipeline of graduates."*

While we believe that more can be done to improve take up of sandwich years in industry, there can be issues which mean that they will not work for all. For instance, many students come under peer group pressure to opt out of taking a year in industry for fear of going a year behind their friends. A matching website could facilitate alternative routes for students to gain industry experience while studying. While UK Governments do have various websites available already, such as E-placement Scotland and England's Graduate Talent Pool, we believe that a matching website of the model we advocate would provide a new way to connect businesses and students. We would advocate that such a matching website should initially focus on high skill digital placements and projects, but that it could then extent to connecting students with organisations in other sectors as well.

## Increasing the uptake of sandwich years

Formal sandwich year placements as part of a degree can offer considerable benefits to students, businesses and universities. One especially keen advocate of sandwich placements we met was Professor Andy Phippen, Professor of Social Responsibility in IT at Plymouth University, who attended our Plymouth regional meeting. He added:

*"One of the great successes within up to date, industry related tech degrees is the inclusion of a year long work placement, where students will work in industry during the third year of a four year sandwich degree. This allows them to apply their learning from the first two years of their degree in a real world setting and gain experience and understanding of the workplace. I have been involved in programmes that have delivered placements for over 20 years and one thing that is clear is that for those students that do them, they almost always think it is the best part of their course."*

There are clear economic benefits to graduates who have taken part in sandwich courses. The Government's response to the 2012 Wilson review of business-university collaboration highlighted that 78% of graduates from courses which included sandwich placements are in employment 6 months after graduation as opposed to 71% of graduates who did not have such placements.[lxii] It also found that there is an 8% wage premium for graduates across all subjects who have had sandwich years in industry.

The BCS said in their submission of evidence to this taskforce that this might be even higher for computer science students, with partial data which they had collected suggesting they could enjoy a starting salary 20% higher than the wages earned by other graduates. The benefits also extend to academic performance. For example, Nathan Davies had a placement with Goss Interactive while he studied for a web applications degree at Plymouth University. He told us at our Plymouth regional meeting that the placement had really played into

his advantage for the final year of university and became *"quite fundamental"* to his subsequent study. It also helped him to secure a job at the company after graduation.

Student sandwich placements also offer considerable benefits too to universities. At a department level, placements can help academics develop links with industry and facilitate knowledge transfer. As a result of these links, departments can find research opportunities, develop a network of guest speakers, get assistance on curriculum development and keep updated with the latest in business practice. At a higher level, universities should support placements for the benefits they offer to graduate employability. In England in particular, universities are under unprecedented pressure to demonstrate that their education is worth the £9000 a year cost. Research from London Economics suggests that a one percentage point rise in graduate employment rates is seen by parents as *"three times more valuable than a one place increase in ranking"* in league tables.[lxiii] Opportunities to gain work experience are also seen as important considerations by students. According to a NCUB survey of 4000 students, 93% of think that work experience and internships are either essential or somewhat important to their progression into their preferred sector for future employment. In addition, 68% of mathematics and computing students stated that job prospects were important in choosing their institution.[lxiv]

However, the vast majority of years in industry are only offered by a small minority of institutions: 70% of sandwich placements are provided by just 20 higher education institutions. In 2012/13, 22% of the 72,990 undergraduate students enrolled on computer science courses in the UK were on a course that will involve, or has involved, a sandwich placement. However, the number who actually take a sandwich year in industry is consistently considerably lower than those who sign up to take one. On average, 5630 computer science first year students have been started their first year on courses due to involve a sandwich year between 2007-08 and 2012-13. However, the average number of computer science students actually on sandwich placements on each year across that period has only been 2671. Less than 50% of computer science students who sign up to courses including sandwich placements actually go on to take a year in industry.[lxv]

We need universities and governments to take steps to both increase the availability of sandwich placements and to address the drop off between those who sign up to take a sandwich placement and those who actually do. In order to make sandwich years more accessible to SMEs and so increase the opportunities for students to take a year in industry, we would advocate that renewed consideration is given to the Consortium model of apprenticeships which the Wilson Review highlighted as an example of best practice:

*"The model is designed for SMEs in a flexible manner: students enjoy three or four 12-week internships at different companies rather than a full year at one company. This innovative practice is to be welcomed in that it provides students with a variety of experiences, and the companies involved find such placements useful, although the*

*university's direct costs are likely to be higher than for a single placement."*[lxvi]

The Coalition Government's response to the Wilson review did not mention this new model which seems to have not gained traction. We advocate that universities pilot such schemes as part of their sandwich year placements. They have considerable merit for digital microbusinesses. Just as with apprenticeships, many may find the prospect of committing to take on an apprentice for a full year daunting. Instead, the consortium model would offer a way for SMEs to take on a student for a placement. This approach could help to increase the number of computer science students taking years in industry.

Universities should encourage students to take sandwich placements by highlighting the considerable benefits that these can offer to both students' educational and employment prospects. In addition, departments can try to ensure that assessment in a module based curriculum is timed so that students have the space to make applications for sandwich years in industry. Course structures can help students to gain work experience. Universities can take steps to encourage learning alongside work by being flexible and accommodating of the needs of students. For example, City University London has a Professional Pathway scheme for its School of Mathematics, Computer Science and Engineering which allows students to combine study and employment. The Wilson review highlighted the need for universities to keep fees as low as is feasible during the year in industry. The University of Wolverhampton does not even charge fees for the year students are in industry so as to encourage them to go on a sandwich placement as part of their course. If fees are excessively high then students will not see placements as viable.

### Summer placements

We have heard that universities, students and careers guidance services all too often focus on the placement opportunities with larger businesses. We would also like to see more SMEs gain from the benefits of taking on a student for a placement. We believe that the Government should subsidise a small number of summer placements to establish a scheme along the lines of the 'Top50' Work Placements Scheme run by the Institute of Physics. This scheme will fund 50 students to carry out eight-week summer placements in organisations in the UK which do not currently offer paid placements. Such an initiative for computing students could be focused on SMEs which have not previously taken on a student for a summer placement. Administered by the BCS, the scheme would boost the demand for taking students on placement and help SMEs to see the benefits of taking on a student for a summer placement.

Universities can take alternative initiatives to boost their students' employability. The BCS highlighted what the University of Sheffield

has done to help their students gain work experience:

The University of Sheffield's Department of Computer Science set up a business called epiGenesys in late 2007. The enterprise is wholly-owned by the university, employing Sheffield graduates and offering experience to current students. The key industry collaborators for epiGenesys are IBM, ThoughtWorks and Microsoft. The company works on IT projects for businesses and charities, as well as for other university departments and research groups. The distinctive ties that epiGenesys has with the University of Sheffield mean that they are able to offer various opportunities to current students to help them gain experience of operating within a real business environment. Working with epiGenesys enables students to gain real life skills and experience that is valued by employers. Students can choose to work in one or more of five areas of the business: sales and marketing; project management; software development; software testing and systems administration. We would encourage other universities to consider whether they might take similar initiatives to help their students and graduates gain work experience.

## Postgraduate policy

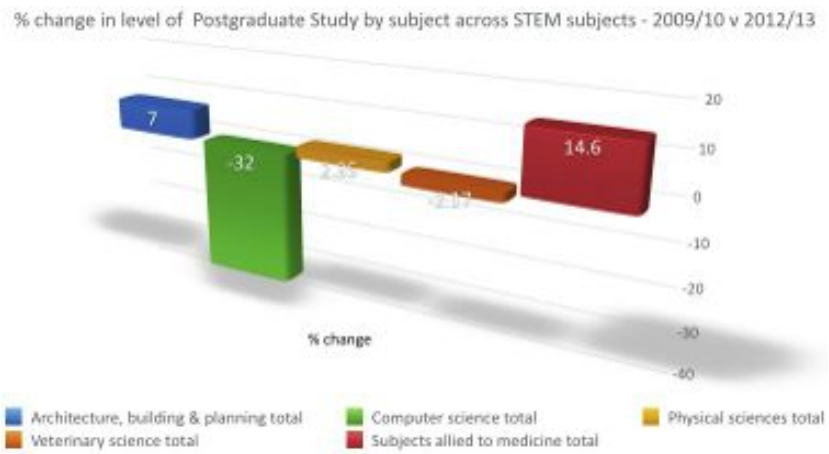
Higher level study is extremely important for making sure the UK has the highest level skills needed in an information economy. It is at this level that expert skills in roles such as cyber security are typically taught to the level necessary for people to enter the industry as specialists. The value placed on further study is reflected in the evidence: postgraduates earn higher wages and are less likely to be unemployed. Research for the Sutton Trust found that a person with a Master's can on average expect to earn £5,500 more a year, or £200,000 over a 40 year working life, than someone with an undergraduate degree.[lxvii] People with postgraduate degrees are more likely to be in employment. Research from the Higher Education Careers Services Unit and the Association of Graduate Careers Advisory Services found that only 5% of all postgraduates in 2011/12 were unemployed six months after graduation as opposed to 8.5% for all undergraduates.[lxviii]

Access to postgraduate policy is limited for most by whether they can afford to pay for the cost of tuition fees. Unlike undergraduate study, most postgraduate students do not receive Government loans. Consequently, access to postgraduate study is determined by ability to pay rather than by ability: 66% of postgraduate taught students on computer science related courses are self-financed according to research from Universities UK.[lxix] Alan Milburn, the Chair of the Coalition Government's Social Mobility and Child Poverty Commission has described the lack of access to postgraduate study as a potential *"social mobility time bomb".*[lxx]

Lack of access to postgraduate education is a specific issue for computer science. The latest data found that 15% of STEM students in 2012/13 went on to further study and 14% of graduates of all subjects. By contrast, only 9% of computer science students did the

same.[lxxi] Where more students go onto postgraduate study, fewer students are unemployed. For example, among computer science graduates from Welsh universities, 17% go onto further study and only 10% of graduates are unemployed. Another consequence of low progression onto further study is that the UK is not developing home grown talent for the highest level jobs. Universities UK research revealed that, in 2012-13, only 35% of computer science postgraduate taught students (PGTs) were UK domiciled, as opposed to 58% of PGTs across all subjects.[lxxii] Given restrictive immigration policies, the result is a doubly damaging effect on the UK economy: we are not educating enough of our own citizens for the highest skill jobs in our economy but instead we are training up overseas students and sending them back to competitors in a global race for talent.

In the 2014 Budget, the Coalition Government recognised that "the changing nature of the labour market is demanding higher skilled workers" and that there are "potential barriers in the postgraduate system that may be restricting the supply of these higher skills."[lxxiii] It set out its intention to put forward proposals in the 2014 Autumn Statement. There are strong reasons for why this gap must be addressed. We would encourage that the Government focuses its resources on those who currently lack the means to go onto postgraduate study, especially in strategically important subjects such as computer science which have experienced large drops in postgraduate numbers in recent years.

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## Beyond the curriculum

It is clear that digital advances are affecting all jobs and so it is important that every graduate has the opportunity to develop relevant skills while at university, regardless of what subject they are studying. Universities can provide opportunities through a variety of means. Digital skills training can be provided as part of Skills Awards, which provide a framework to recognise students' involvement in, and development from, activities outside of their degree programme. There are approximately 80 in existence as of 2013 according to the

Association of Graduate Careers Advisory Services' submission of evidence, a number which has been steadily increasing. These Skills Awards signpost broader attributes which are needed in any career, such as team-working, communication, leadership, critical thinking and problem-solving. However, we believe that there is a strong case for these awards to recognise and include the development of digital skills. Here is a selection of case studies of best practice:

The University of Bath's Student Union have made 'Digital Practice' a key competency of their Award. Students must engage in activities that promote digital skills in order to be eligible to achieve the Bath Award. As a minimum, students are expected to be able to: combine digital and non-digital methods to benefit learning and working; facilitate effective digital communication and collaboration to engage an intended audience; and evaluate the usefulness of digital technology based on understandings its benefits and limitations.

Students performing at the top level of the Award will have engaged in extra-curricular activities that will have enabled them to: be confident in the creative use and personalisation of digital technologies and content; use technology to find new and innovative ways of learning and working; identify the legal, social, ethical and professional issues relating to working within the digital environment.

The University of Birmingham run a competition for students to devise and design a mobile application, which is sponsored by a range of IT-related organisations. Running from October to March, students attend a workshop in November before then submitting their idea in mid-January. The app must be completed by the end of February and awards are given in March. Amongst the prizes are paid industrial placements with companies such as Deutsche Bank and IBM. The competition is open to all disciplines and winners and runners-up have included students from Law, Economics, Physics as well as Computer Science. This activity is formally recognised through Birmingham's Personal Skills Award.

There are also initiatives which have been set up to help students develop digital skills. One example is CodeFirst:Girls, which provides 6 to 8 week coding courses across 14 universities in the UK for girls. A beginners' course introduces HTML, CSS, JavaScript, Git, GitHub collaboration with a focus on front-end programming. The follow-on course teaches Ruby, Rail, Sinatra, Heroku and other frameworks. The scheme was set up in 2013 by Alice Bentinck, one of the founders of Entrepreneur First (EF), after noticing the very low percentage of women applying for the EF Seed Investment Scheme. Alice Bentinck said:

*"I have been helping build tech startups through EF for the last three years and we have consistently struggled to get young women involved. I set up Code First: Girls in reaction to this and we are now beginning to see that it's leading to more young women choosing a career path in tech startups".*

CodeFirst:Girls have also begun to focus on running extra events

outside of the Academic Year, offering a number of events including a series of Hack Your Career talks which aim to give the girls an insight into careers in Tech, with people from various departments giving talks on their own careers and pathway into Tech. Alongside this, the scheme is also running a Summer Hack School for the courses' alumni, which gives the girls an opportunity to build an idea from scratch.

## Additional roles for industry

Businesses can contribute to higher education through a variety of ways beyond offering placements and sandwich years. These include accreditation, collaborating with academics on course design, assessing project work for students and providing guidance to students on what units or courses are the most helpful to study. We would highlight the importance of an Industrial Advisory Board to computer science departments. These can help departments to keep their curriculum up to date. There is a need here for an Industrial Advisory Board with representatives from commercial organisations, previous students and accrediting bodies such as the BCS. Strong links with employers will indicate that the course is much more likely to be up advisory board from industry.

Professor Alan Woodward, a member of both the UK Digital Skills Taskforce and the University of Surrey's Computer Science Department's Industrial Advisory Board, said:

*"Not all computer related degrees teach the right mix of subjects to make graduates attractive to employers. There is a wide range of employment levels amongst graduates from the many universities offering computer science degrees. The evidence suggests that universities offering computer science degrees with modules that focus on hot topics (such as security and cloud computing), as well as those who offer degrees that specifically cater for those entering the software development industry perform well where it comes to graduate employment. An Industrial Advisory Board are well placed to advise on course content in the context of industry changes, thereby helping universities to keep their curriculum updated and so improve graduates' employment prospects."*

Universities will and should regularly review their courses in light of technological advances. This is not limited to computer science courses. Many other courses, such as marketing and journalism, must also be updated in line with industry developments. This is not suggest that a university education should merely focus on skills training. The variety of employer needs is such that no one course can cater to the specific skills requirements of every job that their students will go into after graduation. However, instruction in technical skills is one core component of a university education. Policy change may be necessary here. As the Creative Industries Council Skillset Skills Group has noted, "the time required to approve and accredit university qualifications can take anything up to 2-3 years – acceptable perhaps for a degree in History, but not for a

Masters in Interactive Media Design".[lxxv] Universities will need to be able to adapt provision more quickly than that in a digital economy.

We also welcome employer involvement in developing new courses such as Software Development for Business and the ITMB degrees. These have been designed in collaboration with e-Skills UK, employers and universities. They may appeal more to certain prospective students than a pure computer science degree. In addition, specific industries can provide students with guidance on vocational subjects. For example, the Next Gen. report highlighted that when Skillset's Computer Games Skills Forum reviewed all of the 141 higher education courses with word "games" in the titles, they found that the overwhelming majority were not fit for purpose, that *"many video games courses do not provide any hands-on technology training"*.[lxxvi] Industries can take a lead in providing accreditation here to guide students as to which courses will actually prepare them for the workforce.

Many roles in the creative industries need advanced digital skills. The computer games and visual effects industries are two examples. Writing in the introduction to NESTA's Next Gen. report, Ian Livingstone and Alex explained that their industries "combine art and digital technology, and rely on a highly specialist, yet flexible, workforce that can adapt to furious rates of technological change".[lxxvii] Here, industry has collaborated to ensure that students know whether their course is recognised by employers by creating the Creative Skillset Tick. The Tick lets employers know which higher and further education courses and apprenticeships are well regarded by the creative industries. It helps employers know that they can have confidence that the graduates will have the education which will stand them in good stead for the world of work.

## Extra research

This chapter has highlighted the need for further evidence to inform policymaking. Just as the CPHC undertook additional research into the unemployment data, granular research of the wages of computer science students would be useful. Evidence on how factors such as unit choice, work experience, institution and academic attainment affect post-graduation outcomes could help clarify what universities might do differently. Further research into the benefits of both sandwich years and other forms of work experience would be helpful. In particular, in addition to data on the effect of placements on employment prospects and wages, it would be helpful to understand how they affect students' educational results. It would also be helpful to understand why there is the high drop off between the number of computer science students who sign up to take a sandwich course and those who actually take one. In particular, it would be useful to understand whether this drop off varies between institutions.

# DIGITAL SKILLS FOR LIFE


**ARM**

We are looking for candidates with experience in technologies ranging from C, C++, OpenGLES, OpenCL, WebGL, HTML5 and JavaScript to compilers and virtual machines. Experience in performance and power optimisation of embedded and mobile devices would be ideal. Candidates also need a good understanding of computer architecture. We're looking for hardware design specialists with knowledge of Verilog; in addition, ARM assembler and C/C++ are useful, as well as experience in scripting in Python, Perl, Tcl or Linux kernel. We are also keen to hear from open source developers and graduates who have experience with Unix/Linux.

The stronger candidates are those who have a capacity for self-development. A candidate who has experience with the Linux kernel, or something like an mbed for example, in their own time, immediately stands out. We have interviewed students who have taught themselves about graphics processors by writing games and demos for their Android smartphone, or who have made contributions to open source projects. It can make the hiring decision very easy for us.

UK DIGITAL SKILLS TASKFORCE

# Digital Skills for Life

## Recommendations

1. Government should make the necessary investment to extend basic digital skills to all of the UK population by 2020, taking steps to share the cost of this transition with businesses and the charitable sector.

2. Government should ensure job seekers are offered digital skills training to help them back into the workforce.

3. Businesses ought to take responsibility for ensuring existing members of staff are offered training to keep their digital skills updated.

4. Government should mount an awareness campaign about the need to improve digital skills among SMEs and charities. This should include piloting of voucher schemes to access digital skills training.

5. Government should commission a major review of the provision of lifelong learning for digital skills across the UK. Digital advances are making retraining and lifelong learning more important than ever.

## The importance of upskilling

This report has made recommendations around the education of the next generation, examining schools, apprenticeships and higher education. However, it is also vital we ensure that digital skills are being improved across the whole of our population so that all of our society benefits from technological advances. At every stage, we need to open up pathways to the next level, be that a route to becoming a digital citizen, a digital worker or a digital maker. We all have a role here. Businesses should, for example, take the responsibility for retraining their staff. The Government cannot and should not foot the bill for employers who fail to take steps to keep their staff up to date. However, there is a clear role and responsibility for Government to facilitate upskilling, especially in relation to basic digital skills.

## The digital divide

There are many excellent reasons for why we should prioritise extending basic digital skills to all of our society. The possible added economic value of improved digital skills at every level is enormous. A 2012 report from Booz & Company with Go ON UK set out the case for universal digitisation, estimating that full digital take up from businesses, charities and the population as a whole could add £63

billion to the UK economy.[lxxviii] There are many specific economic rationales: for example, supporting and incentivising more citizens to use services online could help the Government to make savings of £1.7 billion a year. That many are unable to access and use services online means that digital exclusion has a cost for all taxpayers. However, there are powerful arguments which relate to social justice. Extending basic digital skills to all would offer considerable benefits for the most marginalised sections of society, helping to connect the elderly and the isolated. Those who lack basic digital skills risk being increasingly restricted from participating fully in society, be it in terms of accessing public services, finding information or participating in the labour market.

If we believe that basic digital skills are a universal requirement, we must address the deep digital divide across our society. In the Great Britain there are 36 million adults, 73% of the total, who use the internet on a daily basis. However, we also have a sizeable minority who lack basic digital skills, including 6.4 million adults, or 13% of the total, who have never even used the internet.[lxxix] As of March 2014, only 81% of the UK adult population have at least basic online skills according to research by the BBC.[lxxx]

The gap in basic skills is especially concentrated among certain sections of society. For example, 52% of those who lack basic online skills are aged 65 or older. There is also a socio-economic dimension: 72% of those lacking basic online skills were from C2DE social groups, despite these groups only representing 46% of the population. According to the ONS, 30% of those with disabilities are non-internet users, as opposed to only 7.5% of those without a disability.[lxxxi]

In terms of the overall percentage of the population using the internet, the UK does less well than certain other countries. While 87% of the UK population have used the internet, 93% of the population in Denmark, 94% in Sweden, 95% in Norway and 96% in Iceland have used the internet.[lxxxii] While some may not wish to use the internet and we should not compel those who do not wish to do so, at the moment digital exclusion hits hardest those who are most vulnerable in our society. Too many remain disconnected because they lack the basic skills rather than as a result of an active decision to remain offline.

The focus for successive Governments has been to expand internet access by rolling out the cables to make this possible. The Coalition Government, for example, has committed over £1 billion in extending broadband across the UK, to 95% of premises by 2017. Such a transition has been an important step to strengthening the UK's digital economy. However, the next stage must be to have a similar roll out of basic digital skills for all. It would be a considerable waste of that large investment if well over 10% of the population continue to lack the skills to take advantage of an improved physical digital infrastructure.

There are also major risks of unintended social exclusion. Advances in technology are being seized by governments to move services online. From benefits forms to booking for your GP, more and more is being

moved online. However, it is vital that we ensure people have the skills to use these websites. Otherwise, we risk creating new divisions. For example, Conservative MP and former GP Sarah Wollaston has warned that it is necessary to be careful when using technology with healthcare so that we "do not inadvertently end up widening health inequalities in the process". The Department for Work and Pension expects 80% of universal credit claimants to make claims online by 2017. Is this realistic in light of the how many lack basic digital skills?

### Digital citizenship for all

The Coalition Government's Digital Inclusion Strategy aims to get *"everyone who can be digitally capable"* online by 2020. It estimates that between 3.5 million and 4 million, or 6.8% to 7.9% of the adult population, will never have basic digital capabilities. We must aim for as few to be excluded as possible and ensure that the next Government makes a major focus. Research for the Tinder Foundation and Go On UK estimated that the cost of equipping 100% of the UK adult population with basic digital skills would be £875 million.[lxxxiii] The possible benefits to the Government, to businesses and to our society are so considerable that we must make this investment. The analysis noted that were that to be split Government, the private sector and the voluntary and community sector, each group would need to make a £292 million investment. However, for business to make its equal contribution, we would need *"a step change in private sector behaviour".*[lxxxiv] A combination of a corporate social responsibility drive and experimentation with matched funding schemes might help to increase the business contribution to this task.

It is important to note that this digital exclusion is not just about skills. It can also be about the motivation. Here, both local and national government have a responsibility to make sure that their websites are clear, easy to use and accessible for all. Council websites, for example, might be one of the first websites someone who is digitally excluded might visit. All too often, they can be difficult to negotiate and put people off at the first hurdle. Why would someone use a government website if they find making a phone call easier? Gareth Ford Williams, Head of Accessibility, User Experience & Design, at BBC Future Media emphasized the importance of good web design to ensure that the internet is open to all, a challenge to those in education:

*"When the architecture of public or commercial spaces it taught in the UK, access for all people, regardless of their mobility needs, is an integrated part of the discipline. Media City UK is a great example of the outcome of this this, with access to all areas considered for people with mobility challenge and people with vision impairment. This is achieved through a holistic person centred approach to design and engineering and recognition that architecture can express a morality through its ability to include or discriminate. Arguably the same can be said for code. All client facing user experiences and the code used*

*"The people who could potentially most benefit from digital access – not just in terms of access to devices or connectivity, but crucially, in terms of the technical and critical skills to make meaningful use of access - are typically people facing the biggest barriers to access and skills. Infrastructure, connectivity and device ownership aside, the biggest barrier to being able to engage with, take advantage of and be an active citizen in online environments is digital literacy, and lack of basic digital literacy education for all."*

Josie Fraser, ICT Strategy Lead, Leicester City Council

*to develop them has the potential to be inclusive. This is why industry recognised standards for developed by organisations such as the W3C, are based on an ethos of universal access."*

*"Universality is a core principle of the standards that define best practice in web development, however through conscious and often unconscious choices, standards and best practices are not adhered to or applied incorrectly and therefore inaccessibility is designed and engineered in, resulting in discriminatory experiences. The issue underlying this is that the skills to enable this to be done correctly are not taught from the outset, which is why most Designers and Developers only learn about accessibility outside of the education system. There are exceptions to this, University of Dundee's School of Computing being one of only a handful of examples.*

*The problem is compounded further by accessibility being taught as something used to 'fix code' or 'add value' and is treated as a 'nice to have', rather than it simply being a way experiences are designed and code is developed from scratch. This is where the myth that accessibility is an expensive afterthought originates from. This is like thinking that a building with steps up into it is cheaper to build than a building whose entrance is at street level.*

*There is also a second myth that accessibility comes with unacceptable compromises to product design. This is simply not true and the; BBC iPlayer, Apple iPad/iPhone, YouView and the YouGov website are just a few examples that prove that baking accessibility in from the start creates a better technology product overall.*

*In their defence it would be wrong to accuse either Designers or Developers of conscious discrimination, however what is often the case that they graduate with an approach to user centred design or development that is based on a standard issue fictitious person rather than embracing the fact that even standard issue people will be disabled at some point in their lives, sometimes through illness, injury or environment and if these were temporary experiences they will eventually experience permanent disability as they grow older.*

*It's interesting to note that in every instance I have witnessed, once a new joiner to BBC Future Media recognises what impact inaccessible design or code has on people with challenge, they embrace any opportunity to further themselves through training in HCI (Human Computer Interaction) research skills, or develop a deeper appreciation of the application of Progressive Enhancement and accessible coding techniques can have on users. This is how the BBC is able to deliver accessibility at scale.*

*There is an opportunity here to recognise that the UK's future digital society can be both technically skilled and inclusive as long as these objectives are treated as one in the same thing by our education system."*

Much can be done and is already being achieved as part of initiatives at a regional or local level to improve basic digital skills. We do not want to duplicate what already exists, such as the excellent work of

*"The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect."*

Sir Tim Berners-Lee

Go On UK, the Tinder Foundation and their partners across the UK. We must build on this work to make sure that all can go online. Many businesses and organisations already do considerable good work in relation to this at every level.

There are also excellent initiatives to target specific disadvantaged groups. Savvify's #techmums program teaches mums basic online skills, app design, web design, social media, blogging, how to stay safe online and coding. In five two hour interactive workshops run in a relaxed and friendly environment, mums learn how to become tech savvy. Outside of the classroom mums are supported in an online environment. Teaching mums how to use the internet, be it learning about the internet, email, Google Drive, blogging or social media, #techmums aims to reduce fear of technology and instead give mums the confidence to go online. The focus is on improving online tech skills as a means of both personal empowerment and raising aspirations for disadvantaged women.

The founder of #techmums, Dr Sue Black, said: "If we can get mums excited about technology we don't just help one person we get to the whole family. We are all about building confidence too and having more confident and happy mums means more confident and happy children who are all connected into the modern world."

EE has set up Techy Tea Parties, informal events where EE volunteers help those who want to learn a bit more about technology and build their digital skills. It has run over 100 Techy Tea Parties across its offices, contact centres and out in community locations in 26 locations across the UK. Techy Tea Parties are informal events that are designed to inspire and educate to help build confidence in using technology. There is no set agenda, it is about a one-to-one interaction where a volunteer will help people with their specific needs. The events last just over an hour and combine learning how to use technology with tea and biscuits. Volunteers work one-to-one with the guests so they can directly answer questions and help the guests overcome any challenges they have.

In order to help with basic digital skills, Barclays Bank took the initiative to train a group of 'Digital Eagles', employees who can provide technology advice to people at branches across the country. The programme started with 18 in May 2013 and now there are 7000.

Steven Roberts, Strategic Transformation Director at Barclays and Pioneer behind Barclays' Digital Eagles, said:

*"The Digital Eagles programme is all about taking our customers and non-customers on a journey to improve their technology capabilities and feel confident to embrace the new digital revolution, so they can reap the benefits of being online. We want everyone, regardless of age, to reap some of the benefits of being online, whether that's saving money, keeping on top of finances or staying in touch with family and friends."*

Part of the focus has been on improving basic digital skills amongst the elderly. Beyond the benefits in terms of reduced loneliness and isolation amongst the elderly, there are also significant savings to be made by being online. Barclays undertook research which found that those who are aged 55 and online can make savings of around £750 a year as a result of shopping online, using price comparison sites and lower travel costs.

The strength of schemes like Barclays' Digital Eagles programme is that it offers training to people at places where they already go as part of their daily lives. We need to help people get online at places where they go, be it their bank, their shops or their GP. We need to take the support to them and make use of existing networks. For example, Unionlearn has worked with Go On UK and its partners to train 183 Digital Champions in 2012/13 as well as helping 22,946 ICT learners through its Union Learning Fund.[lxxxv] The TUC's 54 affiliated unions represent over 6 million working people and have retired members. Organisations such as the unions can help scale these efforts.

We can also learn the lessons from other access programmes, such as the Digital Switchover Help Scheme.

*"For four years I worked on the Digital Switchover Help Scheme, which was run by the BBC on behalf of all the broadcasters to ensure that no-one was left behind when the analogue TV signal was switched off. More than seven million households were offered this help. Most were asked to contribute £40, with eligible people also on income-related benefits offered the help free. Our remit was to reach the hard to reach, people who might ignore or not understand the messaging being delivered by conventional mail drops, TV and radio campaigns. There were some very valuable lessons which the BBC have collated and which I believe would be a useful reference point for any organisations setting up projects, large or small, working to encourage people to go online from how to engage with customers to how to deliver a quality service. I felt incredibly proud to be part of a scheme which listened so carefully to feedback from older and disabled people on how to improve the messaging and the service so that it was effective.*

*One of the most helpful things for our work was the trust people had in the BBC brand. The other was the wholehearted support of ITV, independent local radio and the local press who covered the story imaginatively and enthusiastically. We relied on the advocacy of local community groups and supporters, organisations like Age UK and micro-groups like community centres to take action across the country. But the cornerstone of the Switchover Help Scheme was the way the whole team worked very closely with people who we believed were likely to be known to the people we most needed to reach. I remember a local postman on the Shetland Islands who made a massive difference by not only delivering leaflets but knocking on the doors of people who he suspected most needed support. He was a trusted face.*

*One of the initiatives we ran was the 'Helping Hand' scheme. We knew that the vast majority of people already had their flat screen multi-channel tellies and paid very little attention to messaging about switchover. So the change in emphasis - asking people to have a think about people who lived in their street, in their village who might not have a digital set and asking them to alert them to the help and support the scheme could provide worked very well. I believe we need a similar, properly funded scheme to help people get online. We risk a massive digital divide in terms of future services if we cannot achieve this."* Maggie Philbin

Extending basic online skills for digital citizenship is also vital for those who we hope to reintegrate back into society. A report by the Digital Prison Reform Trust and Prisoners Education Trust, *Through the gateway: how computers can transform rehabilitation*, highlighted that *"there is huge potential to use ICT and controlled internet access as a tool to improve prisoners' rehabilitation and reduce reoffending"*. Those who lack basic digital skills will struggle. As the report noted, *"the digital divide between people in prison and in the community is widening and will make resettlement much more difficult if these skills have not been addressed while in custody."*[lxxxvi]

The importance of ensuring basic digital skills for all of the UK's population is enormous. We cannot leave the elderly and the most vulnerable in our society locked out from the benefits of the internet. The digital divide has a major cost to us all and is an issue of basic social justice. While delivering basic digital skills for all may have a high price, the cost of inaction would be far higher.

## Basic digital skills for the unemployed

Retraining people without adequate digital skills is a major task for Government, for businesses and for individuals. There are many reasons why we need to improve the basic digital skills of people who are in work or who wish to find a job. Increasingly, basic IT skills are a requirement for even making a job application. A lack of basic IT skills is sufficient to entirely put employers off considering an applicant: one ICM/UK Online Centres survey in 2012 found that 72% of employers would be unlikely to interview a candidate without basic IT skills.

While many basic digital skills problems are concentrated amongst older workers, it is also a large problem amongst NEETs. Research from the Prince's Trust found that 10% of young people who are not in employment, education or training (NEETs) cannot send a CV online and 11% of NEETs believe that their IT skills hold them back in their career.[lxxxvii] NEETs are far less likely to be confident in their own computing skills, with only 48% of them rating "themselves as 'very good' at using a computer compared with 71 per cent of those in education". 46% of those claiming job seekers' allowance struggle to send a basic email.[lxxxviii] It is essential that Job Centres have the

capability to support people to improve these skills. As soon as someone signs on, they should have their digital skills level reviewed. Should they lack the basic skills needed to even apply for a job, they ought to get the basic support they need to help them into the world of work.

There is considerable good work done by organisations which work to equip NEETs with the skills they need for the world of work. In particular, the Prince's Trust helps support disadvantaged young people take positive steps in gaining control of the direction their lives by, for example, helping them to undertake training with organisations such as Free:Formers and Fluency. These organisations help young people to retrain and find their digital job.

*Kaishia Barnes worked as a sales assistant before finding herself in unemployment, a single mum with a passion for online gaming. In 2012 Kaishia was accepted onto The Prince's Trust Team Programme. During the 12-week course she went on a number of different training courses and work placements. One of these courses, an app creation course by Free:Formers, stood out from the rest, sparked by Kaishia's gaming interests.*

*For the first time Kaishia learnt how to make the web as well as use it, discovering coding, app and website building. She saw which skills she would need to turn her passion into a job, and open up new opportunities to develop her talents for digital creativity. She knew what she wanted to do after finishing the Prince's Trust programme; become a Free:Formers trainer. At the end of the workshop Kaishia spoke to one of the team and agreed to keep in touch.*

*In 2014 Kaishia is a Free:Formers trainer, leading the one for one social workshops on behalf of the company alongside The Prince's Trust, UK Youth and other organisations supporting young people into work. Since getting a job with Free:Formers Kaishia has trained CEOs, Members of the Houses of Parliament, celebrities and inspired dozens of young men and women just like her.*

*Free:Formers trained 1,200 young people in 2013 and is on target to train over 3,000 young people in 2014. In 2013 forty five per cent of the young unemployed people they trained were women. Free:Formers provide training for businesses with a one for one model which means that for every business person they train, they also train a young person for free.*

Initiatives to tackle skills gaps can be taken by businesses working together. The Camden Town Business Improvement District, Camden Town Unlimited, provides a good example of how measures can be taken to address a digital skills gap at a local level. Camden Town Unlimited runs an intensive 6 week programme for over-18s with a Camden connection to develop programming skills. 'Coding the Web' has now taught its second cohort. The project aims to give those with little or no coding skills a grasp of computer science and software development.

Given the importance of digital skills to employment, we would advocate that back to work programmes offer digital training to offer a pathway into this growing sector of employment. In Wales, the Government is funding a pilot programme called "Pathways to Digital Employment". The scheme will up-skill and retrain up to 300 people who are not in work, including recent graduates and military leavers. We need experimentation with new ways of restraining at all levels, be they national, regional or local.

## Retraining digital workers

Employers have a responsibility to reskill their workers for a rapidly changing digital economy. Be it national or local government, businesses or the third sector, organisations of any form can work better by making the most of technological advances and improving the digital skills of their employees. It is not just the private sector but also employers across the public and quasi-public sector which risk losing out if they do not retrain their staff. Institutions such as schools, colleges, universities and employers across the NHS all employ large numbers of people. Retraining is not only important for doctors and educators but for the administrators and all of those who work in these organisations.

The Government cannot and should not meet the bill for employers who fail to take steps to keep their staff up to date with technological advances. A poor commitment to training amongst firms has contributed to the skills gap in technology roles. E-skills UK's Tech Insights 2012 report warned that *"the likelihood that IT & Telecoms staff will have been trained has declined substantially"* since 2003.[lxxxix] Professional level workers in non-IT & Telecoms roles were found to have been almost twice as likely to receive education or training as IT & Telecoms staff in equivalent roles. In particular, the survey found that around half of businesses' skills gaps *"were thought to have been in existence for 6 months or more despite the fact that they were also thought avoidable in a similar number of instances (by better planning, more training or other means)".*[xc]

There can be a lot of immediacy in the tech sector, with focus on very specific skill set requirements in the short term. However, it is important that companies look to the medium and longer term in relation to skills needs. Creating entry level opportunities to bring in fresh talent is one way to address future skills needs. Another part of the solution is to make sure that their existing workforce gets the training to keep their skills up to date. Otherwise, companies risk finding their workforce out of date and left behind in the face of technological change.

We are aware of some excellent examples of steps being taken to address skills gaps, retraining those already in the workforce for digital jobs. Network Rail has taken steps to improve their workforce's digital skills as part of a change to track inspection processes. Sarah Jane Crawford, a Project Manager at Network Rail,

explained the changes:

*"One of the best examples of up-skilling within our workforce is the project to establish Plain Line Pattern Recognition (PLPR) within Network Rail. This high-speed track inspection system has been labelled as one of the most important projects Network Rail is currently delivering. The current method for inspecting track for faults requires individual track inspectors to walk approximately five miles per person per day. With around 20,000 miles on the network, this is not the most efficient way of inspecting track. The PLPR provides us with more consistent, high quality and better value information. There are currently hundreds of track inspectors working within our maintenance department who along with other duties, carry out manual inspections.*

*The new roles that have been created are reliant on existing track inspectors as in order to reliably analyse the information they have to have adequate training and the experience. The project recruited on-train inspectors on a secondment basis with the individuals applying themselves for the roles. This has resulted in a team with a variety of experience from passed out apprentices with a year's patrolling experience to hardened patrollers with 10 or more years' experience. Additionally the team are from a variety of geographic locations and routes which has proven to be very beneficial given the variety of components within the PLPR recording programme.*

*There have been a number of challenges with recruiting from existing Network Rail staff one of which being the need to integrate technology within the new teams' everyday roles. The typical manual track inspector had very limited technology integration. However, the PLPR requires the team to have at least basic computer skills which would lead to the team being empowered and champions of the technology. In order for this to happen, there have been multiple training approaches. These have included classroom based teaching alongside mentoring from those who are more confident in using the system. This mix has been successful as it has combated a number of different issues. A number of the team had fears around the use of technology that were supported by those team members who were confident in using it, and those who had less experience in track inspecting could rely on those with more experience.*

*One interesting outcome of the project is our realisation that our entire workforce isn't Microsoft literate. We've now incorporated this into our training approach and we have developed methods to reflect this. This also ties into the concept of the constant change that occurs when using technology, specifically technology that is as innovative as the PLPR system. One example of this change is the amount of time that it now takes to export the information from the measurement train; this will impact the processes that are undertaken. This change can either be embraced by the team or act as a barrier, this is dependent on the role experience of the individuals but this attitude has been shown to change alongside the length of time they are working within the team.*

*We are slowly changing attitudes as people realise the manual*

*processes they have previously relied on can be combined with new technology to deliver a better result. We will use this early adopter scheme and share it with the wider business for future schemes. In addition to this the PLPR project are creating a new standard that will incorporate the old track inspection competency alongside the additional information about how to use the system on a day-to-day basis."*

Companies should also consider what they can do alongside other organisations to retrain their employees. The unions in the UK, for example, have an increasing focus on education and training. Unionlearn and the unions supported 221,000 learners in 2012/13, supporting a mix of both informal learning and courses across all levels. Of those learners, over 20,000 were on computing courses with around 3,500 enrolled on online basics courses.[xci] At its core, Unionlearn has a network of union learning representatives (ULRs) who help support learning at a local level. There has been a longstanding focus on IT as a basic third skill. Businesses can collaborate with unions to ensure that employees have the opportunity to undertake the ICT training which they need and to ensure that it is aligned with career progression opportunities within companies.

Technological advances are opening up new opportunities for learning and education. In particular, Massive Open Online Courses (MOOCs) offer people the opportunity to study courses from leading universities all over the world via the internet. For example, The Open University's FutureLearn partners with over 20 of the best of the UK's universities and EdX was established by Massachusetts Institute of Technology and Harvard. Many MOOCs do not charge a fee but offer the opportunity for independent study with the use of videos and articles. The courses are flexible and fit around learners' timetable with a modular approach. They offer the opportunity for education and learning at any stage with MOOCs being taken by people of all ages. Edinburgh University's MOOCs have had their greatest take-up in the age group 25 – 34 followed by 18 – 24, and then 35 - 44 yrs.

The courses have tended to have especially high take-up amongst people who have already studied at university. For example, a study of the University of London's MOOC users found that 70% of learners already had a higher education qualification. [xcii] They offer considerable potential for helping to upskill those in work, a development which has already begun. For example, The University of East Anglia is to provide a MOOC in September 2014 with FutureLearn for teachers on the new computing curriculum. With bite sized learning as part of professional development, teachers will be able to study a course which master teachers from Computing at School have helped to design. While MOOCs cover all fields of knowledge, they can provide one new way for those already in the workforce to expand their knowledge and retrain.

## Retraining to become Digital Makers

Beyond intermediate digital worker skills, we need pathways into the higher end roles for those in the workplace and for those who have missed out on other routes into the highest level skills. Many opportunities at a higher level involve expensive training which is too often not affordable for most people. For example, Makers Academy offers a highly regarded intensive programme that teaches people how to code to a stage where they are ready for a software developer role in just 12 weeks. The course is not just focused on technical skills to be ready to work, but rounded soft-skills that the graduates will need to be successful in their careers. However, with an upfront cost of £7200, or £9600 if paid for in instalments, many will not be able to afford the training.

Alternatives approaches to financing might be necessary to fund the training for people to become digital makers. For courses with large upfront costs that are not eligible for public support, there are new options for funding emerging. For example, StudentFunder.com is a website which offers loans for masters and professional courses. Given the high pay of its graduates, earning in the range of £25-£35,000 per annum, investors could provide financing options which might make this sort of transition viable.

There might be scope for the tech industry to imitate the approach taken by law firms in paying for expensive postgraduate training. Certain law firms offer their prospective trainee solicitors financial support for the postgraduate qualifications they need, be it by fully funding the cost of the course or an interest-free loan. As part of this deal, the trainee lawyer is then normally committed to work for the firm for two years. Given the high cost of using contracted developers, companies could consider undertaking variations of "golden handcuff" style deals to train up people into high skilled roles, with a guarantee that the upskilled individual will either remain with the employer for a minimum period after the training is complete or pay back the cost of the training.

Certain companies have taken steps to help people into higher level tech jobs. For example, ASOS, Makers Academy and the Prince's Trust are running a pilot to create a pipeline into high skill software engineering jobs. ASOS currently employs around 100 contracted developers at a very high cost for their website. Given the skills gap for developers alongside continued high levels of youth unemployment, ASOS collaborated with the Prince's Trust and Makers Academy to train someone up to a high level developer role. The Prince's Trust will take a cohort of NEETs aged 16-25 onto their Get Started programme which will get them to work together to design and create a website that could be the first step in building up their very own portfolio. The next stage will be a 4 to 6 week Get Into Digital programme, which will initially focus on developing the generic Digital skills, essential for any work place.

ASOS will recruit some of those who complete the scheme into one of their teams into a job with multiple training and development opportunities, focusing on four key areas of ASOS business – Service

Management (including IT/Service Desk), Quality Assurance, Business Analysis and Software Engineering. ASOS would provide internal training for many of the skills areas, but training someone to be a software developer is much too expensive and hard to do in house. This is why ASOS partnered with Makers Academy to provide an immersive training experience to turn two of the young people into fully fledged developers to return to work at ASOS.

## Addressing digital skills weaknesses in SMEs and charities

As the internet becomes the first port of call for people searching for information or looking for shopping options, certain SMEs and charities risk being left behind because of their lack of digital presence. The 2014 Lloyds Bank UK Business Digital Index found that "a third of SMEs and charities do not have basic online skills" and that only half of SMEs and charities had a website.[xciii] A digital presence can be extremely beneficial for both SMEs and charities. For businesses, it can provide a way to market online, an effective way to grow a business and let customers find and reach you. The efficiencies possible as a result of a website can help businesses to cut costs and improve profits. The research suggested that their limited use of the internet was not due to either a lack of physical access or slow internet. Instead, it found that "only 2% cite lack of connectivity as a barrier to doing more online".[xciv] The problems were more linked to attitude and skills: these organisations lacked both an appreciation of the possible benefits of digital and the skills needed to get them online. To address the attitudes towards digital, we would advocate an awareness campaign targeted at offline SMEs and charities to set out the case for why getting online could help them.

*"SMEs aren't necessarily yet quite aware of how important these skills are going to be to their business over the next 5 to 10 to 15 years' time so I think an awareness campaign would be helpful."* Chris Mairs, Chief Scientist at Metaswitch Networks, speaking at our London regional meeting.

Certain companies have taken steps to help address the digital skills gap among SMEs and charities by providing support. For example, Google's Grow Your Charity Online website gives NGOs a free online health check and step-by-step videos on how to increase reach or fundraise online. However, while websites such as these have their place in helping those who are already online, there is a further step needed for those lacking absolute basic digital skills who need hand holding through the process. In 2013, Virgin Media partnered with Free:Formers to conduct an intensive, three week training programme for 25 small businesses in Birmingham. They targeted businesses who had to date had not invested in digital services and were unconvinced by what broadband could offer them, hard to reach businesses from a range of sectors. The digital training module was designed to start at a very basic level of technical understanding and progressed to provide training on how to code, build a website and populate it with content, embed video and develop a social media strategy. The fast moving curriculum demanded a classroom-

based environment to ensure that the participants could ask questions and build as they learnt. We would advocate pilots to establish how the Government might provide support to those businesses and charities which need help taking that first step. A subsidised voucher scheme with approved training providers for a short training course could provide the face-to-face guidance and support which those disconnected SMEs and charities need.

## The importance of lifelong learning in a digital economy

Digital advances compound the importance of lifelong learning in an unprecedented way. If we want to make sure that people can remain in the workforce for longer, they will increasingly need to improve their digital skills at all levels. These problems are often concentrated amongst those already in work. For example, a September 2011 CBI report on the needs of the Creative Industries stated that 66% of firms reported problems with IT skills, problems which are *"likely to be concentrated amongst older workers"*.[xcv] Many future job vacancies will be filled by people already in the workforce. The National Institute of Adult Continuing Education (NIACE) highlighted in its *General Election Manifesto 2015* that the UK will have 13.5 million job vacancies over the next decade but only 7 million young people will enter the labour force in that period. Consequently, NIACE warn, *"we are heading for a major labour market imbalance".*[xcvi]

Alongside technological advances, we have higher life expectancies and are retiring later. The result of these factors is that we are more likely to remain in the world of work for longer: according to research from the Institute for Fiscal Studies, by 2022-23, the proportion of women aged 65-69 in work could reach 37%, up from 16% in 2010-11 and 8% in 2000.[xcvii]

However, despite the unprecedented need for people to be learning throughout their lives, certain policy changes have actually weakened lifelong learning. Higher education reforms in England have preceded a sharp-drop in part time students, who are generally mature students. According to HEFCE, there has been a 46% drop in the number of part-time undergraduate entrants to English universities between 2010-11 and 2013-14. As 92% of part-time UK and EU undergraduate entrants in 2012/13 were mature students aged over 21 years of age, these drops have hit the number of mature students.[xcviii]

In order to retrain the existing workforce, we will have to adapt our approach to skills policy in the UK. There were a series of suggestions which we relate to this challenge. For example, one of NIACE's recommendations in their manifesto was for "a new personal skills account for all adults linked to an entitlement to career reviews to help people decide what skills development will work for them."[xcix] In their submission, the Institution of Engineering and Technology wrote that "many employees spend significant personal time and money up-skilling themselves, however at present the only allowances

claimable are for professional membership fees. One could easily imagine a situation where tax allowances were given for individuals if they attended a course endorsed by the pool of approved professional institutions." One large company advocated a "Mature Apprenticeship Model" which would support re-skilling whilst in-role and maintains a viable level of earnings.

All merit consideration as ways to improve the provision of lifelong learning in the UK. However, it would seem clear that the current level of support we offer to lifelong learning is not fit for purpose for our digital future. We recommend that the Government should commission a major review of the provision of lifelong learning for digital skills across the UK.

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