

WOMEN IN IT

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WOMEN IN IT

INSPIRING THE NEXT GENERATION

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FOREWORD

I wish this book didn't exist. I wish that BCS had not spent its valuable time on a 'women in IT' campaign. I wish that, in my job as *Computer Weekly* editor in chief, we would never write about the topic of women in technology again.

Why? Because if none of those things happened, it would mean we had a truly diverse workforce in IT, one that reflects the technology users it serves and took advantage of the range of skills available from employees of every age, gender, race or creed in the UK.

It would mean that as we look to find the 250,000 new entrants to the IT profession that are forecast to be needed over the next five years, employers would be able to choose from the widest source of talent possible, men and women.

It would also mean that at school, boys and girls equally saw IT as a desirable career to pursue, creating a pipeline of the skills required to develop the UK as a high-tech economy.

But none of those things are true.

At *Computer Weekly*, we thought it was a good idea to recognise the most influential women in UK IT, and promote them as role models to help get a little closer to the sort of situation, as imagined above, that we should be able to take for granted.

I'm pleased to say that many of the women in this book have featured in our annual list of the 25 most influential women in UK IT – but we still need many more of these amazing female role models. In fact, we need so many that they are no longer seen as role models – just people, forging a career in IT, helping to grow the UK's digital economy.

But until that happens, I hope that anyone who reads the stories of these successful women in technology will be suitably inspired to join them.

Bryan Glick, Editor in Chief, *Computer Weekly*

PREFACE

In the spring of 2014 **BCSWomen** ran a highly visible campaign to highlight the poor numbers of women in the IT sector in the UK and to present female role models in order to encourage girls and women to consider a career in technology.

The plan was to have a calendar that gave voice to a prominent and respected technologist for each day in May. The hook to this campaign was that each of the role models was to be a female working in the IT professions in UK industry or in an ICT role in an academic institution. We knew that it was key to showcase women who have been successful – there are many prominent and successful male technologist role models: Steve Jobs, Bill Gates, Mark Zuckerberg and Tim Berners-Lee to name but a few. We needed to show that there is a great showing of successful women in technology too.

What we spawned, along with the calendar and role models, were radio interviews on the issue, a **UK Scorecard** in conjunction with **e-skills UK**, which produced up-to-date statistics on the current situation, and thousands of page hits for the campaign.

We hope that all the activity, the research, the role models and now this ebook give girls and women in the UK a positive impression of careers in technology. We also hope that women who are currently working in the IT professions in both industry and academia will believe that there is a sustainable and exciting career for them which will be both fulfilling, and if they need it, prominent.

I would also like to offer a word of thanks to everyone involved who believed that a really visible campaign was possible, and without whom none of this would have happened.

Gillian Arnold, Director, Tectre; Chair, BCSWomen

SECTION 1
SOME BACKGROUND

1 LADIES AND GENTLEMEN... THESE ARE THE REAL FIGURES

*Whilst many of the headline figures for 2014's **Women in IT Scorecard** report are still negative, there are some points of optimism in the thorny issue of gender diversity in IT. E-skills and BCS, The Chartered Institute for IT, have updated their scorecard for gender representation in the IT industry – a robust and rigorous exposition of an issue that still surprises in the 21st century. Brian Runciman, MBCS, reports.*

We need to start with setting out the problem. Despite the fairly high profile of this issue, the trend for representation of women in IT over the last decade is actually slightly down, with current figures showing just 20 per cent in the industry as a whole.

Drilling down to specialist areas it gets worse: within the IT sector itself only 11 per cent of IT specialists were women and the median gross weekly rate of pay for female IT specialists was 16 per cent less than the comparison figure for men working in IT roles.

Karen Price OBE, CEO of e-skills UK, says in her foreword to the report: 'No-one who is fortunate enough, as I am, to visit employer premises on a regular basis, will be surprised by the contents of this report – a simple glance around will invariably confirm that men are significantly in the majority in tech workplaces. While the scale of the gender imbalance itself is shocking, its persistence is no less so.'

THE IMPORTANCE OF THE ISSUE

Quite aside from the obvious ethical dilemma, the IT and telecoms industry accounted for an annual gross value added (GVA) of £75 billion in 2012 according to the **ONS Annual Business Survey** – approximately eight per cent of the UK total in that year. Continued adoption of IT has the capacity to generate an additional £47 billion of GVA to the UK economy over the next five to seven years.

Likewise, IT accounts for a significant proportion of UK employment. In 2013 there were just under 1.4 million people working either in the IT industry sector or in IT roles within other parts of the economy (753,000 in the IT industry and 643,000 IT professionals working in other industries) according to **e-skills' 2012 Technology Insights** – and that doesn't include the 29.7 million employees who use IT in their daily job – these are the experts upon whom they depend.

The value of a gender-balanced work force in such a vibrant sector of the economy is considered self-evident by most; especially with the UK facing a challenge to keep up with IT demand. E-skills UK's recent employment forecasts, in partnership with

Experian, identified that there is a need for around 129,000 new entrants a year into IT and telecoms specialist job roles through to 2015, with a minimum of around 22,600 likely to be filled by people joining from education.

WHERE ARE THE PROBLEMS?

Karen Price cites the societal influences that affect all STEM roles and the widespread misperceptions about IT careers – from the difficulty of the work to IT's undeserved antisocial image – but however much employers want to recruit women they can only choose from those who put themselves forward and have the appropriate qualifications. The report shows that employers strongly believe that the key to reducing the gender imbalance lies at an earlier stage – in schools, colleges and universities – which is where the gender divide starts.

Lower female participation rates exist at GCSE level, with the gap increasing at A-level and continuing into higher education and thus the IT professional workforce. The lack of females taking IT-related qualifications directly impacts upon the proportion of females that are employed today as IT specialists.

Given that the trend in the representation of females throughout ICT education and careers has been predominately downwards for some years, it suggests that the employment situation is likely to worsen further unless there are some significant and meaningful interventions. By 2013, of the 1,129,000 people working as IT specialists in the UK, less than one in six were women.

ANY POSITIVES?

Firstly the absolute number of women in the IT workforce has risen. The indicators from the self-employed have improved markedly over the past decade with numbers of women more than doubling.

In the education area, when girls do take part in computing subjects at GCSE and A-level, they outperform their male counterparts. The research shows that 76.3 per cent of females (compared with 69.2 per cent of males) who took an IT-related full course GCSE were awarded A*–C grades.

Of course this provides a potential pool for IT employers, but only if females can be encouraged into IT careers. This also shows that where a motivating curriculum is offered, young women show an appetite for degree level work in tech – this is demonstrated in the high level of female participation in e-skills UK's ITMB degree.

IT DEPENDS HOW YOU LOOK AT IT

Some of the headline figures from the report can be seen either as pros or cons, especially if a more global view is taken. For example, female representation in IT specialist roles is higher in the devolved nations than in the UK as a whole (19 per cent vs 16 per cent). Compared with other EU15 nations the level of female representation in IT positions in the UK is slightly below the norm.

It is positive that women are much more likely to hold technician/engineer grade positions than men, with 34 per cent representation among women compared with 20 per cent amongst men, but that goes hand-in-hand with women being less likely to be working in 'professional' (primarily development related) occupations (46 per cent vs 57 per cent).

THE EDUCATION PICTURE

Looking at ICT education compared with other subjects the picture becomes less positive. Across all subjects in higher education in 2013, females accounted for 57 per cent of UK-domiciled applicants and 55 per cent of acceptances, but females made up just 12 per cent of applicants and 13 per cent of acceptances in computer sciences subjects.

STEM subjects – science, technology, engineering and mathematics – see better representation for females, with 34 per cent of applicants and 35 per cent of acceptances (UK domicile), but again for the computer sciences there is a huge drop to 12 per cent applicants and 13 per cent acceptances.

Whilst across all subjects in 2012 females accounted for 59 per cent of UK-domiciled qualifiers, they accounted for just 18 per cent of qualifiers from all computer science/IT-related HE courses. Females who sat an IT-related GCSE in 2013 decreased three percentage points compared with 2012, and in 2013 females accounted for just 6.5 per cent of those taking computing A-level, a decline of 1.5 percentage points compared with 2012.

WHEN THE WORK IS THERE

When women's education is taken into account, we see a highly-qualified group: over two-thirds (69 per cent) of female IT specialists held some form of HE qualification in 2013 – a proportion that is not only equal to that of their male counterparts, but that is also much higher than that observed for either women or men within the wider workforce. These are capable people. Which makes it all the more problematic that, at £640 per week, the median gross weekly rate of pay for female IT specialists was 16 per cent less than the comparison figure for men working in IT roles (£760). 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.

CONCLUSION

It's clear that gender imbalance is still a large problem in IT. Reports such as the **Women in IT Scorecard** show, however, that the issue is not one of competence. If anything, the performance of girls in education shows that the IT profession is missing out on high-quality potential. It's still a question of keeping this issue in the public eye.

Read the full report: **Women in IT Scorecard**

2 THE GENDER CONUNDRUM

Dr Hannah Dee, University of Aberystwyth, examines the current gender gap in the IT industry and asks whether we should be worried for the future of our profession.

The early years of computing were full of women. It's estimated that over 80 per cent of the staff at **Bletchley Park** during the Second World War were women, operating some of the world's first computational machines and contributing to the foundations of British computing.

Early computing courses attracted equal numbers of men and women students. Sometime around the 1970s, this changed. Computing became a discipline and indeed a profession with a gender problem.

Now, women number about 15 per cent of the technical workforce. Why this is happening is hard to determine: it happens in most Western countries (but less so in other parts of the world).

Maybe women just aren't interested in computers. Or maybe there's something that's putting women off – for example, maybe there's something about school computing that makes women think computing is not for them. Or maybe there's a broader image problem?

SKILLS GAPS, JOB MARKETS AND THE POWER OF DIVERSE TEAMS

One of the turning points of the last decade has been a recognition from business that diversity is something to be valued. McKinsey have released a series of reports under the '**Women Matter**' banner, which show, from a business perspective, that diverse teams perform better in the business world.

As an example, when you compare companies in the top quartile for executive gender diversity against companies with no women on their executive board, those with diverse boards have 41 per cent better return on equity, and 56 per cent better EBIT (earnings before interest and tax).

It's important to note that these teams aren't doing better because women are more talented at business; they're performing better because diverse teams behave differently. Monocultures tend to be self-reinforcing: if all your decisions are taken by

one sector of the population, then the decision-making and management style is going to be similar.

Diverse boards provide a range of different backgrounds and management styles, all engaging in the business process, and when this happens, McKinsey show that the resultant business process is more effective.

There are other arguments for diversity in the workplace. In professions with heavy gender imbalances, the minority generally has a more difficult time. Male nurses take more sick days and female accountants are more likely to register on the anxiety and depression scales.

There's a term – sex role spill over – for the way in which unrelated aspects of gender roles seep into a profession when that profession has a major gender imbalance. There's no need for system administrators to be interested in beer and trains: having unrelated but common interests doesn't make you a better system admin (although it may make it easier to chat with colleagues).

There's also a skills shortage in IT roles. Neelie Kroes, the EU commissioner for the digital agenda (and EU vice president), recently proposed grand coalitions to address technical skills gaps.

Skills gaps aren't uniform across the entire ICT/computing field, but exist in most subdomains; for example, the UK's National Audit Office has recently said that unless recruitment to computing courses increases dramatically, we face a 20-year wait for enough skilled professionals in the cyber security domain.

So diverse teams perform better, and there are lots of jobs in some parts of the profession at least. Where are the future employees going to come from?

WHAT'S HAPPENING IN SCHOOLS?

There's been a crisis in school computing, which came to a head last year with the Royal Society calling for a major reform of the technical curriculum in their publication **'Shut down or restart?'** The problem is that the nation's school children simply don't know what computer science is. Pupils are taught ICT in schools, which involves spreadsheets, word processing and maybe some database or web design. Computer science – systems, programming, networks and algorithms – hardly gets a mention. In universities we see this at interview every year, and in computing departments across the UK there are freshers wondering what they've let themselves in for. This isn't a problem that's unique to computing (most law students, for example, haven't studied law before they get to university), but coupled with our image problem it has major implications, particularly in terms of gender.

School computing in the broadest sense has seen falling numbers, and not just with women. ICT A-level numbers dropped 34 per cent in 2003–12, and computing A-level dropped 60 per cent in the same period. In 2012 the number of women choosing to do computing at A-level fell to just 297 across the whole of the UK. In most UK university

computer science departments, the student gender ratio is just as bad as that in schools – hovering between 10 and 15 per cent.

COMPUTING CAN BE FUN

Computing can be an incredibly rewarding subject. When you're programming, you're quite literally building things out of ideas, and the sense of achievement you can get from getting a tricky piece of code to work is great. When I'm programming, those 'Aha!' moments are actually quite common. Sure, some of the work is boring, but name a job that doesn't have boring bits. The problem is that our profession is seen by children as a job made up from mostly boring bits.

Another thing we have to get across is that computing isn't just programming. There's system design, algorithms, user experience design, software testing, user testing, technical training, technical writing, networking, user support and helpdesk roles, and lots of other careers. That's before you consider management and analyst roles further up the business tree. Only a handful of these potential careers involve sitting in a cubicle on your own writing code. The vast majority of careers require teamwork, creativity and (dare I say it) social skills.

GIRL GEEKS AND CODER CHICKS

Computing now pervades our lives. Most of us have devices in our pockets that are far more powerful than those used by the computing pioneers of the 1960s. This is a hugely exciting time to get into tech.

Social networking emphasises the computer-as-communication device, and now the gender ratio of computer users, gamer and purchasers is pretty much equal. Indeed the largest growing demographic in computer games is my own (35–55-year-old women). Women are active consumers of technology; we're just not getting involved as creators.

Organisations and events targeted at women exist to try and break this pattern. These can be linked to professional societies, like **BCSWomen** (the BCS group for women in technology) or they can be grassroots organisations like **Girl Geek Dinners** who put on talks and dinners around the world.

There are also organisations aimed at particular areas within computing, like **MzTek** for women interested in computing and art, or **CAS #include** who work to make computing in schools more inclusive. Dr Reena Pau, a member of CAS #include, says, 'we want to offer opportunities for as many students as possible to be able to experience computing, whilst of course realising it will not be for everyone!'

These organisations provide a space for women to meet and network, but they also provide support and mentoring opportunities. School computing is being rejuvenated by organisations like **Computing At School**, and a lot of the big companies are coming on board to help out (Microsoft, Google and IBM have all been sponsors of some of the initiatives mentioned so far).

So there's a problem: to perform at their best, businesses need diverse teams, but there just aren't women coming through the educational pipeline. This is because computing in schools, until recently, hasn't actually represented computing. On top of this, there is a general image problem of the subject as a solo pursuit dominated by men, which means that students looking for other careers – creative, social careers – don't think of applying.

What can you do to help out?

- If you're a manager, encourage your employees to get involved in schools, or, if you're technical, think about helping out in schools yourself. **Code club** and **Computing++** link programmers with schools across the UK.
- Encourage your women employees to get involved with **BCSWomen**.
- If you have a daughter or a niece (or a son or a nephew), think about encouraging them in creative computing. The programming language **Scratch** introduces programming concepts to children from the age of about seven upwards.
- If you're interested in finding out more, the book **Little Miss Geek** by Belinda Parmar is a great introduction to this general area.

In the words of the late **Karen Spärck Jones** 'Computing's too important to be left to men'.

SECTION 2

IT PROFESSIONALS

3 MAGGIE PHILBIN

CEO, Teentech



My career as a technology reporter very nearly didn't happen – in a way that now makes my blood run cold. When a letter arrived asking me to join the ***Tomorrow's World*** team, I hesitated. I'd spent four years working on *Swap Shop*, the BBC's Saturday morning show, and I wasn't sure my informal style was what the producers really wanted. So, unbelievably, I asked for a couple of weeks to think about it.

Thankfully I made what turned out to be one of the very best decisions of my life. It felt like coming home. I joined a programme that was at the top of its game, giving me the opportunity to tell significant stories about science and technology from all over the world. I held the very first digital camera, shared the first experience of virtual reality and had the heart-stopping experience of trying to demonstrate the first voice recognition phone – which of course didn't recognise anything. It was only when I joined the show that I had any sense of just how big the world of technology was, how many different opportunities it held and how very much I enjoyed being part of it.

I'd watched *Tomorrow's World* when I was a child, but although I'd been transfixed by the array of ground-breaking tech from the first home computer to the first hovercraft, I never believed I could ever belong in this world or be anything other than a fascinated outsider. Looking back I can understand why I felt that way. Through the 1960s and 1970s, the programme was not only presented by men, but produced, directed and researched by men. If you watch some of those early programmes on the BBC archive, you'll see how the tech world of that time was very male dominated.

By the time I joined in 1982, it was a different story. Judith Hann had made her mark and so had a very brilliant and talented group of women researchers, directors and producers who made sure there were no careless references to engineers or computer scientists as 'he'. I loved every minute of my eight years on the show: the teamwork, the challenge of explaining really complicated stories in three minutes, the attention to detail and sometimes the sheer sense of relief when we'd managed to get to the end of the live programme without a disaster. We all cared deeply about getting it right.

I'm now asking people who are kind enough to say that *Tomorrow's World* inspired them to work in tech to 'pay it forward' as I still think that, from the outside, most jobs in technology are completely invisible. It's easy to see how young people and their parents have the impression it's all about bashing away on a keyboard, surrounded by people cracking jokes no-one understands. They don't see the team building, risk-taking, creativity and the opportunities. I co-founded **TeenTech** five years ago because I was so frustrated that young people didn't have enough opportunities to see beyond

the technology to the people behind it and the understanding they could be the ones shaping, developing and building the world and our future.

Those young people included my own daughter, Rose, now working with a leading software company, who says that nothing she experienced at school gave her any inkling she would love working in the industry.

It's really Rose rather than me who should be writing this. I'm very proud of her. In an industry where women are very much in the minority she says it's so important to ask for what you want. In the past she's stood up to bosses who told her she was 'too young' to be given the commission she'd earned on a large deal. They backed down.

So I'll take her advice and ask for what I want. Make sure we have real diversity in IT. Pay it forward ;-)

ABOUT MAGGIE

Most people know Maggie from her work on the much loved BBC TV programme, *Tomorrow's World*. She's now presenting *Bang Goes The Theory* and in the last five years she's reported for *BBC Breakfast*, *Inside Out* and *BBC Webwise*, as well as heading up the BBC's Digital Switchover and writing for *The Guardian*.

In 2008 she created **TeenTech**, an interactive science and engineering event for teenagers that was awarded Best Engineering Event by the British Science Association in 2010.

At the **WISE** Awards in 2012, she won the Communication and Outreach category of Women of Outstanding Achievement for her work with TeenTech. In the same year she received an Honorary Doctor of Technology degree from De Montfort University. In 2013 she was given the Promotion of Design Award by the Institution of Engineering Designers for her work as a broadcaster and with TeenTech. In 2014 they invited her to become president, an office she took up in July.

4 ANNE-MARIE IMAFIDON

*Assistant Vice President,
Deutsche Bank; Founder
and Head Stemettes,
Stemettes*



I love working in technology. I love being a woman in tech.

I loved the feeling I got as a four-year-old when I saved my version of *Little Red Riding Hood* on my dad's computer. I also really enjoyed taking his VCR apart and putting it back together. Aged 10, I'd spend hours building websites and putting together clever database schemas to store masses of information. For me technology has always been about solving problems using creativity.

I love the feeling I get when I purchase a domain, publish a new website or finish off an app prototype. It still amazes me that others can visit that domain and see my handy work, or navigate the app without instructions from me. Being able to create new layouts, use colours and play with graphics is a huge part of the experience. There are endless possibilities for the creations you can make.

I love that carrying my iPad and mobile phone with me means that I can work from anywhere at any time. Sometimes no-one knows where I'm sending an email from or joining a call from, and most of the time they don't care. It's only during the times that I'm sat next to a building site that someone might ask, 'Where are you?!' I'm also able to communicate with people in other languages without the need for a translator.

I love working with our social platform at work and the way we've been able to connect thousands of people across the world within our company. These people are able to find information, find colleagues and ask questions so easily using the technology. Some of them have found new jobs, found new passions and discovered new skills using the technology. At work I'm able to regularly create infographics and electronic reports showing the data we collect on the platform — these help decision makers make better decisions.

I love introducing girls to my technology world. I especially love the expressions on their faces as they create their first app or publish their first game. This is made possible by the people at the companies who support my work and the work of **Stemettes** volunteers. It's an incredible atmosphere in the room when Stemettes get together to talk 'Science, Technology, Engineering and Mathematics – STEM' with girls. The project and my career have opened up many travel opportunities for me – trips in London, to Glasgow, Brussels and further afield to the USA – all physically made possible by engineers and technologists. On one occasion I was even picked up by a limo from the airport!

I love the amazing people working in STEM – from those in my team to greats like Mae Jemison, the first black woman in space, to Athene Donald, a senior professor of physics at the University of Cambridge, to tech CEOs like Alicia Navarro, founder of Skimlinks. Many of these people love science and technology as much as I do.

I love that a simple post published on my blog reaches so many people that I don't always know who has read it, why they've enjoyed it or who they've passed it onto. I'm able to connect so easily with like-minded people via my followers on Twitter. I'm kept up to date with former classmates and close ex-colleagues via Facebook. I get daily inspiration and motivation from Tumblr. New notes in Evernote automatically know which meeting I'm sat in. I can keep professional acquaintances up to date with my latest publications via LinkedIn.

I love the technology I carry around with me each day. My Jawbone UP tracks the steps I take and quality of my sleep without intruding on my life. The on-board GPS, accelerometers and gyrometers on my mobile devices help the apps I use regularly to help me. I don't need to carry a separate camera, notebook or torch around each day.

I love being a woman in tech. And most of all I love working in technology.

ABOUT ANNE-MARIE

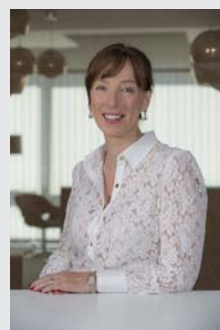
Anne-Marie has always been interested in business, maths and technology. Her rather unique set of achievements include passing two GCSEs aged ten (mathematics and ICT), holding the current world record for the youngest girl ever to pass A-level computing (aged 11), being named on *Evening Standard's* recent list of '25 under 25s' and a *Guardian* 'Top 10 women in tech you need to know', and being one of the youngest to be awarded a master's degree in mathematics and computer science by the University of Oxford, aged 20. She was also named the UK IT Industry and BCS Young IT Professional of the Year 2013, FDM Everywoman in Technology 'Rising Star' 2014 and won UnLtd's Innovation Judges' Choice Award in 2014.

Most recently Anne-Marie is founder of the **Stemettes** project – a bid to inspire the next generation of females into science, technology, engineering and mathematics roles via a series of panel events, hackathons and exhibitions.

More about Anne-Marie: <http://aimafidon.com/about/>

5 TRUDY NORRIS-GREY

Chair, WISE



How did I end up here? Let me start right at the beginning. I was born and brought up in Swansea, one of eight children, and my first proper job was in accountancy. I'd love to be able to say that it was a well-thought out, strategic career decision but, to be honest, my main motivation was the fact that accountants were the only people I knew who had any money – and I hadn't had any of that growing up!

After graduating in business studies and completing my accountancy training with, back then, a tiny start-up company called Vodafone, I moved into the nascent IT industry in the Thames Valley and I've never really looked back. I moved from finance into the male, testosterone-driven field of sales after a senior colleague tapped me on the shoulder and said, 'Why not come over to the dark side?' A move that had its challenges, but the excitement and the explosive rate of change far outweighed them.

While other sectors at the time still seemed to be operating in an old-fashioned way, bound by gender and cultural stereotypes, the tech industry just didn't care where you came from, what gender you were or what colour your skin was so long as you could deliver. Over the decades any gender career barriers there were quickly dissolved, allowing me to journey through a wide variety of companies from Hewlett Packard, to an international role at Kodak in emerging markets, to Oracle at the height of the dot com boom, and on to lead Sun Microsystems for the UK, to where I am today at Microsoft in Central and Eastern Europe.

I've had a great time along the way, I've worked with some excellent people and I've been fortunate enough to enjoy a very satisfying and well-rewarded career. I want the same for other girls and women because this is an exciting industry: it can take you around the world; it is forever changing; it can help change people's lives for the better; it is packed with all sorts of opportunity for those willing to reach out and take it.

The technology industry, like so many STEM-related industries, is short of creative and skilled people. This is why we need to look to the whole range of talent available. I'm keen to encourage girls and women to consider STEM careers seriously for the reasons I mention above. If you think that you don't have the ability, think again! There is plenty of research out there that says that girls and women can and do very well in these subjects and careers – we just, sometimes, need a little encouragement and belief.

Are women any different from men? For sure, I've met a lot of women in my career who are good at collaboration and multi-tasking, essential skills for success, but then I've met a lot of men who are good at them too! I think it's dangerous to indulge in stereotypes because it can end up creating unconscious bias and then you're just back

to square one. We are passed that now. Most careers today demand a wide range of skills, from technical awareness to being able to work in teams with a wide range of cultures and abilities. The technology sector is not about backroom geeks or hard hats; ultimately it is about how we best serve the customer, meeting their broad and diverse needs including raising living standards and well-being.

My advice to anyone considering a career in technology is go for it, believe in yourself, be true to yourself and enjoy the ride!

ABOUT TRUDY

Trudy has a breadth of experience in a range of high-tech industries. Although her career was grounded in financial roles, she has taken on senior management roles that have been client-focused and have had substantial P&L responsibility.

Her career has been with BP, Racal/Vodafone, Digital/Compaq, Kodak, Oracle, Sun Microsystems, BT and Microsoft, operating at senior vice president, president and managing director levels both within the UK and internationally.

Externally, amongst other things, she has chaired the CBI Committee on Innovation, Science & Technology, the UK's **Resource Centre for Women in Science, Engineering & Technology** and **WISE** and is a member of the National Careers Council.

6 REBECCA GEORGE OBE

Partner, Deloitte



I am either lucky or thick skinned. I have worked for two large, international, successful and male-dominated companies – IBM and Deloitte – and have never been aware of any discrimination against me. In fact I have had lots of support, mainly from men I like and highly respect, to develop my career and achieve my potential.

IBM and Deloitte both have a strong track record in diversity and inclusion and there are networks, support and mentoring available. However, it's always a two-way process and you have to learn how organisations work to make them work for you. This includes making sure you do more than you are expected to and have two or three senior people who rate you and will speak up for you.

I also didn't have as much 'choice' as other women. When my sons were one and three we moved to America and my husband gave up work. What started out as a couple of years out while we were abroad turned into a long-term decision and he ended up at home, bringing up our boys. So I was the major wage earner with all the responsibility that brings. I knew my family depended on my income and I worked hard to make sure I maximised that – and IT is a good place to work if you want to earn a good living.

I am also lucky. I have always enjoyed work, the challenge of taking on new things, working out how to solve new problems, working with bright and friendly people, and figuring out how IT can help.

'IT-enabled change' is the phrase I use to describe what I love to do. All organisations rely on IT, and usually the bigger the organisation, the more complex is its IT. All organisations are continually changing – some due to changes outside their boundaries, sometimes because they invent something new. Changes, these days, don't usually happen without implications for IT.

These days, I work with the NHS – an amazing organisation, which is a real asset for the UK. It is huge and complex and not perfect, but delivers healthcare to everyone all day every day. They are going through continual and challenging change, and there is little they do that isn't influenced or impacted in some way by IT.

I have always worked in and around IT, though I didn't have a conventional IT start. I read English at the University of Oxford and then went to America on a Rotary Foundation Scholarship to do a Master of Science in Broadcasting, and I specialised in cable TV and satellite systems. I wasn't ever really technical, I was always more interested in the application of IT than how the nuts and bolts worked. After a few years working in the cable TV and consulting sectors, I joined IBM and ended up staying there for nearly

20 years. I stayed because I got a new role every couple of years, lots of challenges, and international experience in America and Europe. I lead a couple of big IT implementation projects at IBM, but spent most of my time there in a variety of sales roles. I had a very good career at IBM. They are a great employer, with a long and strong tradition of diversity and investing in bringing through leaders. I meet a lot of ex-IBMers in senior and influential roles.

However, I didn't ever want to be a '30-year IBMer' and so seven years ago I moved to Deloitte as a partner. Now, I run our UK public sector health practice and co-lead our global health care strategy. I manage the relationship between Deloitte and the Labour Party. I am also active in BCS. I chair the Policy and Public Affairs Board, and I am a vice president and trustee.

What inspires me about IT? I am endlessly fascinated about how IT can help solve new problems. Right now we are analysing the way that cancer is treated, we run the system that places NHS grads on their work placements, we provide tablets for community nurses to write up their patient notes securely off-line and online as they travel around, we help hospitals work out how to implement electronic patient records. We are contributing to the continual improvement of the NHS and ultimately I hope improving patient outcomes.

ABOUT REBECCA

Rebecca leads Deloitte's Public Sector Health Practice in the UK and is co-leader of Deloitte's global health care strategy. She is responsible for the work Deloitte does with the Department of Health and its ALBs, health regulators and the NHS. She leads Deloitte's relationships with the Department of Health and Monitor, and organisation Deloitte partners with in public sector health and in IT-enabled transformation in health.

Rebecca is a senior business manager with practical experience of managing businesses and improving operational efficiency. She joined Deloitte as a partner in 2006 after spending nearly 20 years at IBM in a variety of roles including sales, business process re-engineering and HR in the UK, EMEA and globally.

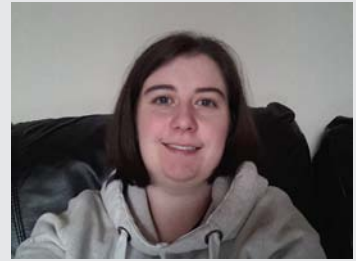
Rebecca has been involved in activities to increase the participation of women in the IT industry since the mid-1990s. She is a VP and Trustee at BCS, where she is a Fellow, and she chairs the Policy and Public Affairs Board. She has the overall lead on inclusivity and is leading a programme to roll out unconscious bias training across the Institute, which she will then take to 29 other professional engineering institutes across the UK. She is a Liveryman at the Worshipful Company of IT.

She was honoured with an OBE in 2006 for work she did for the Government on sustainable communities.

Rebecca is married with two sons aged 21 and 19. Her husband gave up work as an academic in 1995 to be a house husband when they moved to the USA. He has recently qualified as a lawyer.

7 MICHELLE BARNETT

Software Engineer



I had planned to talk about my typical day as a software engineer in this blog, but I started a new job recently, and as I settle in and learn the ropes, I don't really have a typical day. So I thought I'd talk about what made me get into the field in the first place.

I guess I've always had an engineer's brain. When I was about four, some of my favourite books were 'a day in the life of...' books. They were a day in the life of an articulated lorry, a plane, a digger and so on. They told you about how machines worked and what they did every day. When I got a bit older I loved taking things apart and putting them back together, seeing how they fit and how they worked. I liked Lego, but I always preferred Knex and Mechano because you could make more things that moved. My dad and my step dad are both kind of techie too, and I used to help them out from time to time.

However, I suppose my real interest in computing started when I was about 11. My step dad had brought home a *Teach Yourself HTML in 24 Hours* book, and one bored day in the holidays, I picked it up and started, well, teaching myself HTML.

Later, when I got to secondary school, I had a few friends who were also interested in computers, and we used to have fun hacking free javascripts to extend and change them and discovering a program for making 8-bit console style role playing games. Learning to use that program was an exercise in itself because it was translated from Japanese into English by a Russian, so we had to work out how it worked by trial and error. We had a lot of fun figuring it out.

About the time I was doing my GCSEs, we were given a careers questionnaire at school. It asked you to rate activities based on how much you enjoyed doing them and from that compiled a list of career matches. Most of my top-10 matches were computing or engineering related, and it was then that I first started to consider that avenue as a career.

I loved maths and physics so they were obvious A-levels to take. I decided to study computer science at university because I couldn't pick between the two, and it seemed like a good bet to get to use a mix of them.

I loved my degree and I don't think I ever thought for a second that I would do something other than software engineering once I graduated.

And the rest, as they say, is history.

My story is fairly typical. I think most software engineers have a similar start. The big difference is that I'm female. I was never interested in the stereotypical feminine pursuits.

I was a tomboy through and through. If I hadn't been, I don't think I'd have ended up in the job I'm in. No one has ever discouraged me, but all of my drive has come from me pursuing things that I enjoyed. We were never taught computer science at school. I didn't like dolls so I got bought Lego. If I'd been a 'girly girl', I don't think anyone would have ever thought to suggest to me that I might enjoy a career in engineering. It seems that, from the youngest of ages, children are socialised into gender stereotype roles with girls' activities and boys' activities, and it would seem that science, technology, engineering and maths subjects fall firmly into the boys' camp. Girls don't get interested in engineering because everything they see and hear subtly reinforces the message that it's 'not for them'.

Which is why, once a week, I help run a **Code Club** at a local girls' school. From four until five on a Tuesday, I have twelve 10- and 11-year-old girls and it's my job to teach them about coding. They learn how to make games and animations using Scratch, the graphical programming language developed at MIT. They have projects to complete, they gain certificates, and hopefully some of them get interested in programming. I think it's working – one of the girls made a Scratch animation as a birthday present for her mum, another one used the projects as a starting point for her own highly imaginative and ridiculous ideas, which, of course, we encourage. All in all, my kids seem to think that Code Club is cool. They get to be creative, they get to learn useful problem-solving ideas and some of the basics of coding, and most of all, they have fun.

If, in the future, just one of them considers a STEM career, then I feel I will have scored a victory.

That's what we need. More girls to have their minds opened to the possibility that they could have a career in a STEM subject. More girls encouraged to make things, to have fun, to learn useful engineering skills and maybe, one day, we won't need campaigns like this.

8 **MAGGIE BERRY**

*Executive Director for
Europe, **WEConnect
International***



I believe the technology sector is a great place for women to work – technology is everywhere, influencing every area of life and business. It is a huge growth area and I want to see more women succeeding and achieving in technology careers. IT offers such a wealth of opportunity – after all, no sector of industry can survive without technology in some form.

So how can female technology professionals really succeed and achieve? There are the obvious solutions, including working hard to gain a promotion and meeting objectives in order to move into the next pay bracket, but those are just the standard building blocks to career success. Progressing in a predominantly male sector can be challenging, but by utilising the multiple career boosting options available to you, it can really pay off.

NETWORK

Don't underestimate the power of a network. Networking is something you need to do right from the start of your career. It should be part and parcel of your professional life. You can join a professional body (like BCS), a specific network for your specialism, or something locally where you live – and make sure you're part of a women's network too.

With social media tools like Facebook, Twitter and particularly LinkedIn at your fingertips, it is easier than ever to keep in touch with old contacts, friends and colleagues. Your LinkedIn profile is a great tool to showcase your abilities and experience for the business world to see. It also gives colleagues the chance to acknowledge publicly their appreciation of your work by recommending you. Many people have also found jobs through Twitter so ensure you fill out your bio with what you do – and if you're looking for a new opportunity, say so!

Also, remember that your network doesn't just consist of the people you know, but friends of friends and their friends too – think of the 'seven degrees of separation' experiment. The more people you connect with the more doors you could open. Face-to-face networking events are also incredibly useful ways of meeting new people, expanding your network and getting advice from those who may have been in your position before.

MOVE JOBS

Don't be afraid to move positions if the time is right or a good opportunity comes along, and remember that a job specification is just a wish list – aim high. Women often

underestimate their abilities – anecdotally most men will put themselves forward for a position if they tick 40–50 per cent of the boxes, most women will only do so if they tick 80 per cent. As such, men tend to change jobs more often than women, are perhaps more are often promoted above women and enjoy more pay rises – they go after the opportunities.

Recent figures have showed that it may be almost 100 years before we have truly equal pay and it's time for women to play a part in changing that by asking for more. If you don't ask, you don't get.

FIND A MENTOR

Getting regular advice and guidance from a mentor who you trust and respect is a fantastic way to progress your career. Someone more senior than you, who might have once been in your shoes, will be able to offer words of wisdom that may prove very helpful. Even better is finding a sponsor, someone within your company who will root for you, promote your work and push you for promotion.

Women tend to be good at finding mentors, but not so many have sponsors who will speak up for them and actively work to progress their careers. Women can feel quite isolated because they might be the only female in their department or team, so it is very powerful to have people looking out for you. The more people you know in your sector, the more people you can call on for help when you need it.

BE CONFIDENT

Self-promotion is ok. The relatively small number of women working in technology should mean it's easier for women to build a profile, but in reality the opposite is often true. Many women struggle with selling themselves and their achievements; but this is crucial if you want to be in the running for a promotion. Women are much less ready to put themselves forward for promotion – they tend to tell you what they haven't done, and point out the gaps on their CV – which is directly opposite to what many men will do. So make sure you share your successes and believe in yourself – it really is half the battle. Your technical skills will speak for themselves, but to get on you really need to focus on promoting yourself: speak at events, write a blog, provide comments to journalists – take all opportunities to let people know what you're doing.

KEEP IN TOUCH

The technology industry loses a huge number of talented women who find it hard to get back into jobs after a career break. Technology changes so quickly with new releases and new software, which means it is really important to keep your skills up to date. Unfortunately there are no easy answers to being out of the industry for a number of years, and for me this is one of the biggest problems facing the technology profession and its female talent. I'd love to see employers running 'return to work' schemes to help women get their technical skills back up to date after a career break and back into the industry.

MAKE THE RIGHT CHOICES

It might sound obvious, but think carefully about your career choices. Make sure you're working at a company where you're happy. If you want to take a particular career path, choose an employer where that progression is possible and supported. Whatever the culture of a workplace, it's important to be true to yourself. Technology is a great and exciting industry to work in, with so many options and opportunities. You don't have to act like a man to succeed in a male-dominated industry: confidence, self-belief, doing a good job and being seen to be doing a good job are key to successful career progression.

ABOUT MAGGIE

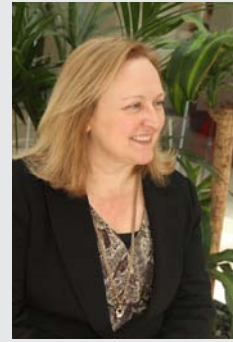
Maggie Berry is the founder of the **Women in Technology Network** and Executive Director for Europe for **WEConnect International**. She has responsibility for the management, leadership and development of WEConnect International's activity in Europe and her role involves developing corporate and public sector support as well as growing a network of majority owned women's businesses across the UK and Europe.

In her 'spare time' she runs the Women in Technology Network, which she set up in 2005 and which grew to a membership of 14,000. She is a Freeman of the Information Technologists' Company and supports many initiatives to increase the number of women working and achieving in technology careers, including **BCSWomen** and **Women in Telecoms and Technology (WiTT)**.

Maggie is also a World Economic Forum Young Global Leader 2012 and a member of their Global Agenda Council on Employment. You can follow her on Twitter: [@womenintech](https://twitter.com/womenintech)

9 HEATHER DUNLOP-JONES

*IBM Distinguished
Engineer, CTO Public
Sector, IBM UK Limited*



So why did I decide to work in IT? Well, it was a pretty pragmatic decision. At the time I graduated, there were thousands of unemployed graduates, and alongside the heady idea of wanting to go wherever my intellectual curiosity took me, future financial security was definitely something to think about. IT appealed because there seemed to be all sorts of people working in the industry – creative brains as well as technical wizards – and it looked like an industry that was always going to be in demand, at least as far as I could foresee. So it ticked all the boxes.

Over 20 years later, this is still the case. The technology is endlessly fascinating and changing, and carefully chosen IT skills give you a relatively secure and relatively lucrative career. The shortage of IT skills is well known, and is not likely to diminish in the foreseeable future. IT research and development continues to generate staggering advances – for example the current developments in cognitive computing and natural language processing are mind-blowing. The commercial field is sufficiently broad that if you get a grounding in what IT can do for a business (what solutions the technology enables, how it enables, what the risks and benefits are), you are then equipped with a tool that's useful for every functional department in most organisations, which is a big market for your skills.

As well as continuing in pure technical IT work, there is the option to move into more application- or business-focused IT work – consulting, business analysis, specialist solution work, service delivery. As well as entry-level developer roles, working as an analyst on an IT helpdesk is an interesting example that has been the entry point to commercial IT for many: you get to know how every department uses IT (and how dependent they are on it when it goes wrong) – it's a window on what IT delivers. The only prerequisite I would say is that you need an affinity for numerate and analytical disciplines.

I really like having contact with IT development labs. Seeing how the scientists work is hugely interesting, as well as impressive. Every time I have visited IBM's labs, I left thinking 'How on earth did they come up with that?' When I get back to the office or work with customers, it's good to have some insight into what went into designing a product I'm working with, and it's always good to know that I can pick up the phone or message the developer or scientist in the lab with a detailed question or with feedback that might be useful.

A COUPLE OF TIPS

Get a mentor – or several. Most successful business people have had a great mentor at some point in the road, and it's no different in IT. There are times when a mentor can

nudge you in a direction you wouldn't have otherwise considered that can turn out to be pivotal, or give you enough confidence to 'do it anyway' – helping you to operate just out of your comfort zone for long enough to make a career change. Finding good mentors can be a matter of luck – I didn't have mentors continuously – and not all mentoring relationships have been especially effective, but it only takes one or two nuggets of gold advice to make it worthwhile. Sometimes it might be a one-off conversation that has been significant.

Think hard and be realistic about IT services work if it involves mobility – I mean the type of work where you move from project to project, which can mean working away from home for weeks or months at a time. This kind of work can be really exciting and builds experience very fast. In fact in most supplier organisations, the big and challenging programmes where you develop cutting-edge skills and really get to understand about IT delivery are almost exclusively to be found in services parts of the organisations. Often the technical leaders in these organisations are either from the services divisions or have passed through them at some point in their career, so it can be a really important part of your CV. Being mobile can also be fun and exciting, but there are times in your life when it just conflicts too much with your personal life. So if you want to become a technical leader in this sense, plan ahead for when and how you are going to fit in this kind of experience.

ABOUT HEATHER

Heather is an IBM Distinguished Engineer who specialises in the application of IT technology throughout the lifecycle of complex IT programmes. Her career spans more than 25 years of involvement with enterprise architecture, solution architecture, design, development, systems engineering, technical governance and design authority.

Her current role in IBM is as CTO for Public Sector, Healthcare and Life Sciences in the UK. In her spare time she mentors, sponsors technical community exchanges within and outside IBM, and dabbles in astronomy. Married with two daughters, Heather is a Chartered Engineer, Fellow of the BCS, and Fellow of the Institution of Engineering & Technology.

10 ELIZABETH SPARROW

*BCS past President; Consultant
and Strategic Advisor*



As an undergraduate in the 1970s I studied maths at Southampton University and took a module in computing, but wanted to pursue something different in my career.

I'd always been fascinated by information – how it's accumulated, managed, retrieved and stored – and decided to take a Master's degree at Sheffield University in information science, an interdisciplinary field primarily concerned with the analysis, collection, classification, manipulation, storage, retrieval, movement and dissemination of information. Little is heard of this term today, but the principles of information science underpin many aspects of today's information society, especially the web and search engines. We studied pioneers such as Karen Spärck Jones, whose main research interests were natural language processing and information retrieval.

After graduation I started work at the British Library, indexing newly published materials, and then moved on to project manage a major database conversion exercise. I later worked in customer support for some of the earliest adopters of computerised library systems and also managed an online information retrieval system.

Early on in my career I realised that I was being labelled. I regularly worked with IT practitioners, but it was clear to me that I was labelled as a librarian. Wanting to expand my horizons, in the 1980s I moved to a Government business that provided furniture, furnishings and a transport operation for the public sector. We served civil servants, local authority staff, ambassadors and spies! I was recruited as a member of the finance division, acting as the liaison with a project developing IT systems for sales, purchasing and warehousing. I was intrigued to find that no one saw me as a librarian any more. I was labelled now as a finance person.

As my career progressed I became more involved in the world of IT, specialising in project management, business analysis and leadership rather than software engineering. For many years now I have been labelled as an IT person, but I have never forgotten those days when I was viewed as someone quite different. My expertise might have grown, but it hasn't changed that radically – just the label people put on me.

I have not, of course, even mentioned the label I have always carried: that of being a woman. I've never experienced losing that label!

Labels can constrain our views of what we are capable of achieving. I saw for myself how meaningless labels can be and how quickly I changed labels when moving from one job to another. Labelling someone as an IT person can be linked to all sorts of negative connotations and stereotypes, which are completely misleading about a field

that offers such a wide range of possible career options and the opportunity to tackle issues that are crucial for the future of our society.

Whatever labels other people might attach to you, do not let them (or the labels you give yourself) restrain you as your career progresses. As Michelangelo said, 'The greater danger for most of us lies in not setting our aim too high and falling short, but in setting our aim too low and achieving our mark.'

ABOUT ELIZABETH

Elizabeth has worked in the IT industry for thirty years, delivering major programmes of change and improved performance in both public and private sectors. She was a senior IT leader in the public sector, managing multi-million pound outsourcing relationships. As IT Director at the Home Office she led a major infrastructure upgrade project and launched an innovative private finance initiative. While at the Crown Prosecution Service, Elizabeth coordinated a substantial change programme involving not only the CPS but also the police service and courts.

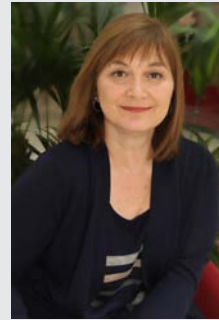
Elizabeth served as President of BCS between 2009 and 2011. She was awarded an honorary doctorate by Kingston University in January 2012 and also by the Open University in 2008.

She has authored two books: ***Successful IT Outsourcing*** and ***A Guide to Global Sourcing***.

From 2011 until 2013 Elizabeth was on the board of AbilityNet. Today she is active in the Worshipful Company of Information Technologists where she is helping to develop their volunteering programme and communications. She also works on publications and publicity for Barts Guild, St Bartholomew's Hospital's League of Friends.

11 SARAH BURNETT

*Research Vice President,
Everest Group*



IT has come a long way from its early days, when it was primarily technology for corporate bean counting, but the mindset and the language of the industry appears to be stuck in the 1970s.

Ironically, it is technology, the product of the industry, that has been instrumental in changing the way that we live and work. Yet, IT continues to fail to connect and appeal to digital natives, the generation whose lives technology has helped change so much – the children who have grown up with the ever-connected internet at their fingertips.

We now live in an era of IT that I call 'humanised'. This presents us with an excellent opportunity to redefine IT, its vocabulary and image, in order to become more relevant to digital natives, including young women who are making their career choices in schools across the country today.

Humanised IT has technology that has crossed over from the consumer world into the corporate world, such as social media, but it has more humanised interfaces such as chat, video and holographic presence. Humanised IT is also about making corporate technology as appealing to users as the consumer apps that they use on their mobiles and tablets. The user experience is overriding in humanised IT and has to be as good as in popular games and other consumer software.

Designing an excellent experience for a software application requires a mindset that rates the creative and visual part of application design as highly as the technology and the logic of the software. Managers with this mindset would bring creative and visual design talent together with good programming logic and problem-solving skills to create outstanding product functionality to gain significant competitive differentiation. This is a change from being mostly technology-led to experience-focused, experience that also addresses business needs.

The new mindset would have managers no longer thinking 'I am developing the next version of the xyz enterprise software', but 'I am going to produce the best ever multimedia work experience'. This would mean extending the types of jobs that are on offer within the industry with new roles and job titles, such as creative directors and 'gamification' specialists.

With a fresh mindset, a new vocabulary and jobs that span the creative and the logical spectrum, IT should become much more relevant to the next generation of workers, including women who might be put off by the current inaccessible jargon that we encounter far too often.

ABOUT SARAH

Sarah is an IT services and BPO sourcing expert with a deep understanding of both the demand and supply side of the market. In her capacity as Research Vice President at Everest Group, Sarah advises clients on market trends and developments and their commercial significance.

Sarah has worked in the IT industry for over 20 years, often in charge of implementation and service delivery, either directly for organisations or on their behalf as an outsourcing services provider. Her roles and responsibilities have included eGovernment program management in the public sector, eprocurement services and application outsourcing in financial services and telecoms sectors.

Sarah is deputy chair of **BCSWomen** and also represents the group on **Tech UK Women in Tech Council**.

12 LOUISE BENNETT

CEO, Vivas Ltd



When I was at school, fifty years ago, computing did not even exist as a university subject or career option, but my very first job introduced me to this new skill.

As a meteorologist I was forecasting locust plagues in Africa. We drew the weather charts for Africa and the Middle East by hand every day from the weather station reports. I suggested we asked the USA to let us have their satellite imagery of weather systems across the northern hemisphere to fill the gaps. This enabled me to write computer models describing evolving weather patterns and forecast where the locusts would be carried on the wind and whether it would rain where they ended up. The rainfall determined if they would breed successfully and enabled us to direct teams to control the pests before the locusts destroyed the crops, so helping to ensure families in some of the poorest parts of Africa did not starve. From that moment I was hooked on the power of computing to solve problems and make the world a better place.

Large-scale modelling is fantastic. It enables you to test theories and answer all sorts of 'what if' questions. What will the effects be if we have a policy to do this or that? You can apply it to anything that interests you. You can look at the epidemiology of diseases and see how you might best control an outbreak of something like foot and mouth disease by seeing all the ways it can be transmitted round the world in the food chain and how you could stop it.

In fact there are many jobs today that you might think do not need people to be familiar with computing, but those are exactly the skills they need. For example, marketing jobs now need people who can analyse the data collected by search engines to decide what products people might want to buy and how to influence the behaviour of different groups of people so that such things as public health awareness campaigns have the greatest impact.

I have been lucky enough to get involved in real-time computing as well as modelling. When I worked at the Royal Aircraft Establishment I wrote the software to run air-to-air and air-to-ground simulators to test out new ideas for how aircraft cockpits should be designed. One of the most exciting challenges was how to design voice-activated commands that would work under all circumstances and could reduce the workload on pilots in highly stressful situations.

It is really exciting when these systems become the normal way of putting in the coordinates for a flight route. This early work has carried on into all aspects of our interactions with machines. Now a machine can take near perfect dictation. Voice

activation can be used by disabled people to control machine assistance and make their lives easier by turning on the lights or a kettle, closing the curtains or calling a lift. There are programs now to do simultaneous translation from one language to another. You name a problem and you can program and control a device to do it for you.

Raspberry Pi is a wonderful way to get in to this new world and experience for yourself the power of computing. See a problem and build the solution. With IT skills you can really make the world a better place.

ABOUT LOUISE

Louise chairs the BCS Security Community of Expertise and Identity Assurance Working Group. She started her career as a scientist modelling weather patterns and locust plagues in Africa. She then moved into operations research and real-time computing for aircraft systems in defence.

Over the last 25 years she has been an IT and R&D director (Thorn EMI, Logica, AEA Technology, Vivas). She has also worked on Government advisory bodies (including the Defence Scientific Advisory Council, the CO ID Stakeholder Group, the ICO Technology Reference Panel and PITO as a non-executive director) and as an expert for the European Commission.

Her consulting focuses on strategic and corporate governance, the exploitation of new technology and risk management. Her latest work includes identity assurance and payments on the internet, developing resilient organisations, from environmental, security and privacy perspectives, including information assurance and fraud prevention.

13 SUE SUMNER

*Global Transform Lead
for Global Finance
Technology and
Solutions, Barclays*



My parents encouraged me from an early age to work hard and helped me to believe that I could achieve anything if I put my mind to it. It was only later in life that I truly recognised this and gained the confidence that I previously lacked earlier in my career.

Looking back, I now realise that role models have had a significant impact on my career and have really helped me to become the successful woman in the IT industry that I am today. It is for this reason that I am passionate about providing guidance and support to women in the career choices they can make. The message I would like to convey is that you don't always need a degree in computer science or have to fit the stereotypical tech-image to have a rewarding and successful career in technology. In my opinion, we need to ensure we provide inspirational role models, male and female, to encourage women and give them confidence to believe anything is possible.

I started my career in customer services at a utility company and at the tender age of 20 I met my first inspirational role model. Wendy was my line manager who had faith in me and gave me the confidence and opportunities to develop as a young working mum. Back in the 1970s the recession had a major impact on the UK job market and many young women struggled to find employment. As one of those women myself, after many interviews, my heart sank as I was repeatedly asked by the numerous HR managers if I had any children. As a mother with a young son, companies were reluctant to recruit a woman in my position and seemed to favour single women over married mothers.

Luckily for me, Wendy broke the norm. She was supportive and even though the HR manager tried to discourage her from giving me the job, she persuaded him that I could be as dedicated as any other single woman with the same experience. Thankfully, things have moved on and interviewers are no longer allowed to ask openly the question about children – and quite rightly so. I went on to have a successful career by securing a promotion very quickly thereafter and eventually became a manager. Ten years later, the HR manager moved on and I reminded him that women with children can be successful and will not always be distracted by family commitments. I have had two further children and maintained my career progression, firmly believing that they are not mutually exclusive and that you can have both. I believe I have instilled this ethos in my children, who have grown into three very independent and successful individuals.

My interest in technology was first born more out of curiosity than design. Being a working mum, I was always looking for ways to make my life easier and quicker and so when the first computer arrived in our office I was immediately keen to get involved. The new technology inspired me to develop a database that improved customer service and saved valuable hours of additional work. Technology was beginning to transform

the way we worked and it seemed like an exciting area for me to get involved in. Many years later I started to get involved in a number of really innovative projects for the companies I worked for. These projects included the first voice-activated system (IVR) for our call centre and the first integrated customer system. This all stemmed from my desire to learn, and after working on these projects I was hooked on how technology could change the world.

I firmly believe that women should consider a career in technology, regardless of their age or what stage they are at in their career. There are so many different roles and opportunities available – the variety is endless and it is so exciting to be at the forefront of technological change and seeing the impact it can have on our daily lives. After many years of working in technology, I still get a buzz from a new system that has been delivered and seeing the benefits it can bring. It never gets boring!

My mission, before I retire, is to help as many young women as possible realise that they can be anything they want to be, ensure they have the confidence to do this and realise that they have a choice. I want people to realise that technology is fun, contradicting the stereotypical view, and use me as a role model to prove that you can have both a family and a successful career in IT.

ABOUT SUE

Sue Sumner is Global Transform Lead for Global Finance Technology and Solutions within Barclays. Her strategic focus areas include driving change to deliver significant cost reduction benefits, innovation in technology and improving IT reliability. Sue has over 30 years' experience in business operations and information technology, having managed many medium- and large-scale business and information technology projects. She has held a number of senior leadership roles working for companies such as United Utilities, BUPA, Heinz and Vertex, and has been recognised for her contribution to change and innovation.

14 SARAH WINMILL

*Director of IT for Support
Services, University
College London*



The arts are seen as an outlet for self-expression, individuality and experimentation; the home for creativity and personal fulfilment. By contrast there appears to be a prevailing public perception that IT provides 'engineer' and 'analyst' careers for those who find socialising uncomfortable and who lack imagination. I challenge all to reframe IT within an artistic paradigm and be alive to the wealth of creative opportunity and fulfilment a career in IT can bring.

The IT industry is perhaps best described as one that empowers and supports the endeavour of others through the medium of information and communications technologies. That IT came to be viewed in narrower terms (the tools rather than the outputs created using them) is, perhaps, our fault as technologists; we have, after all, spent a great deal of time talking about the 'tech'. More creative are the benefits that can be derived using them. Where benefits have been illuminated we are able to paint a glowing vision of possibilities.

I posit that the gap between the vision of possibility and the reality of delivery is evidence of the creative vision and passion of those working within IT and of the current early stages of our technology revolution. The current speed of technical advance is remarkable, but it is the growing overt emphasis on beauty of form rather than just function that increasingly underscores the creativity and passion of technologists.

The artistry of good design is now evident to the consumer, no longer buried within technology only to be admired by other technologists. It is the same elegance of design that, through the most creative coding, improves the performance of our favourite devices or applications. This simplicity and elegance is as self-evident and 'right' to another coder as the quality of a few simple lines from a master artist. As with art, there is a wealth of ways to use a thousand lines, but the one you are instinctively drawn to is the most simple and balanced.

Creativity is not confined to computer coding. As the technology evolves and expands there is an increasing plethora of options in all forms of technology; networking, client devices, integration tools and interfaces, to name a few. I have personally been inspired by the simple elegance of solutions for sending messages between networked devices. Studying data communications I found myself increasingly fascinated by a world of global protocols, peer-reviewed and enshrined in international standards.

I was enchanted by ingeniously simple solutions for avoiding network congestion and ensuring a telephone conversation receives appropriate priority when queuing to go through a network bottleneck, ensuring that modern communications do not suffer the

strangled stuttering conversation of the TV satellite link of my youth. Like so many of the great solutions it goes unnoticed because it 'just works', in the same way that we just use a pencil, never pausing to consider how it works or was made.

I began my personal journey in IT from another creative medium – music. After studying viola at the Royal College of Music I knew this career, probably within orchestras and teaching, was not the creative outlet I was seeking. I began working at the Royal Albert Hall using computers and quickly found myself within a team implementing a key new system. My eyes were opened to the possibilities of technology and the creative challenge of taking that possibility and achieving the best fit to enhance the capabilities of a very specific organisation.

This project was challenging, exhilarating and creative and set my life on a different course. Since then I have relished the challenges of working with iconic organisations to solve difficult problems; installing networks within the scheduled monuments of the Tower of London and Hampton Court Palace without damaging the buildings, or moving equipment and installing cables around the priceless treasures of the Victoria and Albert Museum. Each day has brought opportunities for creativity and a sense of deep personal fulfilment.

It falls to the creativity of the technologist to use their knowledge of the different media to find the most effective, the most elegant path through these myriad choices to deliver their vision of the possible. Like all great art you will know it when you see it and value it highly. IT is the medium and home of the true artists of our generation.

ABOUT SARAH

Sarah joined UCL as Director of IT for Support Services in August 2011. She is also a member of the **UCL 50:50 Gender Equality Group**, campaigning to raise awareness of gender equality at UCL. She is a Chartered IT Professional, a Fellow of BCS and past Chair of the Charities Consortium IT Directors Group. In 2008 she was a Finalist in the Intel IT Leader of the Year at the BCS IT Industry Awards.

15 KATE RUSSELL

*Technology Reporter
and Author*



Thirty years ago today I turned 16. I was anything but sweet. It was 1984 and although the world wasn't the exact dystopian future George Orwell had imagined for us, it felt pretty close at times. Nearing the end of my academic career (a process I had been thoroughly annoyed and often confused by) I struggled to stay out of trouble at an all-girls' school in suburban Hertfordshire, a million miles away from the miners' strikes happening further north.

My school was a comprehensive, but had recently been converted from a grammar school, so still had the faculty and countenance of a stuffy, old-fashioned institution harking back to the days when young ladies were expected to leave school with good manners and an arsenal of domestic skills at their disposal. We had excellently-equipped cookery and needlework labs where I learned to bake a Swiss roll and embroider my name on an apron (presumably in case I ever forgot who it belonged to).

My brother – two years older than me and coincidentally also born on 22 May – went to a mixed comprehensive where he got to study technical drawing and woodwork, although I am reliably informed he could have chosen cookery and needlework if he'd wanted. The point was he got to choose. There was no choice for me. He also got to experience computers, because the school had one (yes, one between the entire school) BBC Micro and a computer hooked up to the Hatfield Polytechnic.

To this day I'm not really sure what that means; what the mysterious Hatfield Polytechnic's mainframe had that needed to be hooked up to, but my brother was pretty impressed as you can see from this **clip of us on a TV game show**. While I languished in endless detentions because I refused to accept that learning to iron was a valid use of my time, he began learning to code. He showed such passion and flair for it that my parents splashed out on a hugely expensive BBC Microcomputer for our home.

That year, 1984, was also important for tech because it was arguably the year home-gaming was born. Elite was a space trading game with simple wire-frame 3D graphics that ran originally on the BBC Micro. I say 'simple wire-frame', but at the time the game was pretty revolutionary in every sense. Until then all you could play at home were rip-offs of arcade titles with gameplay strongly motivated by the coin-drop – in other words getting you to pump more money into the machine to keep on playing.

They were all about chasing a high-score with a number of lives; the average game lasting around ten minutes, fifteen if you were really good. In contrast Elite was an open-ended game, with no score, no levels and no bosses. It had a vast playing area of eight galaxies that you could explore in any way you fancied, picking up missions and earning

cash and notoriety as quickly and as honestly (or dishonestly) as you wanted. They're known as sandbox games today; Grand Theft Auto is a good example.

I remember seeing my brother travel around endless space inside this magical box on the kitchen table, or type in a few commands and have the whole screen fill with the words 'Matthew rules, OK!!' over and over again (despite the fact it clearly wasn't true!), and thinking it must be some kind of witchcraft. I wanted to know how it did it. I wanted to know what else it could do. But more than anything I wanted to play that game, and possibly get better at it than my brother.

At 16 I had discovered my passion. Despite the fact the world still wasn't quite ready for a girl to win at computer games (a notion I took much glee in helping squash during my time writing for games magazines in the mid- to late-1990s), I was lucky enough to have the freedom to nurture and expand that passion in my own time at home. I have my brother and his love of technology to thank for that. I know videogames get a lot of bad press – Grand Theft Auto is also a good example in this context – but for me they opened my mind. It was the first time I felt I had real choice.

I truly believe we learn more if we care about what we're doing. Video games are magical, amazing, enthralling and entertaining. Find the right one for you and it will be the taste that leads to a craving for more. There need to be limits of course – everything in moderation (including moderation as Oscar Wilde once said) – but playing games should never be discounted as simply a waste of time.

Today I read articles and statistics about the lack of women studying and working in technology and I just can't understand it. 'It does not compute' comes to mind as the most appropriate description of the way it makes me feel. If you want to learn to love computers I suggest you pick up a game – as it happens the latest incarnation of Elite is released this year having gained crowd funding of over £1.5 million. Don't worry if you're rubbish; **everyone** is rubbish to begin with. Just let yourself have a little fun. That's how it started for me. If I could have one wish for this month it would be that everybody reading this diary entry learns to play a new game. Just don't get better at it than me.

ABOUT KATE

Kate has been writing about technology, gaming and the internet since 1995 and now appears weekly on BBC2 and BBC World News, reporting for the technology programme *Click*. A regular expert on the sofa at ITV's *Daybreak* and various other TV and radio stations, she also writes columns for several websites and magazines.

Her first book, *Working the Cloud*, was published in 2013. Her second book, a crowd funded sci-fi novel based on the seminal space trading game, Elite, is called *Elite: Mostly Harmless* and came out in 2014.

Kate also speaks regularly at technology events and conferences, and in schools and universities, inspiring the next generation of female technologists. She is involved in UK and global policy meetings to help shape the way the internet is governed. When not writing articles and books she spends (by her own admission) far too much time on Twitter (@KateRussell) coming up with a web recommendation for every occasion – earning her the nickname Kate 'I've got an app for that' Russell among friends and colleagues.

16 SUSAN COOKLIN

Group CIO, Network Rail



I am the Group Chief Information Officer at Network Rail where I am responsible for all the IT services for the railway infrastructure provider and also for shared services, which includes our accounts payable, payroll and a National Records Group in York.

If someone had said to me 25 years ago that I would be running a department of a thousand people supplying software and services to a number of customers and millions of passengers, that I would be sitting on the boards of a building society and a university, that I would have the opportunity to travel globally, I would probably have laughed at them.

At the age of 17 the only thing that I knew was that I wanted to be financially independent. I enjoyed reading and maths. I was an introvert and I didn't like standing up in front of crowds of people and talking about myself. An enjoyable afternoon for me would be sitting curled up for a few hours, reading a Jane Austen novel. However, I had a love of mathematics (strange) and I was given an amazing opportunity in the sixth form of my grammar school to study computing science and economics along with mathematics. That was back in 1978!

I have spent 20 to 25 years in financial services where I was fortunate enough to learn a number of disciplines and have superb mentors (both men and women) and I was given a number of chances where I was dropped in at the deep end. I've run large programmes, big departments and strategic projects. I've always been interested in technology and I hugely enjoy my current role.

If there are young people reading this blog, my biggest piece of advice is be brave. It is a regret that, during my career, I didn't push myself into uncomfortable zones earlier, because that is where I have developed and learnt the most. It is only in the last five years that I have felt confident in talking to large rooms of people.

I fundamentally believe that if we don't nurture and encourage the current 16–24 age group in terms of career opportunities (particularly for women) in science, IT and engineering, then the resultant impact for the country will be dire.

As I reflect back over the last 12 months, I consider myself to have been fortunate to be able to take some of my interests and sponsor a national competition to encourage young women into IT. The '**coulditbu**' campaign, which ran in the last academic school year, resulted in 72 finalists being invited to the Network Rail Headquarters in Milton Keynes for talks, career advice and a range of activities all designed to promote IT as a career for young women. Two weeks ago I had the honour of taking the winner of

the competition and the five runners-up (together with their mothers) out for lunch to celebrate their success.

I shall of course be running the competition again in 2014–15.

ABOUT SUSAN

Susan is a senior executive with extensive experience of leading large and complex change across business and IT teams in global companies. She is currently Group Chief Information Officer and Director of Shared Services at Network Rail, with non-executive director positions on the board of Leeds Metropolitan University and Leeds Building Society. In 2012 she was the only European Finalist for a CIO Innovation Leadership Award from the Massachusetts Institute of Technology. In November 2012 Susan was awarded the UK IT Industry Award for CIO of the Year by BCS and *Computing* magazine. In July 2013 was listed by BCS and *Computer Weekly* magazine as the ninth most influential woman in UK IT.

17 MANDY CHESSELL

IBM Distinguished Engineer



When I was 14, an engineer from IBM visited our school. He explained what he did, he spoke about the IBM company, and listed the great opportunities that it offered, such as working with new technology and travelling all over the world. This really appealed to me because I thought that the world of work was going to be boring.

I selected computer science as one of my options at school, and then applied to Plymouth University to study computing and informatics for my degree. The third year of this degree was a placement in industry and I took a training position with IBM.

This was a great year. I started by building programs for document management and support. I learned how to write in different programming languages, how to build utilities and how to collect requirements. What impressed me were the friendly IBM atmosphere and the level of autonomy I was given to plan my work and deliver the requirements in the way I thought best.

Once I finished my degree, I joined IBM full time.

During the 26 years I have been with the company, I have changed jobs every four years or so. I tend to work on new technology; first as it is being explored through prototypes and proofs of concept, and then turning it into a sellable product.

With each new technology we have to spend a fair amount of time proving the technology works, understanding different customers, and defining the requirements they have for a new product. Often, people do not see the value of new ideas and others are annoyed that you are challenging the existing ways of working. So we also spend time explaining how the technology works and why it is important. Each wave of technology changes what is possible and whom we can serve.

I have been very fortunate to work in these different technical areas; they have allowed me to expand my view of technology and the scope of my expertise.

I did not initially have a strategy or plan to develop my career. I believed that by simply working hard, I would be recognised. This changed for me about 15 years ago when one of the senior directors of IBM explained the IBM career path and asked if I was interested in moving my career forward. I was surprised and thrilled to learn about the possibilities that lay ahead for me, but shocked to discover that my manager did not know I had career ambitions beyond where I was, which meant I was not being considered for the

next promotion. This is an important lesson to learn. No one can read your mind, so you have to explain how you want your career to progress.

Another point to remember is that careers are built on the small decisions you make every day to learn more, work with a variety of people and be excellent in what you do. It is not about the one big chance. Even if a project you are working on fails, it is not the end of your career. In fact you often learn a lot from these projects. Be professional and take every opportunity to understand who uses your technology and how it can be improved. This will give you the knowledge to take the right action and build a successful career.

You can choose to stay safe and do the same job your entire career. I have always looked for opportunities to move jobs within IBM, following our strategy where it is pushing technology into new spaces. As a result I have had a rich and varied career – and the good news is I can see there are many amazing advances in technology on the horizon so there is still a lot more to learn and enjoy.

ABOUT MANDY

Mandy is an IBM Distinguished Engineer and Fellow of the Royal Academy of Engineering. She is known for inventing and implementing tools and practices that have effected a step change in the productivity and reliability of ebusiness application software. Identified in 2000 as one of MIT Technology Review's hundred young people most likely to make significant 21st-century technical innovation, she is distinguished as the first woman to win a Royal Academy of Engineering Silver Medal. Mandy has also published numerous titles, such as her book '*Patterns of Information Management*' on design patterns for better information management and has over 50 patents issued worldwide. More information can be found here: http://en.wikipedia.org/wiki/Mandy_Chessell

18 LYN GROBLER

VP and CIO of Corporate Functions, BP



I am the VP and CIO of Corporate Functions in BP. This is a global role supporting around 7,000 people to deliver IT products and services that allow them to succeed in their daily roles.

At BP I have had a rewarding and fast-moving career in IT. Given the size and scale of the business there are many different opportunities and challenging projects that provide plenty of scope for development. My roles have included heading up Trading IT Infrastructure, delivering IT strategy and running transformation programmes.

There is very little that can function without IT today. Computing and technology is already a massive part of our lives, and as we go forward that influence is only going to continue. The next generation of technology innovators is going to be the people who shape the future. They will dictate how we interact with each other and with the world around us.

IT underpins everything we do in my company. IT allows our traders to trade, our refineries to run, our ships to navigate the oceans and take the optimal routes, our engineers to develop new ways of accessing oil and gas, to analyse and to interrogate seismic data, and our managers to keep track of their teams' development. I get the opportunity to make a difference by solving complex problems, enabling the business to operate, helping people achieve their business goals whilst working in a highly motivated and talented team.

WHY SHOULD YOU CONSIDER IT AS A CAREER OPTION?

You will be helping other people. Technology helps people learn. Working in IT is about helping people work, helping them solve problems. It is about changing people's lives for the better. Working in IT can help people in small groups and at a scale of millions at a time.

It is about being creative and having fun. Technology is about inventing, designing, building and marketing ideas (including yours). It is about seeing something the world does not have today and creating it.

It is about teamwork and problem solving. It is about working with others, collaborating over ideas, working in a team and solving problems together.

Having an opportunity to perform these activities every day at work is extremely rewarding.

MY ADVICE IF YOU ARE CONSIDERING A CAREER IN IT

Don't be put off by computer science and IT subjects at school – they are not always an accurate indication of what a career in IT is all about. Try out a 'learn to code in a day' or 'create an app in a day' course, or learn to program a Raspberry Pi, or get work experience in a technology company or an IT department.

Remember, IT is not just about coding and using complex mathematical algorithms. It can be about application testing, user and application support, helpdesk support, business analysis, system design or project management.

Whatever path you chose you will need communication skills, ability to work as a team and with autonomy.

WHY I CHOSE IT AS A CAREER

I have always enjoyed problem solving and working with people – I like the mix of dealing with the customer and doing something analytical. As a young teenager in a school holiday job at a toy shop I used a computer to manage our stock – I was attracted by the prospect of analysing information that led to increased sales and the ability to stock the right level of goods for our customers. It was satisfying and good business to ensure we had enough stock of the latest craze for kids. So, with a mix of having enjoyed working with computers in a holiday job and doing a careers test that pointed me in the direction of computer programming, I studied computer science after school and went on to be a computer programmer.

THE FUTURE...

IT has moved and developed significantly since I started my career and it is still constantly evolving from one month to the next. This progressive development means we all have opportunities to take on new challenges and learning.

ABOUT LYN

Lyn joined BP's commodity trading business, Integrated Supply and Trading (IST), in 2003 after gaining experience leading large-scale IT projects and strategies within the banking and trading environments in London and South Africa.

Lyn has held various leadership roles in BP including CIO Oil Europe & Finance Trading, Head of Strategy & Architecture and Head of Portfolio Planning in June 2010. She recently became the VP and CIO for Corporate Functions in July 2011, making her the most senior female leader in IT and a Group Leader in BP, with responsibility for the IT strategy and

WOMEN IN IT

capability that supports the operations of all of BP's functions and the alternative energy and shipping businesses.

She is an active advocate of BP's Diversity and Inclusion agenda, leading the global Women in IT group as well as being a sponsor of the BP-wide International Women's Network.

Lyn is currently listed in the latest Cranfield FTSE 2013 Report as one of the '100 Women to Watch'.

SECTION 2.1

ENTREPRENEURS

19 DAME STEPHANIE SHIRLEY

Philanthropist, formerly first woman President of BCS and Past Master of WCIT



In 2004, BCS honoured me with its Lifetime Achievement Award. I'd joined as a student member, upgrading to full member, then Fellow – and later served four years as Vice-President (Professional) helping to get it to chartered status. Then, in 1989, I was elected the first ever woman president. It was a matter of enormous pride for me to head my professional body.

There's now a revival of computing in schools and girls are getting the best marks and dominate most universities. Britain's economy demands that all of us are not just consumers, but also creators of new technologies and applications. I aim to be a positive role model to encourage critical thinking and engineering.

My years in business proved exhilarating – never two days the same, always focused on managing customers and staff, always doing new things and making new things happen.

My colleagues, male and female, have been unfailingly likeable. Generally operating in collegiate mode and learning from each other. And I've been well remunerated – scarcely able to believe how well I was paid for doing something so enjoyable.

I belong to the generation when you needed mathematics to work in software. From being a glorified mathematical clerk at the Post Office Research Station, I moved to work with computers, and it was like falling in love again! I wrote programs in machine code (sometimes in binary) on projects related to transatlantic telephone cables, electronic telephone exchanges and testing the randomness of the special purpose premium bond computer, ERNIE. And no, neither my husband nor I have ever managed to win anything greater than £100!

I started off as a techie but soon found myself much more interested in the social and economic aspects of computing. And I wanted opportunities for women. So I set up a software house, a company of women, a company for women, as one of the first such British start-ups. That eventually employed 8,500 staff of whom 70 had become millionaires – yes, 70! It pioneered distributed computing. People laughed at the very idea of a software house – software was at that time given away free with the hardware. And they laughed even louder at my crusade for women! It was fine as a woman's company until equal opportunities legislation came in and made our positive gender discrimination illegal. As an example of unintended consequences, we had to let the men in (if they were good enough!). Thereon, the company gradually became more balanced between the sexes. Which is as it should be.

My interests were scientific, the market was commercial – things such as payroll, which (apart from the size of some of the files) I found boring. But operations research provided a compromise: scheduling freight cars, timetabling buses, siting oil depots. Who would have thought that the software for the black box flight recorder for the supersonic Concorde would be written by an all-female team?

It's not just the technology. It's about what people can do with it. Entrepreneurs with little or no expertise in technology can create amazing new global companies in this 21st-century new world. The future is limited only by our imagination.

I hope my story will give confidence to women starting out in their careers. A woman can succeed in whatever she wants, provided she accepts the rules of the game and believes in herself.

So, grab the many opportunities that computing offers. There's never been a more exciting career path offering the flexibility valued in women's lifestyles. My unsolicited advice is to

- get trained;
- present yourself at your aspirational level and apply for interesting tasks;
- master finance and marketing; and get international experience;
- think strategically about how you want to spend your life;
- then just go for it.

ABOUT STEPHANIE

Stephanie Shirley is a highly successful entrepreneur turned ardent philanthropist. Having arrived in Britain as an unaccompanied child refugee in 1939, she started what became Xansa on her dining room table with £6 in 1962. In 25 years as its chief executive she developed it into a leading business technology group, pioneering new work practices and changing the position of professional women along the way. She received her Dameship in 2000 for services to IT and the IEE (now IET) Mountbatten Medal in 1999.

She has served on corporate boards such as Tandem Computers Inc., the John Lewis Partnership plc and AEA Technology plc. In 2000 she sponsored the **Oxford Internet Institute**, and was on its strategy board until 2011.

Her charitable **Shirley Foundation** is now one of the top grant-giving foundations in the UK. Her memoir **Let IT Go** was published in 2012. In 2014, she was listed by Science Council as one of the 100 leading UK practising scientists.

20 DR KATE HO

*Managing Director, **Interface3**
and **Tigerface Games***



I remember vividly when I went for one of my first interviews to get onto a 'learn how to be an entrepreneur' programme. At the end of what was a good interview, the head of the programme asked a question that made me incredibly insecure. He said, 'One last thing, when you were little, did you ever have a stall – sell lemonade, or sell comic books, or wash cars?'

I froze on the spot, surprised at the question because, in all honesty, I never was one of those money-making entrepreneurial kids. Truth be told, I wasn't born with some innate ability to create cash flow forecasts or read profit and loss charts. Instead, I was born with a fascination for technology, computers in particular, and specifically programming – a passion that went from being a teenage hobby to an incredibly fulfilling career.

While I was between the ages of 7–14, my family lived in Birmingham. My parents ran a fish and chip shop and the closest I got to a computer was the weekly ICT class where we learnt word processing on old Apple Macs. No one I knew owned a computer; instead, my friends' conversations were dominated by the Spice Girls, Take That and Boyzone.

During third year at high school, we did a module in programming in BASIC. And that's where I got the bug. There's a special 'first time' moment when the words 'Hello World' appears on the screen and you suddenly realise the possibilities of creating anything you like. It's like Lego, but instead of being bounded by physics, you could create flashing lights on blank screens, pixels that become games: I'm sure it's the same wonderment that 10-year-old kids get playing Minecraft.

My parents, who had no idea what to do with a child that was interested in computing, couldn't quite justify buying an expensive computer for me. (Indeed, they didn't do so until I was accepted onto my degree when they realised it wasn't a 'phase' after all.) So I saved up my pocket money and brought a second-hand ZX Spectrum. Borrowing books from the library because internet access was rare back then, I spent my spare time learning to program.

By the time I had to choose what I wanted to study at university, computer science was top of the list. It was a decision that I never regretted: the BSc turned into a Master's degree, and then a PhD at Edinburgh University.

Fast forward to present day. I run a technology business, **Interface3 Digital**, which combines great user experience and the latest technologies to create novel, fun, experiential marketing campaigns. From the gestural-based technology, like Microsoft Kinect, to games on big multi-touch tables, we make apps that help brands engage

with their customers. In addition, we have an education games arm, **Tigerface Games**, which makes games that support collaborative learning and problem-solving skills for 6–11-year-olds. Our games have won the Family Choice Awards 2014, and been nominated in the Best Serious Games category in the International Mobile Gaming Awards.

I love my job. There are tough times, but I wouldn't trade it in for anything else.

As managing director, I rarely get a chance to code. My passion has shifted from writing the code to understanding what should be built: specifically, user experience and business strategy. For things that we build, my role is to work out the business case by balancing potential revenues – How many people will buy this? – as well as production cost – How long and how much will it take to build it? My knowledge of software development means that I can explore possibilities and gauge scope without running to my tech team all the time. This proves invaluable in a fast-paced industry like ours.

Unusually, I'm the sole founder of a tech company. More often than not, I'm the only woman at senior tech events. A few years ago, I remember being invited to a very exclusive dinner, with eight other CEOs of high-growth tech companies in Edinburgh. I looked around the table, and I was the youngest by a decade, and the only woman there.

Sometimes it's tough. Sometimes it's easy to think you don't deserve to be there. Sometimes it's lonely because it's hard to find relatable things to talk about. But times might be finally changing. With the appointment of Marissa Mayer as CEO of Yahoo!, and Sheryl Sandberg at Facebook, we're beginning a new generation of female tech role models that all of us, male or female, can aspire to.

I still love learning new things and brushing up on skills in my spare time, I sneak off to hack weekends to practise. For instance, I won a 'Shakespeare Hack Competition' with an iPhone app, and I also became National Theatre of Scotland's Geek-in-Residence during the latter half of 2013.

Since part of the purpose of this blog post is to inspire others, please allow me to end on this. As the 21st century progresses, there isn't an 'IT industry' any more. Digital technology is already prevalent in everyday life. All industries, healthcare, education, oil and gas, are powered by technology. In no plausible future will there be less technology than there is today. Whereas traditionally the medical or law professions meant a stable career, the reality is that more doctors and lawyers are struggling to find employment. Digital tech, on the other hand, is suffering a skills shortage, lacking people from all sorts of backgrounds to fill our jobs. The notion that the internet is a fad has passed. Alongside it, the notion that the IT industry is only for sad, lonely geeks is gone. It's time we get more people, especially women, involved in the fastest growing industry of our lifetime.

ABOUT KATE

Dr Kate Ho is Managing Director of **Interface3**, which passionately designs and crafts exciting customer-branded experiences using innovative technologies and works with some of the biggest brands in the world including Pearson Education, PBS KIDS, SMART Technologies. In her spare time, she is deeply involved in the start-up scene, writing about start-ups in **StartupCafe**. She is also a semi-keen runner and full-time lifehacker.

21 ELIZABETH VARLEY

*Co-founder and CEO,
TechHub*



Technology is now part of almost everything we do, and it's certainly part of every industry. If you have never thought that the idea of a career in technology thrilled you, what about a career in fashion, sport, education, communications?

All of these industries and many others are now driven by technology in different ways, so focus on what you're passionate about and equip yourself with the skills to become a leader in your field.

Want to be independent? Go your own way? Create something new and exciting? Starting a new business using technology has never been so accessible. From working with start-ups for many years, and founding two companies myself, I've learned some valuable lessons about starting a technology business.

NO-ONE CARES ABOUT YOUR START-UP...

...unless you give them a reason to be interested! The essence of business is communication, and you should always think about your communications from the audience's point of view. Whether it's verbal or written, whether it's a live pitch or a video on your website, whether it's about your product or about your finances, what are the benefits to the person reading, watching or listening? What's your story? Everyone you talk to, everything you write, think: what's in it for them?

TALK ABOUT YOUR START-UP...

...with everyone, everywhere, all the time. The biggest challenge most businesses face is acquiring customers, marketing and gaining market share. Sometimes entrepreneurs are worried about secret ideas and people stealing them, so they start their business in 'stealth mode'. With very few exceptions, I can tell you that someone has already had your idea before. Probably a thousand people have had your business or product idea. But there are reasons why you are going to succeed – drive, skills, expertise. It's all about your ability to execute. The best thing you can do is to create interest in your business or your product right from the word go.

LAUNCH EARLY, ITERATE OFTEN

You won't get it right first time, so do it quickly, learn, and iterate. Your product or service is an infinite process as you review and refine to make sure it's the best it can be. If you wait until it's 'perfect' (which never happens!), you'll miss opportunities, not only to gain market share, but to get immediate feedback from your customers. Having people tell you what's wrong with your creation can be hard, but it's so much better than spending years on something only to have no-one be prepared to part with money to buy it. When you're creating a technology product, a long list of features is really tempting. Find out the core problem you're addressing, focus on that, and your customers will tell you what else they want.

ASK FOR HELP

It's tough starting a business on your own, but other people will give you a hand if you ask them. People can be very generous with their time and expertise, especially other entrepreneurs. You can get a lot of advice and help for free. One of the things I've learned time and time again is to work out what you're best at, and have others do the rest – it saves time and money in the long run.

GET GOOD AT NETWORKING

If you become a hub of knowledge and contacts, people will often come to you when they need a problem solved. You might be able to solve that problem for them, for a fee, or you recommend someone or something else, but either way it adds to your profile as someone who can help others get things done, and that's valuable.

LISTEN TO WHAT OTHERS NEED

Yes, this is about sales. No, sales is not about trying to get people to buy things they don't need. Sales is about solving problems. See above.

BELIEVE IN YOURSELF

This is tough. Eric Ries, the author of **The Lean Startup**, talks about the 'reality distortion field' each entrepreneur creates around them. The more you believe in what you're going to achieve and the more people you can pull into your 'field', the more opportunity you have to get your business off the ground. Remember though, no-one will believe in your product like you will. Get lots of advice and opinions from experienced and successful people, but at the end of the day, go with your gut. It's no fun kicking yourself when you were wrong, but it's even worse kicking yourself when you were right, but didn't follow your instincts.

BREATHE

Starting a business, especially in technology, can take over your life and make you feel like you're always 'on'. Try to make time for yourself and the things you care about, and that includes eating, sleeping and yes, breathing.

ABOUT ELIZABETH

Elizabeth is a communicator, connector and entrepreneur with a background in technology, content and events. She is co-founder and CEO of **TechHub**.

She previously worked with small business advice site Smarta, with Germination on the SHINE unconference for social entrepreneurs, and headed the team for Twestival London in 2009–10.

She ran editorial and content agency Online Content UK for six years, and programmed and produced digital and tech-focused events for Chinwag and NMK. Elizabeth has previously been a judge at GeeknRolla, the Association of Online Publishers Awards, the Information Management Awards and sat on the London College of Communication's Digital Media Advisory Forum.

She is committed to supporting the wider technology industry and was one of the founding steering committee members of the **DigitalEve** women in technology organisation in the UK. In 2002 Elizabeth was a consultant on ITbeat with e-skills UK – a project to encourage girls to get involved in IT and new media.

22 CARY MARSH

CEO and Founder, Mydeo.com



My school didn't allow girls to choose three sciences at GCSE because it was deemed too challenging. The boys across the road could. Luckily for me I had an extremely supportive mother who marched up to the nuns in charge and told them that I would be taking three sciences. In hindsight I realise how lucky I was. My mother was a successful business woman and a fantastic role model.

I took physics, maths and biology at A-level. I came top of the year in physics and my grade A at physics A-level is still one of my greatest achievements to date!

I went on to study engineering at Nottingham University, a degree choice that I know armed me with all the skills to start my own technology business, which I set up while on maternity leave with my first son in 2003. I'm now mum to three boys aged 11, 9 and 4. I doubt they will come up against barriers when choosing their educational options, and I hope that girls these days won't either. But my concern is that the statistics show that there are still not enough girls making science and technology higher educational choices.

As a technology entrepreneur I often find myself at conferences where I am one of only a handful of women among hundreds of men – there's never a queue for the ladies at a technology conference! But when will this change? How do we somehow increase the talent pool of women in technology? I believe we must do this, not just because I know it's a great industry to be in, but because the UK economy will suffer if this underrepresentation of women in these sectors continues.

In India, China and Japan there is far stronger focus on science and technology in education across both genders. We've only got to look at these burgeoning economies, where there is a stronger cultural science and technology focus and corresponding better gender representation, to realise something will need to change here in the UK if we want to remain competitive on the global stage.

We must work to dispel the bad image STEM careers still have (geeks, nerds, white coats, hard hats) that put young girls off choosing science and tech at GCSE, A-level and above. We must create role models and mentors who girls will aspire to be like. Right now it's usually a model, a pop star, an actress – why not a science or technology entrepreneur?

Every one of us can think of a person we wanted to be like when we were young. For me it was **Martha Lane Fox** running a dot com tech start-up, getting rich and being on the cover of magazines. How cool was that!

One of the wonderful things about the technology sector I work in is that everyone is judged on their own merits without a thought given to gender, race or age. This is nothing like the young, male 'City' culture and I'm proud to be part of it! It's a wonderful sector to work in and if more young girls knew that, we'd eventually see more women in top technology jobs, contributing to our economy and influencing the next generation.

I therefore find myself with not only the opportunity, but the duty to inspire and influence young girls to consider science and technology career choices. That's why I'm a big supporter of the **WISE** campaign, why I spend so much of my time as a **STEM ambassador** visiting schools to tell girls that technology is awesome, and why I'm supporting the BCS campaign.

ABOUT CARY

Cary is CEO and Founder of **Mydeo.com**. Having graduated with an honours degree in manufacturing engineering from The University of Nottingham, she launched Mydeo in 2005 following a DTI Research and Development grant for Technical Innovation. She was awarded the inaugural Iris Award at the NatWest Everywoman Awards in recognition of her business success through effective implementation and use of IT and communications. She was named UKRC Woman of Outstanding Achievement 2011 winner for Entrepreneurship & Innovation, and was the Breakthrough Pioneer award winner in *Red* magazine's Hot Women Awards 2011.

Cary regularly speaks at events as a **STEM ambassador** about her passion for getting more girls interested in science and technology. She is a board member of Cancer Research's 'Women of Influence' campaign, where influential businesswomen come together to help beat cancer by supporting world-class women in science.

Cary is mum to three boys.

23 KATHRYN PARSONS

Co-founder, Decoded



Technology is everywhere. It underpins just about everything we do. It affects every single industry, every sector and every level of hierarchy in every organisation. And it's the most exciting place to work at the moment.

There are a lot of misconceptions around what technology is and what skills you need to be good at it. If you ask women, particularly young women, what a technology company looks like, that picture might look very male and it might also look slightly daunting.

At Decoded, our mission is to spread digital enlightenment and empowerment. We are lifting the bonnet and showing what goes on behind the screen, proving that anyone and everyone can be part of the world of technology.

Interestingly, it's very much a 50/50 male to female ratio that has come through our doors. There is clearly a desire amongst women to embrace these skills, yet statistics show that the number of women actually choosing to enter the technology sector is very low. This 'opting-out' starts with the choices they make early on at school around STEM subjects – right through to career level.

The skills required to be a coder or to be digitally literate are not exclusive to men, yet for some reason women are not being attracted to the profession. The idea that technology is more suited to men is nonsense. It's about confidence. Women tend to say, 'My brain doesn't work that way', or 'Don't you have to be good at maths and engineering to master this?' You never hear men say this sort of thing. A lot of digital roles require creative, collaborative skills, being a logical thinker, a problem solver – being able to understand technical concepts and communicate them. These are often considered typically female skill sets. They are now also globally sought-after skill sets.

I think positive role models can help attract more women to the profession in terms of showcasing just how flexible, creative and lucrative a career in technology can be. It's such an exciting place to work and is evolving quickly. If you are a bright, ambitious and technically literate person, then there are a wealth of opportunities available in a fast growing, innovative global job market. Technology is totally changing huge businesses. It has a broad application across all industries: from the team at McLaren to fashion and retail, every industry is now digital. Why wouldn't you want to be at the absolute leading edge of technology, to be part of something that is globally so hot right now and affects everyone's lives and businesses?

WOMEN IN IT

I've always been passionate about languages. I studied Latin and Ancient Greek at university and before that Japanese, Mandarin and French, amongst others. My digital journey began when I graduated. I worked in advertising before setting up my first business working with brands to create digital content, virtual worlds and innovate at the cutting edge of the technology.

This was when I realised that I wanted to understand the languages behind the screen. Without that understanding, how could I confidently innovate, cost, recruit, create or even have a conversation with someone about the work I was doing? It seemed that you had to be a genius to understand coding, but I didn't want to think of it as a dark art. I wanted to demystify the languages behind the screen for anyone and everyone.

At the time Code in a Day was considered impossible, even unnecessary. It's been an incredible journey in the past few years. There is an acceptance that we now need to understand the digital world, take away the smoke and mirrors and embrace digital skills and literacy at every age, from board level to the school curriculum. Now we are expanding that journey to the worlds of data, cyber security and beyond.

ABOUT KATHRYN

Kathryn is co-founder of **Decoded**, a company that is helping businesses be more digital by teaching individuals how to code in just a day. Launched in 2011, Decoded is growing fast, and now has offices in London, New York and Singapore.

24 GILLIAN ARNOLD

Director, Tectre



For the last fifteen years, I have been aware that one of the understated problems that makes it difficult to retain women in technology is the gender pay gap.

Some years ago a woman from the equal opportunities team ran me off the figures specific to IT. At a time when the UK average pay gap was 17 per cent it was horrifying to find that the gap for women working in tech was nearer to 23 per cent. Horrifying because there was no obvious justification. Technology careers do not require workers to lift anything heavy, so the male physique does not confer any special advantage. Nor do the fellas have the monopoly on intellectual prowess, since women come out of the UK's universities with some of the best qualifications.

This week I needed to check that there had been no significant change in the figure. I noted that the Office for National Statistics now suggest that the pay gap for women working in programming, data and so on is 27 per cent. The thought that we in the UK IT industry reward a man 27 per cent more for the same work is truly shocking. That means that a salary of £40k for a man would be less than £30k for a woman for the same work and equal skills, and this over a working lifetime could equate to a third of a million pounds, not to mention the detriment to the pension.

For me, 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. I have absolutely no doubt that the leaders of HR departments and payroll managers have full awareness of the problem and are not doing anything about it because of the impact on their bottom line. They fail to see that, when a woman leaves their organisations, she takes with her the skills that have been bought at some cost over the duration of her employment. She also leaves a gap that needs to be filled, usually incurring significant recruitment and retraining costs.

It really is time that the Government mandated gender pay audits across the UK's industries, starting first with those organisations and institutions that have been found errant in employment tribunals within the last five years. It is time that we complied with the law (which is over three decades old) that says that we should reward equal work equally. Once we do this, the technology industry can prove to other industries that we are forward-thinking and fair to all of our workers.

ABOUT GILLIAN

Gillian has extensive experience in the IT industry and set up her own IT services and staffing company, **Tectre**, in late 2009. Most of Gillian's early career was spent working

for IBM in the UK and she held customer-facing technical, sales, business development, strategic marketing and consultancy roles. She proved her expertise in managing and establishing teams for new software and hardware products, building teams with cross-industry and cross-platform experience across the UK and Europe.

Gillian has a long involvement with work for women in IT, supporting both industry and academic institutions in their work on diversity. She currently sits on the board of directors for **WISE**, the UK organisation that supports women in science, engineering, technology and maths. Gillian is chair of the BCS group **BCSWomen** and is driving the BCS initiatives in support of women in the technology sector. Gillian won the 2012 Cisco / Everywoman In Technology Award for Technology Inspiration of The Year.

25 EILEEN BROWN

CEO, Amastra



I thought that computer studies were boring when I was at school. I did not care about the history, concepts or functions. Perhaps I had an uninspiring teacher; perhaps I was influenced by my friends – away from technology – towards other topics.

I passed the computer studies O-level and pursued my dreams of joining the Merchant Navy. I was far away from technology in the early 1980s. The satellite navigation system had an accuracy to about 1.2 miles, and we had to rely on visual positions and radar fixes.

I hung up my seafaring boots and came ashore. I took a job in a shipping company as a containership planner. The job involved placing the containers so that they would be easily accessible for discharge in each port and make sure that there was enough space to back load cargo for ongoing destinations. It was a manual job in the early 1990s with pen and paper, faxes and telexes.

If the ship was delayed by one day due to bad weather, she would be late in port. This means that she would be one day late in every following port around the world. Containers would arrive at the docks too early and shippers would call to collect their cargo on the wrong day. The vessel schedule was of paramount importance so one day a week we would collate all of the telexes from vessels in port, rub out all the pencilled-in dates and write in the new schedule for telexing to each of the agents around the world. It was a pain and a waste of a day.

There was a stand-alone PC in the corner of the office and I started to tinker with its programs. I worked out that I could use Lotus 123 to update the ship schedule automatically and accurately. Scheduling Tuesdays would never be the same for me. I now had hours of extra time...

...for a while. For this 'innovation' I was transferred into the data processing team. 'You seem to be able to understand what they do and explain it in English', they said.

I loved it. Soon I was helping to migrate from PROFS mail to MS Mail 3.2, then I upgraded the Novell network to Windows NT 3.51, and Windows 95. I loved the challenge of trying to get things to work. I felt like this was a job I could take to new heights.

And I did. I left the shipping company to become a Microsoft Certified Trainer at a training centre in London, consultancy at HP, enterprise presales at Microsoft, management of the IT Pro Evangelist team at Microsoft where I drove forward the adoption of social media tools to connect with the technical audience in 2005. I now run my own company

offering strategic advice for companies that want to make sense of social media and adopt social business methods inside their organisation. My deep technical knowledge holds me in good stead for technical conversations from clients and I still love to tinker with new gadgets and devices. Once a geek, always a geek.

So whilst I have no formal IT degree, I have something that every employer desires when interviewing a candidate for a role. Passion. I have a passion for technology gained at the sharp end, under desks, behind servers, amidst packaging and online. I have changed my career several times and have ended up doing a role that I utterly love.

My career started in the non-technical world and I'm now at the cutting edge of new social technologies. I made my journey from ships to chips. How will your own career story end?

ABOUT EILEEN

Eileen is CEO of **Amastra**. After 10 years in the Merchant Navy as Shell Tanker's first female deck officer, Eileen managed a fleet of containerships, moved into IT support, then training and management at a certified provider in London, consultancy at HP and manager of the IT Pro Evangelist team at Microsoft.

Eileen is a well-known international speaker on social media, online branding, crisis management and an advocate for the advancement of women in technology.

Eileen is a member of the IoD, BCS and a fellow of the RSA. She founded the **Connecting Women in Technology Network** and chairs the **TechUK Women in Technology** committee. She is part of **BCSWomen** and sits on the BCS Essex Committee.

She writes the social business column for ZDNet and is the author of **Working The Crowd**. She writes a successful **blog** and can be found on Twitter, Facebook, LinkedIn and Google+.

SECTION 2.2

ACADEMICS

26 PROFESSOR DAME WENDY HALL

*Professor of Computer Science
at the University of Southampton
and Dean of the Faculty of
Physical Sciences and
Engineering*



I was not always passionate about computing. I started my academic career as a mathematician and hated computing while I was doing my first degree.

It was the 1970s and computing was all about using punched cards to write FORTRAN programs. I gave it up as soon as I found out the course was non-examinable! However, my career took a new turn in the 1980s when I was a lecturer at a college of higher education training the next generation of mathematics teachers. The first personal computers were just hitting the market, and the college had bought a Commodore PET. Because I was a mathematician they asked me to set up a new computing course. I took the Commodore PET home for the summer vacation and taught myself BASIC.

Over the next year, I became fascinated by how these new machines could be used in education, particularly when it became apparent that we would be able to interact with graphics, photos, audio and even video on computers. I did a part-time masters degree in computer science and took a new job back at the University of Southampton, but this time in the Department of Computer Science, and the rest as they say is history.

Within a year or so of my move back to Southampton two things had happened. Firstly, I became very aware of the lack of women interested in computing because we had so few female undergraduate students on our computer science degree. Secondly, I started to experiment with the development of multimedia information systems. I quickly moved on to be interested in hypermedia systems and spent a wonderful six months sabbatical at the University of Michigan in Ann Arbor developing new ideas in this area.

On my return to Southampton, I established myself as one of the few multimedia experts in the UK and began work on the Microcosm hypermedia system that was to lead to so many exciting career opportunities for both myself and my team. At the same time I was working with local schools to try to encourage more girls to study computing, and networking with women in computing at other universities to share ideas about how best to do this on a national scale.

In 1994, I was promoted to full professor – the first female professor of engineering at the University of Southampton – and I realised that the time I was spending on ‘women in computing’ activities was putting me at a competitive disadvantage with my male colleagues. I decided to focus on my research and the launch of the new company that we had set up to exploit the results of my group’s work. In 1996 I was awarded a five-year EPSRC Senior Research Fellowship. These were like gold dust in the UK at the time because only three were awarded each year across all the engineering and physical science disciplines.

During my fellowship, I built up my team and the department at Southampton, and became established as one of the top computer scientists in the UK. My work increasingly focused on the development of the web and in particular the semantic web. Honours and awards followed. In 2002 I took up the position of Head of School at Southampton and was elected to become President of BCS in 2003–04. I had made it! So now it was time to give back.

The situation regarding women in computing in the UK was no better in the first decade of the 21st century than it had been when I started in the 1980s. Despite numerous initiatives, the number of women studying computer science at university, including Southampton, was, and still is, pitifully small, and the latest research indicates that the percentage of women working in IT is falling rather than increasing.

While I was President of BCS I was instrumental in establishing the BCS Women's Forum, the work of which is now being carried forward as part of the BCS Policy and Public Affairs Board in the capable hands of **Rebecca George**. While I was President of the ACM from 2008–10, I was able to establish **ACM-W** councils both at main board level and in the regional councils. I currently chair the **Diversity Committee of the Royal Academy of Engineering**. So I've not stopped working to try to improve the situation.

But being a good role model and mentor is not enough – it doesn't scale. We need big initiatives that are sustainable over a long period of time. We need to excite young people today, particularly girls, by inspiring them with visions of the wonderful careers they can have and how they can help society if they embark on careers in computing or IT. We need to engineer a culture change in our industry to ensure that, as it evolves, it attracts a diverse range of people to work in it, including as many women as men.

When you consider the increasingly amazing applications of IT in areas that traditionally attract women, such as medicine, education and the entertainment industry, and the fact that now as many women as men interact with computers through the web, this should not be difficult to do. But it will take a sustained effort by all concerned – men and women alike.

My term of office as Head of School finished in 2007 and after a wonderful few years returning to research to establish the discipline of web science and set up the **Web Science Trust**, I became Dean of Physical Science and Engineering at Southampton. Yet again I became responsible for student recruitment and trying to encourage women to apply for science and engineering degrees. It has got no easier.

My term of office as Dean is now coming to an end and I am looking forward to engaging with several new projects, particularly our web observatory project that is aiming to establish a global forum for sharing datasets and analytical tools to support web science research. I am enjoying my role in the development of international policies around web and internet governance. This is such an important area for the whole of society going forward. I am still very motivated to explore new ideas and to translate them into practical solutions for the commercial world.

Web science attracts as many women as men because it is so interdisciplinary and tackles global issues at the interaction of society and technology. Also, as I travel round the world, visiting universities in many different countries, I see women just as

eager to learn about computing as men – particularly in India and south-east Asia. This reinforces the hypothesis that the lack of women in computing in Europe and the USA is a cultural issue and not genetically determined. Our industry is one of the most exciting it is possible to work in. If I can make a difference by encouraging more women to realise this, then I will feel I have achieved something.

ABOUT WENDY

Dame Wendy Hall DBE FRS FREng is a professor of computer science at the University of Southampton, and Dean of the Faculty of Physical Sciences and Engineering. With Sir Tim Berners-Lee and Sir Nigel Shadbolt she co-founded the **Web Science Research Initiative** and she is currently a director of the **Web Science Trust**.

She became a Dame Commander of the British Empire in the 2009 UK New Year's Honours list, and was elected a Fellow of the Royal Society in June 2009.

She was President of the ACM from 2008–10; the first person from outside North America to hold this position. Other significant posts include Senior Vice President of the Royal Academy of Engineering, member of the Prime Minister's Council for Science and Technology, founding member of the European Research Council, member of the EPSRC Council, President of BCS and EPSRC Senior Research Fellow. She was Chair of the European Commission's ISTAG 2010–12. She is a member of the World Economic Forum's Global Council on Robotics and Smart Devices.

27 DR SUE BLACK

*Founder and CEO,
Savvify 'Engage
Enlighten Inspire'*



I left home at 16, moved to London on my own at 17, and by 23 I was married with three children. Possibly not the best way to start a career in tech, but I got there eventually. Unfortunately my marriage broke down when I was 25 and I ended up a single parent with three children living on a council estate in Brixton.

I was worried about how I would manage to provide for my three children on my own. I didn't have a well-paid job I could go back to, so what should I do?

I decided that I needed to get an education. I studied maths at night schools and then went to South Bank University to study computing. That went well so I went on and did a PhD in software engineering looking at an area called impact analysis. I wanted to work out how to provide useful information to software engineers maintaining large, millions-of-lines-of-code software systems. I reformulated an algorithm and produced a prototype tool in C, which computed the 'ripple effect' metric, a measure of how a change made to a system would ripple across and cause side effects.

While I was working on my PhD I applied for a full-time lectureship, which I got and started a full-time career in academia. I became a course leader, taught thousands of students and got promoted to senior lecturer. I then applied for a post as reader focusing back on research. I loved teaching and research, and still do.

After a few more years I applied for a head of department role at University of Westminster and was head there for nearly four years before moving to UCL as an honorary research fellow. While at UCL I realised that what I really wanted to do is to get as many people as possible excited about technology and all its benefits.

Technology can open so many doors – from a basic understanding of email, writing documents and spreadsheets through to app design, web design and social media. The possibilities for someone who is tech savvy as opposed to someone who is not are very dramatic. My love of technology has led me to set up an organisation focused on getting people excited about tech. That organisation is called Savvify and our first initiative is called **#techmums**. We are currently on a mission to get the world tech-savvy, starting with mums. We believe that 'educate a man and you educate one person, educate a woman and you educate a nation'.

We believe that if we get mums tech-savvy, they not only help themselves, but will also teach everyone else around them how cool tech is.

I'm writing this sitting at the United Nations HQ in Geneva. I'm here for **Girls in ICT Day 2014**. There are lots of initiatives around now to support and encourage girls and women in tech. There is a skills shortage in this area and there are so many exciting fields in tech to work in. The time is ripe to get out there and get yourself a career in technology. Tech is going to change the world for the better. Be a part of that change :)

ABOUT SUE

Sue is an accomplished academic manager and researcher with more than 40 publications and a PhD in software engineering. A visionary leader, radical thinker and international public speaker who excels at bringing people together to solve complex issues, she is well known for online and off-line activism around women in tech and **Saving Bletchley Park**.

Sue is currently focused on getting the world tech-savvy starting with mums and writing a book about the campaigns to save Bletchley Park. <http://about.me/SUEBLACK>

28 PROFESSOR LIZ BACON

*BCS President; Deputy
Vice-Chancellor,
University of Greenwich*



Keeping pace with the change of IT is like changing the pipes whilst the water is running. IT has such a breadth of fields; I find it distressing when IT people are stereotyped as the nerd in a corner with poor communication skills and so on.

That said, I have to admit I love programming; there is nothing more frustrating when your code doesn't work and nothing more satisfying when it leaps into life. However, I love all the other bits of IT too.

So how did I end up in the most interesting and fascinating job ever? I put it all down to one very significant cup of tea.

IT was actually something I drifted into. It sounded vaguely interesting at school but I didn't really know much about it. A careers teacher pushed me into applying, reluctantly, to study in higher education. I was all for going to do a one year course at a local college and then head off to the world of work, being rather fed up with education by the age of 18. I applied to five institutions, and got accepted at all of them – but how to choose? The interview process in those days was far from the dizzy fanfares of today. One of the interviewers gave me a cup of tea and therefore seemed friendlier than the others – choice made. Turns out to have been the most significant cup of tea of my life!

I expected to complete my degree and head off to start my career in industry, but during my final year, my tutors persuaded me to stay on and do a PhD. Not something I'd ever thought of doing, but I was interested to learn more about artificial intelligence and so was eventually convinced that life wasn't worth living unless I did one.

During my PhD my supervisors regularly threatened to send me to conferences to talk about my work. Being of a relatively shy disposition at the time, the thought of presenting my research to an audience of a few hundred intellectuals was utterly terrifying so I took up the offer of some part-time teaching to get some practice in.

Once I'd got over my fear of public speaking, I discovered I loved the teaching – I don't think my mum could ever reconcile this career move with the shy kid she knew. I got to teach a wide variety of computing topics and, given the rapidly changing technology, there was never a dull moment.

As a result of that cup of tea, I have spent my entire career in academia and at the same institution. Not something I ever expected to do. I'm currently a Deputy Pro Vice-Chancellor at the University of Greenwich and one of my key roles is to lead the university through the revolution of technology-enhanced learning – a currently exploding area.

During my time at Greenwich, I also spent 11 years as Dean of the School of Computing and Mathematical Sciences.

So where has all this IT taken me?

Well first of all, around the world. I give talks on my research all over the world and have spoken about the shortage of eskills, and in particular the lack of women in the field, to many audiences including MPs from all over Europe. In addition, we run degrees in my computing discipline in over 20 countries and as a result I've visited Malaysia, Hong Kong, Singapore, Zambia, Botswana, South Africa, Syria, Bahrain, China, India and Trinidad & Tobago (which was incidentally where I met my wonderful husband). I'm also involved in European accreditation of informatics degrees, which has taken me as far away as Kazakhstan.

My job contains such variety it is impossible to get bored. In one week I can be sorting out a distressed student, commercialising a research output, planning a mentoring scheme for our students with employers, and working with numerous external bodies such as the Council of Professors and Heads of Computing (for which I'm a past chair), attending PICTFOR (all party Parliamentary Internet, Communications and Technology Forum), e-skills UK, the Science Council etc.

I've been involved with BCS for many years, which has been a fantastic experience. I've met so many people and learnt so much. I was Chair of the BCS Academy of Computing, which has done so much to help change the ICT curriculum in schools to focus more on computer science. As current President of BCS (2014–15) I am keen to do more to support the profession.

So, my message to all the women out there is don't think IT is only for men, take a closer look, it's got such variety – something for everyone – but beware of that innocent looking cup of tea, you never know where it might lead!

ABOUT LIZ

Professor Liz Bacon BSc PhD CEng CSci FBCS CITP FHEA is a Deputy Pro-Vice-Chancellor at the University of Greenwich with a university-wide remit leading the development of technology-enhanced learning. She is President of BCS, a past chair of the BCS Academy of Computing and the CPHC (Council of Professors and Heads of Computing) national committee. She has been involved in many professional activities during her career, including working with e-skills UK, the Science Council, Parliamentary IT Committee (PITCOM) and EQANIE (European Quality Assurance Network for Informatics Education). Liz is a co-director of the eCentre research group and has been involved in elearning, software engineering, and crisis management research for more than 10 years. She is an experienced systems designer and developer, with the bulk of her research and practice activity being directly industry-facing, through knowledge transfer and consultancy.

29 DR HANNAH DEE

*Lecturer, Aberystwyth
University*



I've been to loads of 'women in tech' conferences (indeed, I organise the UK's main conference for women computing undergrads). I've also been to loads of ordinary conferences, both academic and industrial.

I'm involved in recruitment and careers support for graduates. And I'm kind of opinionated. So when I was asked to write a blog post I thought I'd try and distil some advice, from careers panel sessions, how-to events, recruiters, and my experience of nearly 20 years in the technical world.

TIPS FOR MEN IN TECH: HOW TO MAKE THINGS MORE INCLUSIVE

Think about your language and your examples. Don't, when commenting on code, assume all future readers are going to be guys. Don't, when addressing a room full of techies, joke about programmers needing to get 'a girlfriend'. **If you need an example image, try to find one that isn't from pornography.** And... this really shouldn't need saying... don't make rape jokes in conference presentations.

I've personally seen all of these things in 2014, and we're not even halfway through the year yet. Most women in tech have developed fairly thick skins about this stuff, but you know what? We shouldn't need to. Using non-gendered language is easy. Choosing examples that don't involve semi-naked women is easy. These are tiny, baby steps that everyone can make, which will help the profession as a whole become more inclusive.

If women in tech are telling you there's a problem, then listen. I lose track of the number of times I've seen someone called out on some kind of sexist behaviour (from occasional use of gendered language to outright sexual harassment), only for the person calling out the sexism to get shouted down by a gaggle of self-righteous internet commenters. Conferences should have a code of conduct, with clear instructions on what to do if sexist or harassing behaviour occurs – there's a good example code at <http://confcodeofconduct.com/>. But on a smaller scale? Just listen to what women in tech are saying.

Realise, when you're dealing with women in tech, that they've probably experienced some form of sexism recently (and realise that an attack on sexism in technology is not an attack on men). It's nothing special about tech. It's structural – it's been shown mathematically that in gender imbalanced groups, even if both genders are equally biased, the minority gender is going to be on the receiving end of more gender-biased behaviour.

If we assume for the sake of argument that 20 per cent of men are nasty to women (sexist), and 20 per cent of women are nasty to men in return, then, given the imbalance between the sexes in our field (let's call it 20 per cent), you can mathematically prove that the women will be on the receiving end of 16 times as many sexist remarks. This argument has been called The Petrie Multiplier, and it holds in general, with a gender ratio of 1 : r , women will receive r^2 times as many sexist remarks as men. More on this can be found [here](#).

What The Petrie Multiplier tells us is that, even without signing up to ideas of privilege, or intersectionality, or any of the other tenets of modern feminism, we can expect an uneven balance of bias within jobs where there's a major gender imbalance. I suspect that male primary school teachers have a hard time for similar reasons.

Realise that getting more women in tech is good for all in tech. Working in a masculine monoculture isn't good for guys either. Sure, you might like working in an office where there's a *Playboy* centrefold on the wall, but wouldn't you rather have some actual women to talk to? On top of this, it's been shown that diverse teams perform better. It's not that we women in tech have got magic business ovaries or anything, it's just that teams perform better when there's a range of opinions feeding in to the decision-making process. This is not some kind of left-wing conclusion drawn by a collective of sociologists wearing dungarees, it's business – check out the McKinsey report, **Women Matter**.

Understand the power of positive role models and examples. For the women in tech that are around, it's great to see other women in tech doing well and getting a platform. There might only be a small percentage of women in tech, but we are here, and we're more than 1 in 10. So if you're putting on a conference or speaker programme and 17 per cent of your speakers are women, then you're making a good start. If you've got an all-male line-up... then ask yourself why this might be, and try to find a woman or two to contribute. We're not that hard to find – and if you're stuck, ask **BCSWomen**.

TIPS FOR WOMEN IN TECH: HOW TO HELP YOURSELF GET ON

Understand the power of positive role models and examples. This can work for you – it can help your confidence to find some women in tech you can look up to. Get yourself a mentor, go to events with women speakers like the **BCS Karen Spärck Jones lecture**, read writing by senior women in tech like **Sheryl Sandberg**. You won't agree with everything they say, but that's fine: just listen to and read about some awesome women.

It's also something you can do to support others, by getting yourself out there. Help other women in tech, put yourself forward as a speaker, sign up as a mentor, visit schools, make yourself heard. It's hard to start off with, but it can really pay off: apart from the feel-good factor you get from helping out others, it'll make your CV look fab.

There are as many ways to be a woman in tech as there are to be a man in tech. You don't have to dress like a guy and go out drinking with the lads... unless you want to. Similarly, you don't have to wear makeup and be perfectly turned out every day... unless you want to. Guys will comment on what you look like, as will women, but at the end of

the day computing is about getting the job done. Indeed, I suspect computing is more forgiving of sartorial eccentricities than many other professions.

Ask for a pay rise. The gender pay gap in IT is really quite major; and research suggests it is because men ask for a raise, but women wait to be offered. So ask. What's the worst that can happen?

One day, you'll wake up, look around yourself, and think 'How did I get here?' – just like in the Talking Heads song. This has got a name – 'Impostor Syndrome' – and the thing to realise is that everyone gets it from time to time. It seems as though women get it more than men, and those who're not in the majority gender for their job seem to get it more. So women in tech get a double-whammy. You can get over it though: if you have a mentor, chat with them about it, or talk to colleagues, or, failing that, read around the issue. There are all sorts of books and blogs about beating the impostor syndrome.

Remember Hanlon's Razor? 'Never assume malice where incompetence is a fair explanation'. It's easy to assume the worst, particularly if you're (say) at a conference and you've had three men in a row assume you're in sales, just because you're a woman. But try to find the good side: if a guy says something stupid or sexist, chances are they're just not thinking stuff through, and they're not deliberately trying to put you down. Give them a second chance, try to make a joke of it, and if they persist – well, you know who to avoid at the conference reception.

ABOUT HANNAH

Hannah is a lecturer in computer science at Aberystwyth University, where she does research into computer vision and robotics whilst trying to teach undergraduates about web programming. She has a BSc, MA and PhD in artificial intelligence-related subjects, all from the University of Leeds. She has held postdoctoral researcher positions at Leeds, Kingston, and Grenoble.

She believes that computer science is an interesting and fun field for work, study and play... but that we don't often manage to get that across, particularly to women and girls. So she joined **BCSWomen** in 2006 and has been on the committee ever since (and was deputy chair 2008–12). She started the **BCSWomen Lovelace Colloquium** in 2008, and continues to chair this event. She also spends a lot of time doing workshops with school kids and their families, and has run outreach computer science sessions involving artificial intelligence, wearable computing, Arduino, robotics, scratch, video processing and mobile app development.

30 PROFESSOR MARGARET ROSS MBE

*Emeritus Professor of
Software Quality at
Southampton Solent University*



As a child, I wanted to work in a flower shop! At 14, I changed schools to start learning shorthand and bookkeeping, ready to start work at 16. I thought bookkeeping would suit me because I always liked playing about with numbers and maths, whereas my parents thought I would be a secretary.

However, my school had other thoughts and saw my potential; they moved me into the O-level stream and later talked to my parents and me about continuing for A-levels at a technical college.

Like many young pupils today, I had to make a choice in subjects. I liked maths, and literature, history and French, but at that time, you could only choose science, art or languages. Thinking about future jobs, I felt the science stream was a better option, but, lacking basic knowledge of some of the subjects, I had to attend evening classes twice a week while studying for A-levels to fill in the missing basics. My advice to young people faced with similar decisions is to try to consider the career options and ensure that you leave yourself with as many options for the future as you can – not necessarily easy, but definitely worth the effort.

Once I'd started my A-levels, the college started talking about universities. My family had no experience of this; I was the first to go to university and do a maths degree thanks to the support of my parents.

From there, I didn't know if I wanted to go into industry or teaching so I followed both, taking teaching qualifications and studying postgraduate aerodynamics via evening classes. The rest, as they say, is history.

My route was not planned, but I had great encouragement at various key points from caring teachers, lecturers and parents, and lots of luck, leading to a career in computing that has given me a great deal of interest, opportunities to meet wonderful people and to travel, all related to a subject that has become more fascinating year by year.

I believe that many children do not understand how interesting and varied a career in IT is. While there are successful TV programmes and serials featuring other professions such as medicine, police, and even plane and yacht design to mention just a few, there's nothing showing IT.

I decided to tackle this issue and entered a competition for a new TV series. My entry had romance, drama, tragedy and comic moments set in the computing and technology industries, and I was lucky enough to win! The prize was that a professional scriptwriter

developed a one-hour pilot script. I've haven't yet been successful in finding a TV production company to take it on, but I'm not giving up; I am currently working on a radio/internet computing series.

So what skills do you need for computing?

My advice is to find out about all the roles that are open to you in IT. It's not all about programming; there are exciting non-programming roles in IT, leading to the top jobs.

One of the most important skills I think you need is good communication; spoken, written and particularly the ability to listen. Problem-solving skills or, in other words, the ability to see a pattern are also important.

How do you know if you're good at this? Traditionally, solving crosswords or maths are often cited as problem-solving 'activities', but I think many other hobbies need problem-solving and pattern identification abilities; everything from designing and making lace, complicated knitting, composing music, designing a garden, cooking a complicated meal and so on. If you are good at seeing patterns, then computing could be the career for you.

Thanks to my career, I've experienced some exceptional moments. Apart from my marriage, the most memorable has to be receiving an MBE for services to education from Prince Charles at Buckingham Palace. While waiting for the ceremony, it was wonderful chatting to some amazing people who were also receiving honours that day.

I was also delighted to accept an honorary doctorate from the University of Staffordshire relating to my work encouraging students, especially girls, into technology and being awarded an honorary fellowship and the John Ivinston Medal by BCS in recognition for my contribution to the organisation and my work.

So how did I get here? In truth, the answer is 'by chance'.

ABOUT MARGARET

Margaret is Emeritus Professor of Software Quality at Southampton Solent University. She studied mathematics and then moved into programming and then the softer side of computing. She currently lectures part time, supervises undergraduate projects and PhD students, and acts as external examiner for degree courses and PhD levels.

She has been actively involved with BCS for many years. Currently, she is a member of Council, and other committees, Chair of the BCS Hampshire Branch, Vice Chair of the Quality and elearning specialist groups. She is also a committee member of the Green IT, Animation and Games Development, Cybercrime Forensics and **BCSWomen** specialist groups. Previously she held the position of BCS Senator on the Engineering Council, and Council Member of PITCOM. Margaret was awarded an Honorary FBCS in 2007 and the BCS John Ivinston Medal in 2011. She also received an Honorary Degree of Doctor from Staffordshire University in 2004 and an MBE for services to education in 2009. She is a Freeman of the City of London and also a Liveryman of the Worshipful Company of Chartered Engineers.

31 PROFESSOR CORNELIA BOLDYREFF

*Co-founder and Director,
Ebartex Ltd*



My initial interest in computing arose when my mother was taking a course on the 'New Maths' for schools that included the binary system. I have always enjoyed mathematics, number systems, and games and puzzles involving numbers.

When I came to England as a teenager, I studied double maths at A-level and went on to study maths, history and philosophy of science at Leeds University. Logic and the philosophy of logic fascinated me, so I changed to studying philosophy. When I graduated, I was lucky to get my first job in the Centre for Computer Studies at Leeds University.

I got my PhD in my 40s and ten years later became a professor of software engineering. With the exception of my first job at Leeds, I have frequently been the first woman to join a department, working at my level. I would like to think that this is changing these days. Throughout my career, I've been involved in groups and activities to encourage more girls and women in the STEM fields.

I do think it is important to do work that you personally enjoy and find challenging. I have been lucky to be able to develop my knowledge and skills in computing on the job, and that is one of the main reasons why I have enjoyed my work in universities so much.

Computer science is a great subject to study and an excellent field in which to work; in particular, my area of software engineering as an applied science has given me the opportunity to work in a wide variety of domains where computers are essential, from steel production to electronic commerce. The rapid changes in technology over the last 40 years have meant there is always something new to learn!

I joined BCS early on in my career. It has been through professional organisations such as BCS, the ACM, the IET and IEEE that I have been able to keep abreast of developments in the field of computing. I'm proud to have been involved in **BCSWomen** from its start and I currently chair the BCS Open Source Specialist Group. I am hoping, through my recent membership of the Policy Committee of the BCS Membership Board and election to the BCS Council, to ensure that more women in computing and students of computing come to enjoy the benefits of BCS membership.

My most recent venture has been to set up a company with two other women. We won a small grant to develop a demonstrator app for the digital currency that we have been developing (see www.ebarts.com). We have been taking part in the Bethnal Green Ventures Accelerator programme for people who want to change the world using technology for good. Our currency, ebarts, is a social currency.

Over my career, I have seen computing make a radical difference to the world we live in and I've greatly enjoyed the part that I've been able to play in computing as a software engineer and educator. Finally, I want to mention that working in computing has enabled me to travel the world: Australia, China, Japan, Korea, Kuwait, Malaysia, and most European countries.

ABOUT CORNELIA

Professor Cornelia Boldyreff is a visiting professor at the University of Greenwich in the School of Computing and Mathematical Sciences. She was previously the Associate Dean (Research and Enterprise) at the School of Architecture, Computing and Engineering at the University of East London.

Cornelia gained her PhD in Software Engineering from the University of Durham. In 2004 she moved to the University of Lincoln to become the first professor of software engineering at the university, where she co-founded and directed the Centre for Research in Open Source Software.

She has over 25 years' experience in software engineering research and has published extensively on her research in the field. She is a Fellow of BCS, and a founding committee member of the **BCSWomen** Specialist Group, a committee member of the **BCS eLearning Specialist Group**, and currently (2013) chair of the **BCS Open Source Specialist Group**. She has been actively campaigning for more women in STEM throughout her career.

Together with Miriam Joy Morris and Yasmine Arafa, she founded the start-up, ebartex Ltd, and together they are developing a new digital bartering currency, **ebarts**. <http://www.corneliaboldyreff.co.uk/>

32 NELA BROWN

*Sound Artist, Musician,
Designer and Technologist;
PhD Student at Queen Mary
University of London*



I often get asked to talk about 'my path' and how 'I got to where I am today'. This sort of implies I have arrived at my destination and, having done a lot of different things along the way, I have settled into a steady career path. But nothing could be further from the truth.

Having studied classical music, followed by engineering, I decided to join a rock band, move countries and embark on further study, this time jazz music and sonic arts.

This led to an exciting freelance career working with companies from different cultural backgrounds and traveling around the world as a sound artist, composer and sound designer and subsequently led to my PhD research in human-computer interaction at Queen Mary University of London, where I am at the moment grappling with my thesis chapters.

My path has certainly not been as straightforward as my parents would have hoped, but it was kind of predictable (at least from my point of view) until I passed my stage 1 exam (for those who haven't done a PhD in science, that would be a second out of four 'hurdles' in one's journey for acquiring a full PhD).

So what exactly happened? I recall the day I was trying to organise my desk pondering about all the time I had spent reading research papers and designing my pilot studies, and all the time I had not spent tinkering with Arduino NG, gathering dust somewhere in my draws. The excuse of not doing physical computing stuff because of the 'no soldering' policy we had in our office had just worn so thin after spending days on end writing my Stage 1 review.

I needed to do something drastic to break this cycle, something I could do on campus and something I could do with other people. I had one of those 'aha! moments' you hear so much about from other people (but never actually happen to you personally) and thought to myself 'why don't I start a hacking club for girls?' No more excuses. Just do it. Just make it happen. And I did.

Of course there were no girls to recruit into this club in my own office (or nearby offices for that matter), but I did eventually stumble upon a whole bunch of ladies from other programmes within our department, some of whom, as it turned out, had been thinking about a similar idea along the lines of a 'supportive space for women to do experimentation and knowledge sharing'.

We joined forces and **G.Hack** was born with me at the helm as chair trying to work out what different activities we could house under the G.Hack umbrella, how we could raise the funding to keep the project going and how our activities would benefit our members (internally) and inspire more women to follow suit (externally).

Not long after that, I got involved with **Flossie Collective** (bringing the first Flossie conference to QML) and **WISE@QMUL society** (which was inactive due to key members leaving QML after finishing their PhDs). I then joined the **BCSWomen** committee and within months started a mentoring working (sub)group, looking at synthesising different mentoring practices our members had expertise in into a framework that could be rolled out across the rest of BCS membership.

And so, I did it. I made it happen. I even got an award for it, but I didn't have to do it alone and that really is the point. Many times before I thought about instigating change, disrupting the norm and making things work better. I wish I had someone tell me there and then that all I had to do is raise my hand in the air, speak my mind and convince a few other people to join me for a ride.

It's that simple.

You can do it too.

No more excuses.

Just make it happen.

ABOUT NELA

Nela Brown is a sound artist, musician, designer and technologist. She is currently doing her PhD in human-computer interaction at Queen Mary University of London, where she is also a leader of **G.Hack** and advisor of **WISE@QMUL society** society. She is a member of **Flossie Collective**, organising conferences and events for women working with open source software and hardware, and **BCSWomen**, where she currently leads a Mentoring Working Group (MWG) collaborating with BCS CPD team with the aim to establish good mentoring practices and mentoring training framework for BCSWomen and the rest of BCS membership.

In recognition of her work with G.Hack, WISE@QMUL and Flossie, inspiring girls and young women to enter the field of computer science, she was presented with a prestigious Highly Commended WISE Leader AWARD by the patron of WISE, HRH The Princess Royal.

SECTION 3
AN INTERVIEW WITH KAREN
SPÄRCK JONES

33 COMPUTING'S TOO IMPORTANT TO BE LEFT TO MEN

Karen Spärck Jones is winner of the 2007 BCS Lovelace Medal. BCS managing editor Brian Runciman interviewed her.

By way of introduction, can you tell us something about your work?

In some respects I'm not a central computing person. On the other hand the area I've worked in has become more central and important to computing. I've always worked in what I like to call natural language information processing. That is to say dealing with information in natural language and information that is conveyed by natural language, because that's what we use.

I think that what has been happening is that those kind of things that were initially thought of as external applications, rather like accounting packages, are becoming more central and not just because more people are using browsers and search engines, but because the information itself they are working with is becoming much more central to what people do.

You could argue that this natural language stuff is the material of an information layer, part of a computing system not just on the periphery.

I can see systems, even operating systems and security, making use of the information that's in that layer. It might be informal information and not nicely coded up, but it might be usable all the same. Natural language isn't coded up for us, but it's there and we use it. What's surprising looking back on the fifty years of BCS is how old some of the ideas are.

What recent developments by others have impressed you most?

I'm not an IT professional, but a researcher. I don't use a lot of things that people swear by now because they're not particularly pertinent for my work. But I do think that the web has made a difference and in my own area, progress has been made. In AI we might not be able to do some of the things that were originally hoped for, like the ideas from the Dartmouth conference in simulating humans. But it's done other valuable things on simulating.

Progress is sometimes made in ways that people didn't predict. Basic ideas can develop slowly but sometimes things come along that are effective yet were unpredictable. Many people say what's exciting now is images and video, but I think that's very overrated. It's nice to see them, but if you want to talk about them, what are you talking with? Words.

Nevertheless, what is important is that research and professionals are connected; computer science produces the stuff that professionals use. One thing that gets me steamed up about teaching in schools is that they don't realise what work goes into producing the stuff they use. Take spreadsheets – it's hard work to produce a good spreadsheet package, but if people only learn how to use them, and not what's behind them, we're missing a trick.

BCS is pursuing professionalism in IT. What are your thoughts on this?

I certainly think that professionalism is very important. I took part in one of the Thought Leadership debates, about security and privacy, and I was having an argument with a young fellow there. He was slightly surprised that I said that to be a proper professional you need to think about the context and motivation and justifications of what you're doing.

A true professional will think like that. With ID cards, for example, I was concerned that people would treat it just as an opportunity to do a good software job, if the Government's got a sufficiently good idea of what it wants. But things like that have a fundamental effect on people's lives and being a true professional means that you must contextualise your work.

Is there an ethical dimension there?

I think there is. This chap, who in many ways was thoughtful, said that his organisation only thinks about what the spec is and whether they can do a good job of it – what I call the first layer of being professional. But the second layer is the rationale for what you're doing.

You see, I could probably write a very good program for choosing people to be killed for some reason, selecting people from a population by a particular criterion. But you might argue that a true professional would say, 'I don't think I should be writing programs about this at all.'

The point is that there is an interaction between the context and the programming task itself. And as we know with the privacy debate, getting the system architecture right is extremely difficult. You need a deep understanding of what the whole thing is about to get that right and to appreciate that it still won't be perfect.

You don't need a fundamental philosophical discussion every time you put finger to keyboard, but as computing is spreading so far into people's lives you need to think about these things.

The UK has a problem attracting students into computer science courses often due to a geeky image, what should we be doing about that?

There is more than one reason why people aren't attracted. One of them is that teachers say they are fed up with the emphasis on what you might call shallow IT skills in schools – focusing on whether you can use a word processor or spreadsheet, so that you completely conceal what the actual things you use are like.

A very good example of that happened 10 years ago, but still applies. We were trying to get at girls in schools and we knew we had to get to the teachers first. We found that the spread of computing in administrative and secretarial world has completely devalued it. When one of the teachers suggested to the parents of one girl that perhaps she should go into computing the parents said, 'Oh, we don't want Samantha just to be a secretary.'

That's nothing do with nerdiness, but the fact that it's such a routine thing.

Then there is the nerdy thing and also people don't see the challenge of designing, building, implementing, testing and evaluating programs. There are plenty of things that are very, very hard to do. Think about someone who wants to model climate change – you've got to do more in the program than just take a few equations and churn them.

Nerds often don't do proper computing either – it's more geeky one-upmanship. Then there's this endless dreary games playing. They talk about the wonders of modern graphics, but if you look at screens with games on them they're not really very realistic.

People, because computing is so routine, don't think about the whole social context. Think about the NHS stuff – if that worked it would affect how the entire health service ran, from the nurses to the consultants and all points in between. People have got to understand that these systems are embedded in our lives.

It's getting across the challenging, fascinating, technical things to do. How do you capture a problem so you can write a programme about it?

This year BCS is trying to improve the public understanding of IT. What do you think we should do to achieve that?

It's interesting – the challenge is to convey why things are worth doing and why it's hard in a simple way. Like tracking a patient through their entire medical life: what's important, how do we relate items to each to each other?

It's the technical challenge of understanding the task and its social context.

How do you feel about winning the Lovelace Medal?

I was stunned. I looked up previous winners and thought, 'What am I doing in this bunch of people?' But I was especially pleased to see that I was the first woman to get it. Very nice. I really appreciate it.

Looking back on your long career, is there anything you would do differently given the chance?

It's hard to say. You can't predict in the beginning what's going to happen anyway. There's unpredictability for a variety of reasons. One is that people find out that they can or can't do things that they thought they were going to be able to do and so that tends to cause people to change course. Alternatively, something can come along from the side and it can blow away what you were doing, or blow you away in another way, and you realise that's the really interesting stuff.

As a researcher you don't usually jump from one thing to another. But there are adventitious factors. When you're older you can choose to an extent what you do, but when you're younger if there's no money then you have to go where the money is. Many computing research areas suffer from a dearth of money.

For example, the funding agencies in the USA cut out everything to do with translation for rather bad reasons in the mid-1960s. Researchers don't throw away what they've done, but cut their cloth accordingly and make a shift. It's complicated. Research is amorphous and has overlapping threads and sub-areas and people move for a variety of reasons.

What impact would you like to see your research having on everyday life?

One thing I did when I was working on document retrieval in the 1960s was to work on automatic classifications. You found classes of words to make matches, but some of the experiments we did didn't work out as we thought and we were trying to understand why it was happening.

This caused me to develop the idea of weighting words statistically – looking at word frequency and in how many documents a word occurs. Because in general if a word appears in a lot of documents most of them are not going to be of interest, so you think of inverse document frequency weighting and I published a paper about that in 1972.

This was put together with another type of weighting, which was how often a word appears in a document. At that time there was no immediate application in operational systems. There were bibliographic services, where it could have made a difference, but they were hooked in things like Boolean searching and thesauri and so on. The library world is very conservative and they only slowly picked up the idea of natural language searching. Researchers were convinced by the 1980s that statistical searching was a good thing to do and by 1992, 20 years later, two things happened.

Firstly, a large research programme was started up called TREC (Text Retrieval Conferences) and that attracted attention because the collections were so large that people thought statistical techniques would work.

Secondly, and more importantly, what came along a little bit later is the web. It accumulated a lot of information, and the point of the web was that it was the computing community not the library community running it.

Mike Burrows, who originated Alta Vista, had a large usenet file that he wanted to retrieve from, and I and a colleague had written a little paper called *Simple proven approaches to text retrieval* in 1994 that contained all the basic ideas of this research and the theories underpinning it. Mike asked Roger Needham about retrieving from his usenet stuff and Roger gave him the paper.

Mike read it and started from there. So he didn't read a lot of library stuff; he took the paper and started the first of the modern search engines. Pretty much every web engine uses those principles.

There was no way these things could be implemented in a useful way in 1972, but by 1997 it was working with the full text it needed. So these statistical ideas that I've contributed to in one way or another are spreading around in this modern computing world.

Who in the IT industry inspired you or was a role model for you?

In a way my first employer. I worked initially for the Cambridge Language Research Unit. It was run by a lady called Margaret Masterman, who was extremely eccentric and was the person who started CLRU with some rather original ideas about how to do machine translation. She got a grant and employed people. Roger Needham worked there too, during his PhD.

She'd been a student in Cambridge and had suffered from all the chauvinism of the Oxbridge model of academic life and she was a firm believer in making sure that women got an opportunity. She had no prejudices about these things, but de facto she encouraged me because she hired me.

She was not a role model in the way she worked and I disagreed with some of her ideas, but she was a role model in that she showed me there is nothing to stop women working in this area. At that stage there were no opportunities for women. You have no conception of how narrow the career options were.

I think to some extent my husband Roger (Needham) has been a role model too, but in a very different way. What he did was encourage me. When you're on your own in a subject and living on soft money, as I did till I was over fifty, that's very valuable. He was always encouraging me and I could always talk to him about my work.

What are the biggest challenges facing your discipline?

The main challenge in text retrieval is that it is a very large area, on one hand represented by people like Google, on the other hand by all the skilled professionals who still use these specialised classification languages and things like that do very specialised searches.

The main problem with web engines is that you don't get anything much in from the user. Typically, if you search for a topic you don't get far with a collection file of billions of documents from a two word query.

People have tried all sorts of carrots to get searchers to put in better queries or interact a bit more – like using feedback to bootstrap a better query. All it requires is for individuals to mark what is useful so the next batch of documents are new.

The other challenge is how to integrate image retrieval. Speech retrieval is not such a challenge because it can be transcribed well enough to do retrieval. But image is a different ball game. How can you find images 'like this one' if you haven't got one to start with? Many people are trying to tag images with text, but it's very difficult to evaluate the efficiency of different methods.

People build systems and throw them at the user and say, 'Isn't this fun?' But that's not the same as demonstrating that a system is better. Controlled experiments are difficult to do with real, live users and they are expensive.

Evaluation of ideas in any field is important. For example, we can all have an opinion about a translation and spot a good one or bad one. But you could have two equally good ones – does that make a difference? Maybe one is better than another. How can we find out?

What are your thoughts on the semantic web?

I think the semantic web has modified its meaning, but the all-singing, all-dancing version, which is a model of the entire world of everything, I'll stick my neck out and say I think is fundamentally misconceived. It's something that philosophers thought they could do in the 17th century, and Leibnitz was no slouch, but they couldn't do it. For good reasons, too: you can't code up the world, it's not tidy like that.

What you can do is code particular worlds for particular people and purposes. That's what biological taxonomies are about, but that's for experts. In some respects there's an analogy with expert systems, people say if only we could get the expert's knowledge out of his head and coded up; and you can do that for a closed world. But you're likely to find yourself walking over the boundary of a closed world without realising it.

Say you want a specialist database on blood, a fluid. You don't include in that a lot of stuff, like if you drop fluid from a height it breaks up into drops. There's a lot of general information about fluids you wouldn't want to put in a haematological database. But at some point people are assuming you know it. What's happening is that the semantic web stuff is going into knowledge representation, but there is a limit to what you can code up about the meaning of an ordinary language word.

We can't model everything. Many of the semantic web people are now thinking more about an upper layer and they are rediscovering some of the stuff that the AI people have already done. The model now is that you will have your specialised world models for specific domains and then a relatively solid bridging layer; a top layer that provides enough resource to get from one domain to another, but even that's hard to do.

It's hard to plug specialised knowledge bases into a general overarching layer. My model is to say you can have your specialised areas, but bridge in a lightweight way through words. Take blood again. Let's just follow the word, don't go via blood is a fluid, blood is red, and has a temperature of x – the upper layer should be a much lighter connective structure, essentially a natural language approach.

Different domains do share vocabularies and words can mean different things, but they are similar enough that we can communicate.

Using speech applications seems to have applications for those who are disabled?

These things are fine. Everyone thought things would be revolutionised in IT applications when we had speech recognition. But they didn't appreciate how slow speech is. You can use transcribed speech faster than speech is uttered. I can scan a document very

quickly, but if I read it you it would take far longer. So the idea that we can throw away boring old text is completely unrealistic.

But that doesn't imply that speech interfaces aren't very useful for the disabled and people also want to transcribe speech – like the intelligence agencies.

If I wanted to rent a car abroad it would be jolly nice to pick up the phone and have my speech translated. All that's cool, but that's not the same as throwing away text for speech as the answer to everything.

What's your view on women in computing?

I think it's very important to get more women into computing. My slogan is: Computing is too important to be left to men. I think women bring a different perspective to computing, they are more thoughtful and less inclined to go straight for technical fixes. My belief is that, intellectually, computer science is fascinating – you're trying to make things that don't exist.

In that respect it's like engineering, trying to build new things. Take skyscrapers, they had never existed and provided fundamental engineering challenges – weight, wind force and so on. We need women to see the intellectual challenges and social importance of computing, all of the things that computer systems are used for now and why it matters to society.

It seems to be a problem, perhaps more with girls than boys, that you've got to get them hooked young enough, then keep them hooked. If they are not interested by the time they are 13 you've lost it – I'm talking about girls who might go into the subject in some depth.

ID cards are a very good example of this. It's a fundamental notion – it will cause a person as a legal entity to have a particular definition.

Think about the implications of CCTV, another example, or health and education. Should we do all of our teaching via IT? What's the function of education? Can this be achieved with IT?

What about climate change and sustainability? Think about the fact that most women drive – traffic modelling is a growing area? What is it? How should it be factored in charging for where you go, convenience of route and so on? All these things are part of the fabric of one's life.

So I've always felt that once you see how important computing is for life you can't just leave it as a blank box and assume that somebody reasonably competent and relatively benign will do something right with it.

ABOUT KAREN

A brief biography can be found on this Cambridge University website: <http://www.cl.cam.ac.uk/archive/ksj21/>

USEFUL LINKS

ORGANISATIONS AND GROUPS

ACM-W – Committee on Women in Computing

Athena Project – For advancement of women in science, engineering and technology in higher education.

AWC – Association for Women in Computing

BCSWomen – A BCS Specialist Group that provides networking opportunities for all BCS professional women working in IT around the world.

Connecting Women in Technology Network

DigitalEve – A women's organisation about technology, creativity and community.

ECSwomen – A group created to support the women in the Southampton University department of Electronics and Computer Science.

EEVL – The Internet Guide to Engineering, Mathematics and Computing.

Equalitec – Best practice recruitment and retention of women in Information Technology, Electronics and Communications.

e-skills UK – Making sure Britain is getting the technology skills it needs to succeed.

Flossie Collective – For women interested in using open source as coders, artists and social innovators.

GFW – The Global Fund for Women

Health Equalities Library Portal (HELP) – Where content management meets equality and diversity.

IWT – Institute for Women and Technology

LinuxChix – Community for women who like Linux, and for supporting women in computing.

#techmums – Offering free hands-on workshops and online support to mums in order to give them the confidence, skills and inspiration they need to take part in the digital revolution.

Systems – An informal organisation for technical women in computing.

TechUK Women in Technology – A programme that focuses on providing a network for women working in the technology industry.

WES – Women’s Engineering Society

WiC – Women in Computing

WISE – Women in Science and Engineering

Women in Technology Network job board

WEConnect International – Connecting women’s enterprises with market opportunity

WiTEC – Women in Science, Engineering and Technology

Women in Telecoms and Technology – An informal networking group focused on education and enhancing women’s careers by sharing experiences and lessons learned in members’ career development.

Women@CL – Women in the Computer Lab at The University of Cambridge

Women’s National Commission – Independent, advisory body giving the views of women to the UK Government.

RESOURCES FOR SCHOOLS

Computing At School – Promoting and supporting excellence in computer science education.

Code club – A nationwide network of volunteer-led after-school coding clubs for children aged 9–11.

Girls In ICT – A global initiative of the International Telecommunication Union (ITU) to raise awareness on empowering and encouraging girls and young women to consider studies and careers in ICT.

Stemettes – Showing the next generation that girls do science too.

STEM ambassadors

TeenTech – Inspiring tomorrow’s innovators

REPORTS AND STATS

Women Matter – McKinsey report

Women in IT scorecard

Women in IT survey

LECTURES AND AWARDS

BCS Karen Spärck Jones lecture – An annual event that honours women in computing research.

FDM everywoman in Technology Awards

Lovelace Colloquium 2014

UK IT Industry Awards

OTHER ARTICLES, VIDEOS AND INTERVIEWS OF INTEREST

Women in IT debate

Looking to the future

The 25 most influential women in UK IT

Listen, it's important... women in IT needed!

Julia Parsons, Speech and Language Therapist

Natasa Przulj – 2014 Roger Needham Award Winner

Liz Benison, CSC

Jo Twist

Being social, Genevieve Bell, Intel

Nicola Cooper, Young Professional of the Year, 2011 UK IT Industry Awards

Kate Craig-Wood

A real rollercoaster ride – Dr Julie Greensmith

Getting a facial – Professor Maja Pantic, Roger Needham Award winner 2011

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Published by BCS Learning & Development Ltd, a wholly owned subsidiary of BCS, The Chartered Institute for IT, First Floor, Block D, North Star House, North Star Avenue, Swindon, SN2 1FA, UK.

www.bcs.org

PDF ISBN: 978-1-78017-287-3

ePUB ISBN: 978-1-78017-288-0

Kindle ISBN: 978-1-78017-289-7

British Cataloguing in Publication Data.

A CIP catalogue record for this book is available at the British Library.

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Typeset by Lapiz Digital Services, Chennai, India.