

Developing the Future

A report on the challenges and opportunities facing the
UK Software Development Industry

5th July 2006

Report by the Initial Working Party for Developing the Future



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Elizabeth Sparrow

Chair, BCS Government Relations Group
Chair, BCS Working Party on Offshoring

The UK Software Economy has a significant impact on our prosperity and growth as a nation. We have witnessed a shift in emphasis over the last forty years from an industrialised country, dependent on heavy industry for the manufacture and production of goods, to one that is increasingly more reliant on selling services. But now a new wave of industrial endeavour, centred on information and the creation of wealth and jobs in a Knowledge Economy, is driving new opportunities.

This new economy has parallels to the impact that the Industrial Revolution had on changing our society in an earlier century; software is at the heart of this new revolution. This presents the UK with incredible opportunities to generate wealth as well as offering the potential to have a profound impact on society. Combining this with the growth of widespread communication bandwidth, software is enabling a new age altogether; an age of global collaboration and opportunity.

It is the ease with which people can now collaborate throughout the world that makes the process of building software solutions such an exciting prospect. This simultaneously presents opportunities and challenges, exchanging traditional models of software construction for processes that take advantage of an increasingly globalised industry.

This paper quantitatively analyses a wide selection of data sources; including HM Treasury, the ONS, DTI and UCAS. It combines this with the qualitative insight and comment from a group of researchers, analysts and senior academics, identifying five significant areas of opportunity. The paper concludes by challenging everyone involved in the UK Software Economy to work together, to create the necessary skills, investment and policies to allow businesses to exploit these new opportunities. This report argues that only enlightened decision making and fresh thinking will enable the UK to become the pre-eminent, innovative software nation of the 21st century.

We hope that within this paper you find the analysis and comment required to help you shape your own part in "Developing the Future".

The Software Century

“The knowledge economy is the future for the United Kingdom’s economic stability, business prosperity and quality of life for citizens.”

Navigating the New Economy: Defining and measuring progress towards the UK knowledge economy – Intellect report 10th May 2006

The benefits of software development to the UK economy are clear. In February 2006 the UK Treasury revised how it measured the overall value of ‘Own Account’ software investment to the UK economy. This led to a massive leap in the estimated value of ‘Own Account’¹ software investment to £13bn from an estimated figure of £2.5bn in 2003; this recalculation raised UK Gross Domestic Product (GDP) by 1%. In total, the UK Software Development Industry employs 1M people and produces an annual Gross Value Added² (GVA) of £30bn; this represents 45% of the total UK GVA.

A trend analysis indicates that the contribution of own account software to the UK in ten years time will be approximately 1.5% of GDP. As GDP is increasing at about 2% per annum, it can be estimated that by 2014, UK GDP will stand at around £1.2 trillion and the own account software contribution would be approximately £18 billion.

The crucial role Information Technology has played in raising UK productivity and wealth over the last thirty years is accepted by most economic analysts and commentators. However, productivity gains in the twenty first century are more likely to be driven by software innovation than any other subset of Information Technology. Software is increasingly to be found all around us, often unseen. Aside from software that drives traditional organisational infrastructure, personal computers and Internet applications, software now enables many other aspects of modern life. From petrol pumps to heart monitors and MP3 players, software technology is all pervasive. The global demand for software is likely to grow significantly over the coming decades, fuelled by a number of factors, such as the growing role of software in social infrastructure, organisational integration initiatives, mobile devices and smart appliances.

The nature of software development is a complex process involving many different roles and development teams globally. Traditional models of software construction are being exchanged for processes that take advantage of the opportunities presented by

globalisation. The trend towards developing software using virtual teams that can be located anywhere in the world, facilitated by technology for collaboration is providing a means to reduce the costs of software construction. This report examines the impact of the changing face of software development and considers the opportunities for the UK software development industry that lie ahead.

Despite the very positive and clear GDP statistics described earlier, much of the key data required to form a set of baselines with which to monitor the progress of the UK software development industry are not adequately tracked by government or industry bodies. Consequently, a detailed analysis of all sectors of the industry is not yet possible. One of the reasons for the confusion and lack of data is the historical emphasis on the collective impact of software development and related services on the UK economy resulting in a lack of focus on the individual contribution of software development. Therefore it is hard to extract data related to software development from the software and services sector statistics.

This report addresses six aspects of the UK software development industry: off-shoring & globalisation, invention and creativity, skills and education, inclusion, investment and incentives and industry image. Key findings from this report identify five challenges facing the UK software development industry:

- How can the UK meet the opportunities and challenges for globalisation?
- How can the industry attract new skills and talent for the future?
- What can be done to create a modern image for sustainable competitive advantage?
- What strategic initiatives, policies and data are required to develop a leading edge industry?
- How can we ensure that the UK is at the centre for European software development and innovation?

The report provides a comprehensive analysis of the challenges; uncovering a complex picture of the reality of the UK software development industry and the opportunities that lie ahead.

¹ Own Account Software: Software systems developed by an organisation for the operational and business needs of that organisation alone.

² Gross value added (GVA): An indicator of economic prosperity measuring the contribution to the economy of each individual producer, industry or sector.

How can the UK meet the opportunities and challenges for globalisation?

Software development is being achieved using a truly global business model, with off-shoring becoming standard practice. Off shoring is beneficial for the continued development of a vibrant UK software economy; it presents the means by which the UK develops a long-term agile business community and is a key accelerator for growth in UK GDP. There are many opportunities for the UK associated with globalisation of the software development; however, it is also inevitable that some traditional UK jobs in the industry will be lost.

How can the industry attract new skills and talent for the future?

There is a significant skills gap in the UK that is especially marked in IT and software development. Research estimates that 150,000 extra employees are needed in IT each year, but only 20,000 graduates in computer science and STEM subjects graduate from UK universities.

What can be done to create a modern image for sustainable competitive advantage?

The image of the software industry pervades all of the other challenges; it has an impact on the skills gap and it affects the drivers for investment to create innovation. The right image is the key to the success of the UK software economy and the gap between perception and reality must be addressed.

What strategic initiatives, policies and data are required to develop a leading edge industry?

The quality and granularity of data that relates to UK software development and the impact this has on tracking its effect on growth of the UK economy requires a fundamental review. The result of this activity would provide a baseline from which to begin to analyse the evolution of the UK software economy.

How can we ensure that the UK is at the centre for European software development and innovation?

The track record for invention and creativity within the UK has worldwide recognition; with a history of substantial intellectual pursuit that has resulted in significant developments within all areas of technology and specifically within software technologies over the last 40 years. Innovation is at the heart of UK competitiveness in a global economy, but invention and creativity alone do not constitute innovation. This report identifies how innovation equates to invention coupled with effective investment and a robust and agile business model that embraces the notion of a global software development skills base. In essence it determines what the key USPs are that will catalyse the growth of the UK software economy over the coming ten years.



'Developing the Future' explores current industry thinking and data to define and analyse the major issues and challenges facing the UK software development industry today. In so doing it aims to stimulate debate and help new initiatives from the key stakeholders in Government, academia and commerce. The report suggests that if these challenges are met there will be a substantial positive impact on UK GDP.

For the UK to retain its competitive advantage the Chancellor advocates that we embrace the key challenges of globalisation as defined in his paper Responding to Global Economic Challenges.

"Globalisation, and the rapid emergence of new economic powers, is accelerating the pace of economic change, creating new opportunities and new challenges. With the pace of innovation faster than at any previous time, the scale of industrial transformation greater, and the breadth of competition more global, the answer lies not in protectionism, but in rapidly upgrading skills, science and technology.

As barriers fall and economic activity moves across borders, new economic opportunities are created, opportunities for increasing employment, raising incomes, and reducing poverty. The rapid growth of China and India in particular, as they liberalise their economies and integrate them with the rest of the world, has lifted hundreds of millions out of poverty, helping to reduce global inequality.

According to the World Bank, the developing economies that have increased their integration with the world economy and created an attractive investment climate have seen the fastest economic growth. But some countries have yet to benefit, and the unprecedented speed of global economic change presents a major challenge. Individuals and economies that can cope well with change should adjust quickly and thrive on the new opportunities. Those that cannot will find themselves at a disadvantage and may need help to adjust."

Responding to Global Economic Challenges, HM Treasury, October 2005ⁱ

To take advantage of this climate of economic change the UK software development industry must respond rapidly to these new challenges by creating new opportunities.

The UK Government, academia and industry, as key stakeholders, need to work together to develop the future of an industry that is seen as being central to the knowledge economy. In so doing this will provide economic stability, increase wealth and business prosperity, and place the UK at the forefront of a new wave of growth.

Evidence suggests that workers must adapt and obtain new skills, industry and commerce should transform or develop to seize new opportunities and the UK Government needs to initiate economic

"...the answer lies not in protectionism, but in rapidly upgrading skills, science and technology..."

...economies that can cope well with change should adjust quickly and thrive on the new opportunities."

Gordon Brown, Responding to Global Economic Challenges, HM Treasury, October 2005

policies and strategies that create a climate for innovation and growth.

Although the industry faces global challenges and increasing competition it has many strengths, indeed they are the foundation on which the future should be built.

"One of the things I am really passionate about is not talking ourselves down in the UK. Manufacturing disappeared off-shore and it took us five years to realise it. With software it is the reverse. There is a lot of work around but we are already talking as if it is gone. It hasn't! We really are risking talking young people out of moving into the IT profession."

Karen Price, Chief Executive, e-skills UK

The UK has a very creative and exciting software industry; in fact it currently leads the world in areas as diverse as mobile technology, computer games and the software used in Formula One motor racing. However in the face of a shifting global landscape the industry cannot afford complacency.

This paper is designed to generate debate and informed discussion and this is vital to invigorate an industry which is central to the UK economy and our future prospects in the global marketplace.

Although there are challenges identified in this paper, there are solutions and tremendous opportunities for the industry to become a world leader.

The software development industry is ideally placed to lead a discussion about its future in a globalised economy; it created the means by which globalisation exists. As a consequence it must devise strategies that embrace these opportunities, accepting that globalisation is only a threat if the industry does not evolve to compete successfully worldwide.

A consequence of globalisation is that jobs within the industry can be located anywhere in order to maximise profits and minimise costs. Therefore the industry must develop unique, high value skills that ensure employment opportunities, creating a strong base for the future. In order to achieve this, the stakeholders identified must swiftly reverse the growing skills gap which threatens the future.

There is a growing skills gap in the UK partly because of the falling numbers in students taking computer science and STEM subjects in higher education. Although this is partly due to the year 2000 and dotcom hangover, it is also in part because of the image of IT as a profession which is beset by undeserved negative media stereotypes of highly technical, socially incapable people working in IT support departments in business.

As a result of analysing the challenges presented here it is evident that there is a need for an accurate centralised record of industry data in order to understand our strengths and provide a method to measure the success of industry initiatives.

This paper uncovers a complex picture of the reality of the UK software development industry and combines significant quantitative and qualitative research and analysis to substantiate arguments. With perceptive conclusions and deep insights into the opportunities that will make this industry the service economy for this millennium; Developing the Future is a catalyst for thought, debate and action by the key stakeholders: Government, Industry and Academia.



The contribution that the software development industry makes to the UK economy had gone largely unrecognised until the recent revision by the Treasury to the way in which investment in software is measured. In the Government white paper "Our Competitive Future: Building the Knowledge Driven Economy"ⁱⁱⁱ (1998) the importance of the growth in economic activity for the production of intangible assets was acknowledged. There has been a recognisable difference in measuring the contribution that different industry sectors make to GDP and exports. For example the City's role in global financial markets and its contribution to the UK economy is acknowledged under the term 'invisible exports'. Software development, however, has in general been regarded as a business cost and not an asset that might contribute to the economy.

It can be argued that in order to manage and provide sustainable growth for an industry sector it is imperative that it can be accurately measured. The classifications used by the UK Treasury to monitor the software industry do not allow for a fine-grain analysis of the contribution that individual sub-sectors make. For example, it is almost impossible to separate out the contribution that software development makes to GDP from other software or more general IT services. It is a matter of providing a coding structure that is fine-grained enough to allow for a more detailed analysis. A greater understanding of the contribution that the software sector makes to employment and the economy overall will lead to better informed policy making and more strategically focused investment.

The Treasury's recently revised approach to valuing software investmentⁱⁱⁱ is a welcome development in terms of the recognition of the importance of this sub-sector. Its revision of the contribution to the UK economy by 'own account software' (i.e. software developed in-house for in-house use) from £2.5bn in 2003 to £13bn in 2005. This recalculation raised Gross Domestic product by 1% and revised annual growth rates for all years since 1992. This revision demonstrates, very graphically, the importance of the software industry to the UK economy.

The scope of this report reflects the huge impact that software has on everyday business and consumer life in the UK. Software is everywhere:

"How do you make a film? How do you transmit something to a mobile phone? It's all about software. In fact, if you think about it, nearly all of our economy is driven by software and I don't think people have twigged that."

Nigel Hartnell, Chair of the Software Working Group, Intellect

"...if you think about it, nearly all of our economy is driven by software..."

Nigel Hartnell, Chair of the Software Working Group, Intellect

In this context, Developing the Future is not concerned with a particular subset of software such as enterprise applications, computer games development or embedded software. The challenges permeate the

industry as a whole and the issues and opportunities are relevant to every individual concerned with software development, from students, through to developers and software architects as well as visionary business elites.

Off-shoring, for example, poses both a threat and an opportunity for UK software development. Research estimates^{iv} that by 2010 102,000 IT and software jobs will have been off-shored from the UK. Nevertheless, off-shoring also presents a significant opportunity for software developers to move up the value chain and provide innovation and architecture skills to help develop leading edge software.

This report argues that there is an urgent need to re-evaluate the structure of the UK software industry and its impact on employment, on commercial activity and on the UK economy as a whole. It is important for public policy makers and industry leaders to recognise where this category of the UK's intangible assets lie and how best to develop and maintain them as drivers of sustainable international competitiveness.

Initial research is beginning to show that there is a difference between the impact that Information Technology has in emerging versus mature economies. It appears that software development and IT services are engines for driving economic development in emerging economies; this has resulted in investment, the creation of opportunities and substantial growth in careers. This is reflected in the growth in importance of IT within many eastern European countries and the Far East. This growth has accelerated the move towards globalisation for software development and many older economies have begun to recognise the opportunities that this offers.

It is crucial to reflect on the historical factors for growth in other economies such as the USA, which dominates the lists of the most successful and largest software companies in the world. There are lessons to be learnt from analysis of the factors that have driven their success and the economic benefits gained from the boom in software investment and innovation over the last thirty years. This paper explains that

trying to replicate this type of success without considering the growing effect and impact on software development from the emerging economies would not be successful.

Interviews undertaken in researching this report suggest that by meeting the challenges in combination will lead to successful innovation in the software development industry. In turn, software innovation, when allied with strong governance, business agility and a continuing dialogue between stakeholders, will lead to strong growth and economic prosperity for the future.



Commentary

DEVELOPING A WORLD CLASS IT PROFESSION IN THE ERA OF GLOBAL SOURCING

BCS has a crucial role to play in the IT profession's response to globalization. Analyst predictions for the continued growth of offshoring suggest that many hundreds of jobs that might at one time have been based in the UK will in future be found overseas in lower wage economies. We need to think about how the UK's IT profession can best meet this challenge.

A working party was established in 2004 to review the offshoring trend. The group analysed the profession's competitive strengths compared to the best in the world; examined the competencies that would be required in the era of global sourcing; looked at ways of helping IT professionals displaced by offshoring; and considered how UK companies might benefit from offshoring without succumbing to the risks and pitfalls. Six key conclusions emerged:

- Offshoring is a reality of business life and will have a significant but not overwhelming impact on the IT profession.
- Free trade benefits the UK economy overall, but can disadvantage individuals who may need help and support.
- UK IT professionals can offer added value.
- We need a new career model that combines technical with interpersonal and business skills.
- For companies, global sourcing will become a competitive differentiator.
- Professionalism will be even more important in the future.

The working party's new report, published in May 2006, focuses on the very wide range of BCS activities that will help the UK's IT profession meet the challenges of offshoring. It also includes contributions from individuals who are carving out successful careers in a world of global sourcing and looks at how other organizations are responding to globalization.

Continuing moves by organizations in all sectors to offshore traditional IT services is putting increasing pressure on UK IT professionals to deliver more relevant skills. UK employers experience difficulties in recruiting IT practitioners that can offer not only technical expertise but also added value skills such as project management, business analysis, supplier management and security expertise. The new BCS report describes a seven-point action plan to help the UK IT profession respond to the globalization challenge:

- promoting professional standards (especially the BCS Professionalism in IT programme and the development of a chartered IT professional designation);
- recruitment and education of future generations of IT practitioners;
- helping employees develop successful careers;
- influencing and advising the government about IT issues;
- working with employers enabling them to make the most of their IT staff;
- supporting innovation and celebrating excellence in IT;
- developing BCS' thought leadership role.

We live today in an era of global sourcing. There is no going back – IT services have become a global industry. But the UK's IT profession can offer value added skills and expertise and has the potential not only to embrace the challenges of globalization but also to exploit the new opportunities that are opened up.

Elizabeth Sparrow
Chair, BCS Working Party on Offshoring
www.bcs.org/positions/offshoring

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How can the UK meet the opportunities and challenges for globalisation?

The effects of off-shoring on the UK software development industry

It is estimated that by the year 2010 102,000 IT and software jobs will have been off-shored from the UK, or 12% of the current IT workforce. This alarming forecast has significant implications for the UK economy and the software development industry in particular. The global phenomenon of off-shoring is recognised throughout the country as being a result of a rapidly changing industry. It is an inescapable fact and its future impact on the IT industry is frequently debated by senior figures in both public sector and commerce. Each spokesperson exhibits different attitudes to this phenomenon but significantly most key figures active within the industry seem to recognise there are both challenges and opportunities.

In his paper 'Responding to Global Economic Challenges' cited at the beginning of this report, Gordon Brown makes clear that globalisation and the resultant movement of skills around the globe has positive implications for both the country providing the off-shored service and the country off-shoring its workload.

In general the UK Government's position on off-shoring, outsourcing and global trade is one of supporting free trade and opposing protectionism. In fact the UK is the biggest off-shoring market in Europe, with the Far East being the main destination for utilising overseas skills.

A complex world of challenge and opportunity

Some of the most detailed work on the impact of offshoring in IT in the UK has been undertaken by the BCS (British Computer Society) Working Party on Offshoring. The group's report of November 2004 outlines the impact to date of off-shoring^{ix}:

"Many factors influence the number of IT jobs within the UK economy and it is difficult to measure with precision the job losses caused by off-shoring. Various predictions have been made about future years. Evaluerve estimates that, by 2010, 102,000 IT and software jobs will have been off-shored from the UK, which is equivalent to about 12 per cent of today's workforce. IT is in the forefront of the off-shoring trend, which will impact many other sectors including financial services, market research, legal services, architecture and engineering design. Forrester Research (Parker, 2004a) have estimated that 150,000 pure IT jobs will move off-shore from Europe by 2015."

Off-shoring: A Challenge or Opportunity for British IT Professionals, BCS, November 2004

"...by 2010, 102,000 IT and software jobs will have been off-shored from the UK, which is equivalent to about 12 per cent of today's workforce."

Off-shoring: A Challenge or Opportunity for British IT Professionals, BCS, November 2004

It is important to look at the wider trends as well as the headline figures. Whilst it is the IT industry which is currently the most affected, this report notes that other sectors will also begin to feel the effects of this trend shortly. Therefore although the IT industry is at the forefront of this change its response to the new challenges and the lessons learnt in adapting to new opportunities will be invaluable to the UK as a whole. Thus the implications of this new global challenge must be recognised across the nation and by all sectors of commerce and society.

"We are looking at somewhere around 200,000 IT jobs in the UK being off-shored in the next 5 years. That's equivalent to the population of Brighton."

Peter Skyte, National Officer for Amicus

In essence there are two ways to approach these statistics. The first is to highlight the fact that hundreds of thousands of jobs moving overseas in the UK could potentially create a lot of unemployment in the UK. This view is taken by Amicus, the largest private sector trade union in the UK.

"We are seeing a reversal of the Silk Road of the Middle Ages. This time the goods, or silks in this case, are going the other way. We are looking at somewhere around 200,000 IT jobs in the UK being off-shored in the next 5 years. That's equivalent to the population of Brighton."

Peter Skyte, National Officer for Amicus

Skyte is clear that if you weigh up all the opportunities and threats provided by off-shoring, that it may well be a benefit to the UK. But he says that it is important that we realise that people will ultimately lose their jobs if the off-shoring trend continues:

"We at Amicus are internationalist and not trade protectionist. We are, however, employment protectionist. Off-shoring is not necessarily a zero-sum game and overall the UK may gain through off-shoring. But there will be losers, people will lose their jobs."

Peter Skyte, National Officer for Amicus

Off-shoring is an undeniable factor in global business and as jobs become more of a commodity, skills and processes will be outsourced to markets with a lower cost overhead. This factor, allied with the retention of 'higher skilled' jobs in the UK will ultimately benefit both parties.

"The UK's relatively open attitude to geosourcing gives it a significant competitive edge globally."

IT Insights: Trends and UK Skills Implications, e-skills UK, November 2004 vii

The software development jobs currently being off-shored are generally said to be the lower end programming and coding skills, the sort of skills that naturally move to low cost centres such as developing countries. Many industry commentators argue that the UK is more likely to retain the development skills close to end user requirements, the creative processes of designing software to fix particular business or consumer needs. Mike Rodd of the BCS draws a useful parallel between how the engineering profession has developed and what is currently happening in software development in the UK.

"As a young engineer some 30 years ago I was designing printed circuit boards. But soon it became a routine technician's job, and not what professional engineers should be doing. It was also an easy thing to send over to Taiwan, it was an easy thing to outsource. I believe the real intellectual level in the application of technology lies in the conceptual design, it's in the understanding of applications, it's dreaming up the next generation applications, it's targeting the real users needs and, not the perceived needs. Software design and the vetting and validation of that design is where the real value is being added in the UK."

Mike Rodd, External Relations Director, BCS.

This may be the current position, but the danger of assuming that the UK will retain the "real intellectual level of technology" may ultimately threaten the industry. The sector is more complex and its development depends upon a continued flow of highly skilled talent. The UK government has recognised that there is a real skills shortage and that, coupled with the fact that HE institutions in this country are unable to attract new recruits onto their IT courses, may mean that the industry cannot depend on retaining high level IT skills in the future. It is a complex and dynamic picture where activity in one sector, such as education, will have a major impact on the industry in the years to come.

"The UK's relatively open attitude to geosourcing gives it a significant competitive edge globally."

IT Insights: Trends and UK Skills Implications, e-skills UK, November

The growing demand for IT skills in a global market

The UK is not alone in assessing the impact of off-shoring and the global market for the supply of IT. Other countries recognise the need to become more competitive in this arena and are developing their strategies and tactics to enhance their own software industries.

The emerging economies will continue to develop their skill sets in software development, consequently some of the creative processes and those closer to the end user will also start to be off-shored.

“The work that has been off-shored to date is only a small percentage of all UK software development. There’s no doubt that there is quite a push from the overseas suppliers to move up the value chain. In fact that is already occurring and, so let’s not kid ourselves, that shift will happen. I think it is also a myth to pretend that somehow Indian IT professionals aren’t particularly well qualified or cannot adopt the latest programming techniques. In many ways they value their jobs much more than we value our jobs in the UK.”

Elizabeth Sparrow, Chair of the BCS Working Party on Off-shoring.

A significant challenge to the industry is how it should maximise the benefits that off-shoring presents. As emerging economies invest in developing a software economy they will inevitably seek out the most visionary and successful countries with which to do business.

The benefits of a lower cost base through off-shoring have already been recognised by many global software and high technology businesses. In some of these organisations employees have benefited as they move up the value chain towards a focus on innovation and knowledge working. Microsoft has termed this paradigm shift as The New World of Work, and in a whitepaper viii outlines some key challenges and opportunities.

Economic transformation: *The transformation from a manufacturing based economy to a services based economy now underway throughout the developed world will accelerate. As cost pressures drain profitability away from activities that can readily be automated, outsourced or off-shored, competitive advantage will accrue to those who can drive value with ideas: intellectual property, process innovation, strategic insights, and personalization of services. In this environment, winning organizations will find new ways to empower information workers with tools that amplify their human talents, connecting them organically to an information infrastructure that allows them to understand their role in the context of larger strategic objectives, find and collaborate with the right people, and make the best use of available data in their decision making and work activities.*

One World of Business. *Political and economic dynamics are forging a single global market, a global workforce, global customers, partners, and suppliers. Collaboration across time zones, across organizations, across firewalls will be commonplace. Organizations will be challenged to maintain the security and confidentiality of their IP in an environment of increasingly collaborative innovation and a nomadic global workforce of mobile and at home employees, engaged through a variety of non traditional employment arrangements.*

NetGen Meets Baby Boom. *For those just barely catching up with the tools and practices of information work today, the value of some of these developments may seem elusive. But for the workers who will be delivering the innovations and productivity growth of tomorrow, this technology not only won’t come as a surprise, it will be a positive expectation. The “net generation” that’s coming of age today has lived its entire life in the digital age. They are rapid adopters of new information technology and are not only comfortable, but expect to work collaboratively with others. They multi-task in ways that seem unfathomable to many. Email, the Internet, vivid real-time interactive games, instant messaging and mobile devices are as natural to kids today as the telephone, television and ballpoint pen were to the previous generation. Given what we know about the sociological profile of netgens, many of these workers will probably find surprising applications for the new technology, resulting in exciting changes that we couldn’t possibly predict today.*

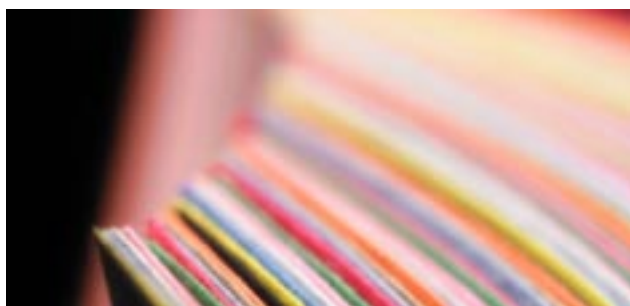
Competing for Talent in a Shrinking Workforce: *Because demographics show an aging, shrinking workforce in most of the developed world over the next 50 years, maximizing the productivity of the workers that are available is critical. Competition for talent will be fierce, and the ability to provide young workers with the kinds of tools and technology that meet their expectations and make their work productive and rewarding, while also providing older workers with accessible tools that leverage their experience and skills, will be a key competitive differentiator among employers.*

Digital Workstyle: The New World of Work, a Microsoft White Paper, May 2005

The paper highlights some fascinating scenarios for the future of the software development industry. The notion of a new dawn for collaboration, in which organisations and individuals will work together across cultural, geographical and time boundaries to supply an emerging global customer base could offer enormous scope to develop new products and enter new markets. This emerging era of collaboration could potentially force a cultural shift which will force us to change the operations both on a business level and within society as a whole.

Following these scenarios through to their logical conclusions could provide clues about how plans might be formed for this new age of global challenge. A cultural shift has major implications for the education sector, not just in terms of what is taught but how it is taught, how the teaching is distributed, is this a new age of intellectual academic collaboration across cultures and age groups?

Is this an age role reversal, where the 'net generation' educate the 'baby boomers' to ensure their continued growth and contribution to the developing digital age? These are some of the exciting opportunities which are revealed through these new scenarios. The importance of developing and exploring these scenarios lies not in their accuracy but in their ability to extend our thinking and stimulate debate and discussion to help us plan for change and opportunity. Planning for the response to the newer emerging economies needs to begin now especially given the recognition that many non UK organisations have already started.



International consolidation

Although many acknowledge the potential for creating new opportunities in these emerging economies the impact of off-shoring on software development cannot be underestimated. Some of the interviewees in this report see a threat from the increase in skills of the off-shore workforce. They also see the potential for overseas organisations to target UK employees to work overseas or even acquire whole UK software companies to allow them to move up the software chain.

"Watch out for the big Indian suppliers buying up British IT companies.

One of the charts I use in presentations shows the size of the major Indian suppliers compared to British companies and in terms of revenue they are fast getting to be size of the large consultancies like Capgemini."

Elizabeth Sparrow, Chair of the BCS Working Party on Off-Shoring.

Amicus sees an additional related threat to the skills of UK IT employees, namely the influx of IT skills from overseas that may dilute the current UK skills base, but may also lead to further off-shoring:

"One of the issues has to do with work permits for overseas workers coming to the UK to fill IT jobs. The number of permits is increasing rapidly and has gone up several fold from 1,800 in 1996 to 25,000 work permits for IT professionals moving to the UK in 2005. Between 2001 and 2005 there were a total 110,000 work permits issued for IT professionals, 20% of all work permits issued for all sectors. 80% of these permits were for workers from India and 75% were internal company transfers from international offices to the UK... Now there are legitimate grounds for internal company transfers when the skills needed are not available in the home country, but that is not a transparent process as far as we can see. Now, are these people coming in so companies can employ cheaper labour without having to off-shore, or, perhaps, are these people coming from India to be trained here as a precursor to off-shoring in the future? This is not just trade union grumbling, it has serious implications for the future skills base of the UK IT industry."

Peter Skyte, National Officer for Amicus

These threats have potentially serious implications, and should be monitored. The issue of consolidating all data relating to the industry is a focus of one of the five challenges referred to in this report. To understand the impact of the growth of overseas software companies and the movement up the software value chain of off-shore suppliers, and the migration of skills into the UK we need to be able to analyse and track this data. In order to do that the information needs to be reliable and easily referenced.

Finally it can be concluded that according to the available economic indicators, off-shoring is still a benefit to the UK. However, there is, and will remain a strong relationship between off-shoring and the development of the skills base in IT within the UK.

Commentary

The contribution of the software development industry to the UK economy has gone largely unrecognised until the recent revision by the Treasury to the way in which investment in software is measured. Hitherto, investment in software has generally been regarded as a cost and not capitalised as an asset. A major challenge in estimating IT-related economic activity is that IT is deeply embedded in virtually every aspect of modern life and commercial activity. Many different types of job involve elements of software development, particularly where customisation needs to be carried out in the end-user environment.

New ways of measuring and reporting in the software sector are needed, not only to explain today's economic activity, but to identify the drivers of tomorrow's growth. Investors seek the ability to distinguish between organisations that have invested wisely in future-proofing their IT systems and those that have exploited their assets to the point of exhaustion and whose current infrastructures are in effect future liabilities. What is urgently needed is an evaluation framework that brings together all this information at a corporate level and which can be aggregated at a national level in a meaningful way.

It is widely recognised that companies need to continuously innovate to maintain their market positions and profitability. IT systems play a pivotal role in supporting innovation whether that relates to the development of internal processes or to the creation of new products and services. This applies in virtually every area of economic activity.

Amongst the UK's competitive advantages are quality assurance, professional standards and an innovative climate, all of which involve activities that lie further up the value chain. These include higher education, complex programme management and systems integration. Jobs in these sectors are more likely to stay in the UK where there is a requirement for a high degree of customisation that is best carried out close to the customer. For example, NHS systems involve continuous software development across the whole organisation - from the central computing centres to individual GP's surgeries.

Software is at the heart of innovation in a knowledge-based economy. New products and services rely on efficient and often novel ways of creating and sharing information. Leading edge software development teams are vital members of innovation hubs such as science parks, innovation centres and the knowledge cities. A healthy UK-based software sector is vital to achieving sustainable innovation in technology-based products and services, such as the development of smart devices and ubiquitous computing. The exploitation of new inventions is increasingly dependent on new software developed as an integral part of the R&D process. Co-location in the UK of the necessary software development skills is vital for maintaining such development and reducing time-to-market, which is increasingly critical to the success of launching new products and services.

We need to develop a better understanding of the structure of the UK's software industry and its impact on employment, on commercial activity across all sectors, and on the UK economy as a whole. Evaluation frameworks are essential to help public policy makers and industry leaders recognise where this category of the UK's intangible assets lies and how best to develop and maintain these assets as drivers of sustainable competitiveness in tomorrow's global markets.

Professor Edward Truch
Management Science Department
Lancaster University Management School

How can the industry attract new skills and talent for the future?

Delivering skills and exploiting our talent for future prosperity

An effect of globalisation is a greater movement of skills across geographical borders. Off-shoring means some software skills are purchased overseas, teams of software developers operate seamlessly across national boundaries, and there is an influx of software skills from overseas into the UK. However, as it has been discussed earlier in this report, the development and retention of core skills in this country is vital to the future of software development and the continued innovation in technology in the UK.

Assessing the skills requirement

The organisation e-skills UK has begun to monitor the movement of skills up the software development value chain. Its research finds that 45% of IT staff are thought to hold software engineering skills at 'higher' level or above during Q2 2005 whilst the percentage requiring this level of skills is forecast to rise to 60% by 2008.

Whilst the 'bands' used by e-skills are not clearly defined (in terms of skills and experiences), this research^{vi} points to an increase in the demand for 'higher' development skills over the next three years. The qualitative information gained from interviews undertaken for this report substantiate this fact.

The falling need for programming skills is an indication of the changing nature of software development, from low level coding and programming to 'higher' skills including architecture, design and those functions of software engineering closest to the end user experience and relevant to the business need of the employer.

Many analysts and academics are seeing a shift from talking about software development and design to talking about software architecture. In essence this means that developers require a greater awareness of business strategy and commercial skills as well as their IT knowledge.

"One of the most important skill sets in enterprise IT today is that of what people call 'architects', roles that help facilitate communication between IT and business decision makers. The key value of an IT architect is fundamentally about balancing short-term needs with long-term needs. The short-term needs of projects don't go away: but fulfilment of those needs has to be carried out against a broader understanding of what the business as a whole needs. This of course means that architects have to be able to understand the longer term vision of where the overall company wants to go, and what that means for IT. These skills are hard to come by and are often only acquired through many years of on-the-job experience."

Neil Ward-Dutton, Analyst, Macehiter Ward-Dutton

"The survey clearly demonstrates that the UK will not be competitive in the global economy in 10 years time if we continue with the level and type of skills being relied on by business today."

Karen Price, Chief Executive, e-skills UK, in IT Insights, Trends and UK Skills Implications, Nov 2004

The skills gap in information technology and a perceived lack of people coming into software development with the necessary business skills to bridge the gap between IT, the business, and end user requirements is a threat to the growth of the industry. As e-skills UK reports^{vi}, the current skill levels of the UK workforce and the predicted demands IT will place on businesses is one of the greatest threats to UK competitiveness.

"The survey clearly demonstrates that the UK will not be competitive in the global economy in 10 years time if we continue with the level and type of skills being relied on by business today... There is a tendency to dismiss the subject of skills as a 'soft issue' with no real impact on the economy. To do so in this case would lead to catastrophic damage of the UK economy. IT intensive industries generate 45 per cent of the UK's Gross Value Added, driving new markets and productivity. Businesses are reporting that IT skills shortages are causing delays to the development of new products and services, rising operating costs and failures in meeting customer service objectives. 'IT Insights' tells us that at present we have neither the everyday IT user skills, nor the IT professional skills within our businesses to avoid an economic crisis."

Karen Price, Chief Executive, e-skills UK, in IT Insights, Trends and UK Skills Implications, Nov 2004

If 150,000 extra IT staff a year are needed to fill demand, and under 20,000 graduates from IT related courses are coming through, that leaves a huge number of IT jobs left unfilled. To meet this excess demand the UK needs to; develop new talent, re-skill the existing workforce to move into IT, and attract professionals from overseas to meet demand.

While the UK has a healthy history in importing many different skill sets from overseas, some analysts see immigration as a potential threat to the career opportunities for home grown software developers.

"There's no doubt that there's a big problem. Many large systems houses, for example, employ significant numbers of systems architects, and indeed most are employing increasing numbers at this level. They know that they can get the code writers relatively cheaply and if they can't find a bunch of South Africans to do it they'll get people in Russia or India to do it. But these same companies are screaming because they haven't got enough of the people at the high end and clearly they have got a really serious recruitment problem. They need developers who understand their business, have quality relevant degrees from a quality universities and have proven competencies. Many only recruit from the top twenty or thirty universities."

Mike Rodd, External Relations Director, BCS

Matthew Deacon, President of the UK Chapter of the International Association of Software Architects is similarly burdened by a lack of domestic talent, saying that he interviews many people but hires very few.

Retirement is another big issue for the software development industry as the experienced software developers, architects and designers that drove the boom in software from the 1970s to 1990s are starting to exit the profession.

"Universities are really scratching around for students because no one wants to come into IT anymore. At the same time, the pony tailed guys who wrote all the code for the mainframes have now retired to spend more time with their money. We face a deskilling of our software workforce."

Dennis Keeling, Chief Executive, Business Applications Software Developers Association

Meeting the skills requirements of commerce

"The numbers have fallen off a cliff."

Karen Price, Chief Executive, e-skills-UK

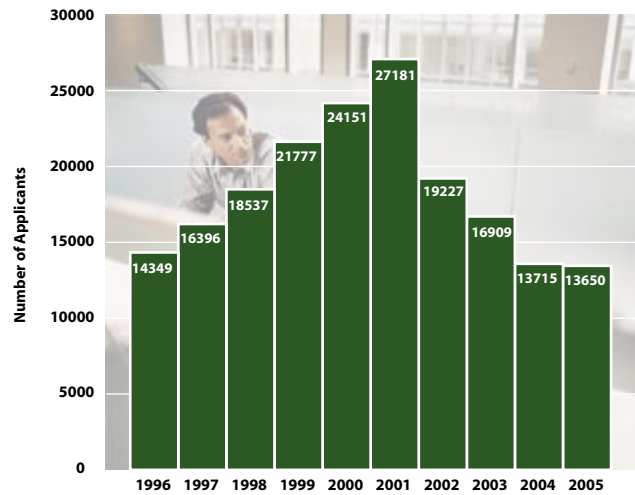
Many academic institutions are failing to attract undergraduates onto their informatics courses; this trend has established itself over the last five years and parallels the decline engineering subjects have seen over the past twenty years.

"The numbers have fallen off a cliff."

Karen Price, Chief Executive, e-skills-UK

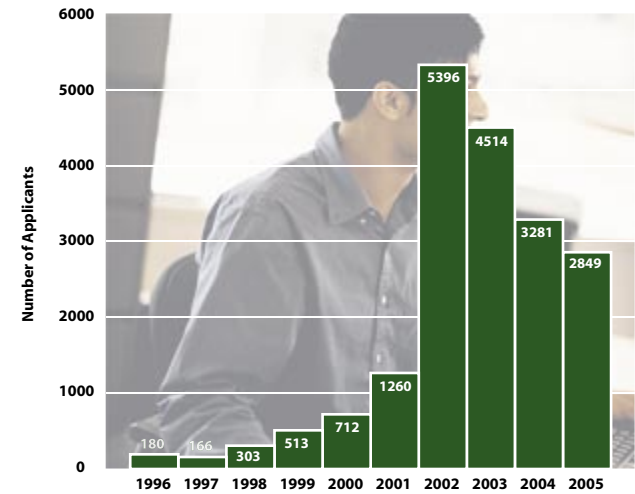
Data from university applications body UCAS shows that there has been a 50% drop in applications for computer science in the past five years, a 47% drop in systems engineering and a massive 60% drop in software engineering applications.

Figure 2 - UCAS Computer Science Applicants 1996 - 2005



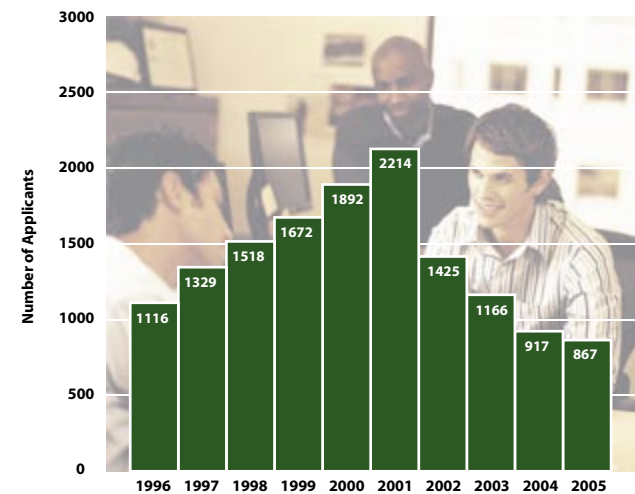
Source: UCAS

Figure 3 - UCAS Engineering/Information Systems Applicants 1996 - 2005



Source: UCAS. (Computer Systems Engineering as a course disappeared in 2002 and Information Systems appeared in its place)

Figure 4 - UCAS Software Engineering Applicants 1996 - 2005



Source: UCAS

e-skills UK also state there has been a decline in the proportion of women on IT courses from 24% in 2000 down to 20% in 2003ⁱⁱⁱ. This trend increases the problem of finding skilled IT people within the UK as employers are recruiting from a shrinking pool of resources.

Industry prefers to recruit employees who have relevant experience: according to an e-skills UK survey, 33% of companies, surveyed, say that they will hire IT people with the relevant experience, rather than inexperienced people or graduates from colleges or universities.

This reliance on hiring experienced staff, rather than young graduates, may be due to many factors. The cost of training and the perceived lack of suitably skilled candidates coming out of universities are two factors that have been mentioned by those interviewed for this paper.

The different perspectives of academia and commerce

The need to develop IT skills is understood by both academia and commerce, however, each has a different set of imperatives. Industry spokespeople representing one side of the argument say that university courses are too focused on basic and outdated skills such as programming. They argue that this produces graduates who are of little use to the software development industry:

“...there is a mismatch at the moment between what the universities are producing and the challenges facing businesses.”

Mike Rodd, External Relations Director, BCS

“Many IT related degrees are presently aimed at the bottom end of the market, aiming largely at producing essentially programmers. However you can go along to some of our very fine, world leading universities and see that they’re still getting the world’s best students attracted by courses which are really up to date. They’re aiming at the higher end of the software development spectrum, essentially the intellectual end whilst others are producing software technicians. Nothing wrong with that, but in ,any cases these are the jobs which are being outsourced.

I believe that there is a mismatch at the moment between what the universities are producing and the challenges facing businesses. Also many universities are not taking on board the many underlying changes that are taking place in the application and exploitation of computing and computer science. Of course many are and are building courses to meet both the needs of business and are also looking to the future and these are the ones which are doing well. They are for example addressing issues of how you bring more business content into computer science degrees. They also appreciate the underlying importance of computer science in underpinning a range of emerging areas, such as cognitive science, medical

informatics, nanotechnology and information security, and are starting to deliver very exciting and attractive cross-discipline degrees”

Mike Rodd, External Relations Director, BCS

“We’ve really got to do some work on education. The people needed to come through universities are the computer scientists with software development skills and those have got to be of a high calibre. Unfortunately some of the degree courses have not been of the highest quality. Consequently we have seen a number of people graduating from university with skills that are OK, but all the feedback I get is that industry is not finding those sorts of people very useful.”

Elizabeth Sparrow, Chair of the BCS Working Party on Off-shoring

“...the speed the software industry is developing is not matched by the speed at which education and training develops...”

Nigel Hartnell, Chair of the Software Working Group, Intellect.

“You’ll get comments from business people saying that the speed the software industry is developing is not matched by the speed at which education and training develops; therefore industry has to train them again. Given that the courses they studied were practical and not theoretical, it is a bit of a waste of 2 years to be quite honest.”

Nigel Hartnell, Chair of the Software Working Group, Intellect.

In summary, this argument states that the poor quality and outmoded courses at the wrong level, irrelevant to today’s requirements, are exacerbating the mismatch between supply and demand within the industry. Indeed commentary like this does little to instil new undergraduates with the confidence that HE is offering innovative courses which will equip them with the qualifications needed to enter a dynamic job market.

With the costs of completing an H.E. qualification increasing (top up fees) those wishing to read for a degree are focusing on the issues of employability and remuneration.

The alternative put forward is that the development of new courses and continual modification of existing ones cannot keep step with the pace of change with the software industry.

“There should be more business skills taught in technical degrees; that is universally accepted as good idea. But when we talk to employers about what they want you will usually get ‘next Monday’s requirement’. We need to be able to balance the huge pace of change with what people are coming through the pipeline with and what specifically they have been taught. On one hand the universities risk teaching history but they also have to

help students build a firm foundation of knowledge.”

Karen Price, Chief Executive, e-skills UK

“The relationship between academia and industry is complicated. I don’t want to sound negative at all, but industry is good at saying that it wants this or that from education and then three years down the line they don’t need those skills anymore. Industry finds it difficult to articulate what it needs in a way that universities can relate to. The crux of the problem is that universities have a very long lived product, while the IT and software industries have very short lived products.”

Keith Mander, Chair, Council for Professors and Heads of Computing

“When I studied Chemical Engineering at university I knew at the end of the day that I could get a job as a chemical engineer in various environments because that’s what they taught me. But the thing is those engineering worlds don’t move very fast. Computing does, and it is moving faster and faster. It’s only recently that businesses have been much more committed to understanding how IT evolves in their own organisation. Businesses aren’t very clued up and aren’t very clear in terms of their own practices and their own processes so you can’t expect computer science courses to match business requirements if they are not clear.”

Bola Rotibi, Senior Analyst, Ovum

These comments acknowledge that there are a range of problems, from the speed of change within the industry, to the lack of clarity of industry requirements. Most industry spokespeople understand that the present situation is a result of a complex set of factors and has to be set within its historical context. The differing opinions indicate there is a need for sustained and honest communication between academia and industry. Bridging the skills gap is vital to the sector and both academia and industry have a vital role to play in ensuring the UK is able to develop its own talent and expertise.

The reluctance of many UK universities to form a partnership with business may have a bearing on the disconnection between business and academia. Many commentators point to a cultural divide between education and business in the UK that isn’t present in the US, for example. But this is not always the case and some universities are using placement schemes with industry to help bridge the divide.

“I run the placement schemes within the school, what we call the ‘industrial experience scheme’ and when I took it over 7 years ago we had 10 students on placement. My colleagues would discourage the best students from going out on placement because it interfered with their academic flow. They were worried if they went out into industry that it would disturb their academic progress. In 7 years that attitude has changed completely because we got more students going out so more of them came into contact with those students when they returned from placement and with all the benefits that a placement gives them. Now my colleagues would take a student that had been on placement in preference to one that had just come straight through to third year because they perform much better in their final year.”

“Now my colleagues would take a student that had been on placement rather than one that had just come straight through to third year because they perform much better in their final year.”

Alexandria Walker, Director PEVE IT, School of Computer Science, University of Manchester

Alexandria Walker, Director PEVE IT, School of Computer Science, University of Manchester

There remains the issue of course content and how this relates to industry needs. In a globalised economy where, basic programming skills will be provided from emerging economies, is there any need to teach these skills domestically? On the other hand, the skills that IT related courses can most easily teach in a fast changing business environment are those which are generic and easily transferable.

“Western developers have a tendency to do ‘art’ in developing programs, unlike their counterparts in the Far East. Development by the latter is seen as a factor of process, where testing tools play a key role and are widely used. However, there is no longer any room for art in the development process. Software applications can be innovative and works of art if created within a well engineered process based framework. The stark truth is that those who underpin development with engineering discipline are more likely to succeed in building robust, reliable, adaptable and maintainable applications that will attract business from all quarters.”

Application Lifecycle Market Analysis, Ovum, 2004^{viii}

There is currently a gap between what academics interviewed for this paper say they can provide industry, and what the companies employing software development say they want.

“We produce graduates with generic skills such as programming that are transferable and adaptable. Graduates will rarely have the skills required of them from industry because they haven’t had experience. It’s always been that way.”

Keith Mander, Chair, Council for Professors and Heads of Computing

However things are changing and efforts are being made towards effective engagement and dialogue between education and industry. It is essential that all stakeholders within the industry understand the importance of this dialogue and the need to respond to the skills crisis at hand.

Professional development

Providing transitional routes into IT may be one way to meet the skills requirement. However the success and impact of this strategy on meeting the need for skills is difficult to quantify.

“The GVA data from the ONS is a very strong message but in a global market we will need a different set of skills. And if 80% of the current workforce will still be in employment in 2020 as is predicted, we will also have a massive re-skilling issue on our hands. We need to start to address both the flow and the stock of people in software and get a more joined up approach to the issue.”

Karen Price, Chief Executive, e-skills UK

Although postgraduate qualifications may be one way to address this re-skilling issue more research is needed to draw further conclusions.

“Some of the people may retrain from other careers and that in itself is a huge issue. Perhaps the solution lies in postgraduate education. There are now as many people with postgraduate qualifications in the UK as there were undergraduates in the 1960s. If there is further expansion in postgraduate qualifications perhaps that is where the future workers in IT and software can gain the specialist skills required by industry.”

Keith Mander, Chair, Council for Professors and Heads of Computing

Commercial investment in universities may help to close the gap between industry and academia while also supporting entrepreneurialism, innovation and research capabilities. It is commonplace in the USA for large software companies to set up and fund research centres in universities and anecdotal evidence suggests that this relationship works well. However, there is uneasiness among the stakeholders interviewed for this report that such strategies for commercial and academic symbiosis would work in the UK, mainly because academics strongly believe in retaining their independence.

“I know that we’re moving forward very much into the idea of building links with companies into our teaching. That way, students will have commercial skills on their CV, and that’s good for us because it means better employability. But companies must realise that there will be resistance from universities if they are at all seen as skilling shops for particular technologies.”

Professor Peter W. McOwan, Department of Computer Science, Queen Mary, University of London

As a conclusion to this section it important to remain focused on the opportunities rather than just the threats facing the UK software development industry in terms of skills. What is required is open and sustained dialogue between businesses, academia, secondary education and the software development community.

“We are already slowly making progress. There is starting to be some collaboration with the higher education institutions. But we still need to do huge amounts of work to address the image of the industry.”

Karen Price, Chief Executive, e-skills UK

There are a number of issues which need to be resolved for the industry to be confident in its ability to continue to innovate and prosper in the future. Available data and stakeholder feedback shows that there is a skills gap and that the single biggest driver for success in this area will be the joint efforts of industry and academia. If the software development industry is to continue to significantly contribute to the UK economy it must resolve this key issue and attract new talent to thrive.

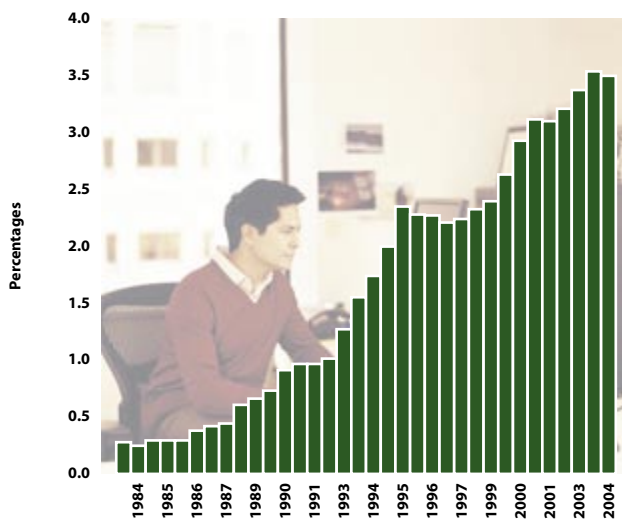


Forecast employment requirements

An in-depth analysis of the predicted number of development jobs required in the UK, the types of development they will be doing and the employment environment is difficult as there is minimal comprehensive data available.

A basic trend can be identified using the rate of increase of people employed in own account software development (figure 5 below) as an indicator or tracker for the industry as a whole. This calculation shows that nearly 4.5% of the UK working population will be involved in the production of own account software by 2014.

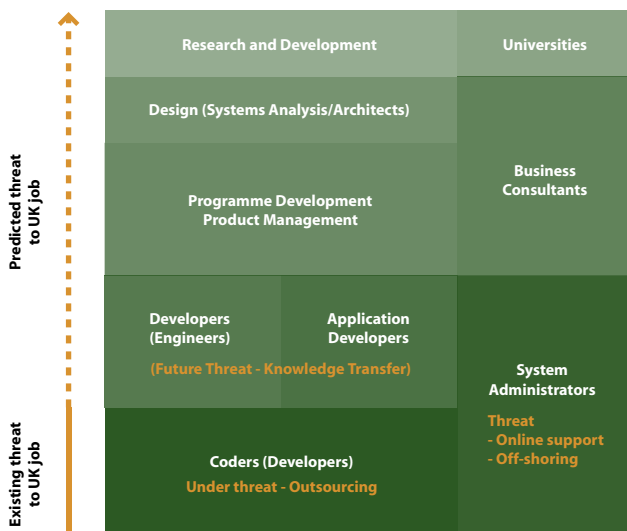
Figure 5 - Employment in own-account production as a percentage of total employment



Source: ONS

As the map (figure 6) of job landscape for software developers shows, the current challenge to UK development jobs lie at the lower level of coding and programming, areas which add relatively little value to the UK software economy.

Figure 6 - Predicted threats to job roles to the UK software development industry Source: Knowledge Partners



Globalisation does not just mean an outflow of jobs from the UK; it is the case that UK jobs are being filled by workers from other countries. This can, in part, be attributed to the increase in size of the European Union and the accompanying EU employment laws that permit people to work in other EU member states.

Over the last ten years the types of software development jobs moved off-shore are believed to have been lower valued; often industry entry level jobs. The consensus of interviewees seems to be that the higher valued, higher skilled jobs are likely to form the majority of those retained within the UK. These include:

- Any skill that requires proximity to the end user
- Design skills that require creativity and innovation
- Skills requiring close appreciation of the business issues that software is written to solve.
- Face-to-face collaboration skills and techniques
- Complex project management skills
- Contract management skills

It has been noted that in the emerging economies there is already a progression from lower level competencies such as coding and programming to higher level skills such as software architecture and business requirements capture. There is no guarantee that the high value elements of software development that UK developers currently consider their own will not move off-shore too.

Skills development

The threat of skills erosion and the decrease in the number of students applying to study computing and STEM subjects are issues that need to be addressed. There are, however, isolated examples of universities (the University of London, City University London and others) that have managed to increase student applications for computer science courses simply by tackling the image of the subject or meeting the aspirations of the young applicants.

Analysis of UCAS³ statistics show a decline of 50% in applications for computer science related courses over the last five years⁴; the qualitative research suggests that these courses need a 30% increase in the number of student entrants year-on-year in order to begin to return to acceptable levels. Even this growth, however, would leave the sector far behind the predicted 150,000 IT professionals needed per annum as predicted by e-skills.

The British Computer Society⁵ has estimated that Indian Universities are releasing 500,000 high quality IT and engineering graduates into the Indian economy every year. By contrast, UK Universities release only 20,000 Computer Science and related graduates every year. This is a clear indication of the importance attached to the software industry by emerging economies; the UK needs to attach similar importance if it is to succeed and remain a global player.

³ UCAS - the central organisation that processes applications for full-time undergraduate courses at UK universities and colleges (www.ucas.ac.uk)

⁴ The decline in applications is greater in other subjects such as Software Engineering and some of the STEM subjects.

Skills & remuneration

Salary levels for the industry appear attractive but some analysts express concern over the impact that substantial salary increase might have on the cost base for developing software.

Software developers are earning in the region of £40,000 p.a. and increases in rates of pay are predicted by Computer Weekly and e-skills at around 3%. Our research indicates that extrapolated rates of pay for software developers will roughly increase in line with inflation to approximately £52,000 by 2014.

As the demand for software architects and individuals with 'higher' value development and business skills increases, one might expect the salaries for these positions to increase more significantly than just by the underlying rate of inflation.

The problem is, however, that the relatively high salaries commanded by domestic software developers put the UK at a disadvantage in a global economy. Emerging economies are already showing signs that they can provide high value skills and not merely software code construction.

The implication is that higher UK salaries will to a commercial disadvantage or unacceptable cost base for production.

There are, however, opportunities for the UK software industry if it embraces globalisation and reduces its cost base significantly and intelligently. Some very agile businesses are already taking advantage of this by changing their business models for software development and distributing the jobs and skills across many countries; thus optimising profits and reducing costs.

One remaining challenge of globalisation is how to develop distinctive competencies in the UK in order to reduce vulnerability from overseas competition.



Commentary

DTI recognises that the UK's computer software and services industry is a major contributor to productivity and competitiveness. The impact of globalisation means that effective management and exploitation of ICT is vital for the UK to remain its competitive edge.

Increasingly ICT employers in the UK are seeking higher-level skills in order to move up the value chain. Highly skilled ICT professionals are needed, including software developers, who can combine business development, project management and technical skills. In addition, the rapid change in technology creates the need to continually upskill and re-skill the existing ICT workforce. DTI works closely with the employer-led e-skills UK (the Sector Skills Council for ICT), industry and other key stakeholders to help sustain and develop the UK's ICT skills and encourage ICT creativity and innovation.

The UK cannot compete on labour costs with some developing overseas ICT markets. ICT firms in the UK therefore need to raise their game by investing in new technology, workforce skills and to move into advanced, higher value activities. The Government will continue to focus all its efforts on keeping the UK economy strong and stable, generating more and better jobs by raising skill levels, supporting enterprise and raising innovation and productivity in business. That will enable the UK economy to be best equipped to respond to global challenges.

DTI Electronics & IT Services Unit

What can be done to create a modern image for sustainable competitive advantage?

Information technology, attracting the elite of the new generation

Attracting new and professional talent into any industry is vital to its renewal and growth. In a communication rich society most people are aware of changing images and perceptions and this is as true of the information technology industry as it is for music and fashion. Image matters. It conveys powerful messages that many respond to, and used cleverly image can manipulate even the most intellectual; the requirement to manage the image of the software development industry is crucial.

Image, a powerful driver for change

Many perceive the stereotypical picture of people working in IT as the truth. When asked what single thing should be done to ensure a healthy future for the industry in the UK, almost all those interviewed said that something has to be done about the negative, male dominated and technical image of IT. This image is pervasive in the media, and is a factor in putting young people off choosing IT as a career.

The stereotypical image, the generally negative perception of off-shoring, the skills gap and a drop in IT employment levels since the dotcom bubble burst, has left many people with the impression that software development in the UK is doomed.

"I do loads of presentations to IT professionals around the country and some guys are really upset, really feel they've been very badly treated, they actually feel it's the end of the profession. They say things like 'I wouldn't recommend my son or daughter to go into IT, it's dreadful'"

Elizabeth Sparrow, Chair of the BCS Working Party on Off-shoring

"I do loads of presentations to IT professionals around the country and some guys are really upset, really feel they've been very badly treated, they actually feel it's the end of the profession."

Elizabeth Sparrow, Chair of the BCS Working Party on Off-shoring

"Once every two weeks I leave a meeting extremely depressed because China is going to graduate 100,000 computer scientists a year and India graduates 500,000. Here we are in the UK, and we've got problems. and so all this grumbling about media studies has some substance behind it... I think there is a serious perception problem. You'd say it's amongst school kids but it's really not, it's amongst parents. Is IT a good profession? Look

at the IT Crowd sitcom on television. There is that image of the traditional IT geek again. I don't want my kids to do that. We've seen this problem in the engineering profession for the last 50 years, and we have the same problem in software."

Tom Wills-Sandford, Deputy Director General, Intellect

"Once every two weeks I leave a meeting extremely depressed because China is going to graduate 100,000 computer scientists a year and India graduates 500,000."

Tom Wills-Sandford, Deputy Director General, Intellect

"You look at the media profile for computer science and information technology, and it is fairly geeky. The Channel 4 sitcom, the IT Crowd is a classic example of that, where they're showing people as being figures of fun, kept locked away in a basement who are unable to communicate with people. Whereas of course the reality is that to be a good software engineer requires very good technical skills combined with very good interpersonal skills."

Professor Peter W. McOwan, Department of Computer Science, Queen Mary, University of London

"You look at the media profile for computer science and information technology, and it is fairly geeky. "

Professor Peter W. McOwan, Department of Computer Science, Queen Mary, University of London

"The whole image of our sector as a long term career leaves a lot to be desired and this is a problem when you look at the sixth forms and students making choices for university education. We need a consistent supply of young people."

Karen Price, Chief Executive, e-skills UK

The perception of IT in business is due to many things. IT has had a bad press in the UK since the collapse of the dotcom economy in the late 1990s. As Tom Wills-Sandford, Peter McOwan and others point out; the media's portrayal of IT employees is not necessarily sympathetic, gender inclusive or aimed in any way at overturning the stereotype of computer scientists. Furthermore, the IT trade publications and

national media are full of stories about high profile IT disasters in business, project overruns, poor budgetary control, and the loss of jobs and skills overseas.

"We're going through a horrendous period of outspoken highly-visible public criticism of IT project 'failures' and this is very unfortunate and damaging, especially given the amazing success of many extremely large and innovative projects. In truth though are these failures due to IT problems? Of course they are no, the inherent technology is well proven. It's largely a problem of expectations (normally by politicians) of what IT can do, accompanied by little understanding or appreciation of the real user needs. Much of the reason the IT profession is getting criticised at the moment is the misconception by the public, and particularly by parliamentarians, of what IT can deliver, rather than the fault of IT."

Mike Rodd, External Relations Director, BCS

For the software development industry, the issues surrounding project failures and the high costs of developing and deploying software have been particularly problematic.

"Many business users at the receiving end of developed applications have found software development to be lacking. Development projects have tended to have unacceptably high failure rates, failing in one way or another to deliver the value expected by the business. Development projects and the subsequent maintenance of the applications, have taken an unjustifiably larger cut of the IT spend... The backlash against IT, particularly software development projects not delivering value, has driven software vendors to take on the responsibility of restoring the credibility of the software development process. Compliance, governance, process and accountability are the main themes driving the way software vendors position themselves in the market today."

Application Lifecycle Market Forecast, Ovum, 2004*

Software development in business is maturing, it understands the need to closely manage its processes and increase value adding capabilities. Businesses cannot justify large scale research and development and the huge software budgets of a few years ago without a full analysis of the benefits. Serious financial and business issues are the ones now supported by software development, where the finance directors and heads of UK businesses can see the most benefit from the software they are paying for.

This is of course a generalisation, but there is growing pressure on software developers to become more process and commercially focused. Whilst these skills may not promote software development as an exciting and creative industry, they prove that it has the professionalism and commercial awareness to ensure its future.

"The geek image of the developer is a perpetual problem. It takes a long time, from personal experience, to overcome this to get business engagement. But what do you do? Do you make the developer wear a suit? It's like the rock star scenario; if you took the lifestyle away from the rock star

would they still produce the same output?"

Matthew Deacon, UK President, International Association of Software Architects

Creativity is important for innovation, and a balance needs to be struck between pushing software developers into commercial roles with business and retaining and cherishing their inventive skills.

The importance of industry image to young people

The image of IT within business is important but not as high profile as the image of IT among young people when they are making their career choices. This overall industry image and perception of IT among pupils in all levels of education, and their parents, is an important factor in fulfilling the demand for software developers domestically.

E-skills UK data^{xi} shows that only 3% of students take an IT related A-Level and GCSE students passing IT related subjects decreased from 83,000 in 2002 to 65,000 in 2003. Of course not all software developers have IT backgrounds as has been noted previously, but these statistics are nevertheless worrying.

There are many factors that key spokespeople interviewed for this paper cites to help explain this drop off:

"In the past probably 50% of the students that came to do computer science in all universities saw IT as a career to go into, where you could earn good money and there was plenty of work. Parents encouraged their children to study computing because they saw it as an industry with opportunity. If you didn't want to do accountancy, law or medicine, then computing would be a good choice. When the bubble burst there wasn't so much of a push from parents to look at IT as an option for a career. You don't get made redundant as a doctor."

Alexandria Walker, Director PEVE IT, School of Computer Science, University of Manchester

"Kids in schools are unclear about the subtle differences between computing, IT and computer science. It is all the same as far as they are concerned. Up to about the age of 10, kids do a lot of IT. Between 10 and 11 they sit their SATs and computing takes a back seat. Then they go to secondary school and because not everyone is at the same skill level, a lot of kids end up repeating stuff they did when they were 10. At that point they switch off."

Keith Mander, Chair, Council for Professors and Heads of Computing

"A particular concern is in the perception of the subject by kids in school. I think that there are significant difficulties here caused by the pervasiveness of ICT technologies. Schools teach ICT A level and there is also a computer science A level and it's very easy for students to confuse the two of them. So we end up with these weird situations where we speak to school kids and ask 'would you like to study computer science at university?' First most kids don't know what the subject is about, some think it would

be too hard because it involves maths, others that it wouldn't be very challenging at all because it's like ICT and they can already do that. 'I can use spreadsheets and I can use word processors, so I don't want to bother doing that at university,' they say."

Professor Peter W. McOwan, Department of Computer Science, Queen Mary, University of London

"In terms of recruitment into the profession and kids going to do degrees there is a misunderstanding of what the IT profession is about. For a lot of the kids, to study IT or computing at university is seen as a pretty boring task. They just don't see the intellectual challenges, the exciting range of applications and the relevance of all this to every aspect of our future society"

Mike Rodd, External Relations Director, BCS

The image perception of software development and IT is the result of the interaction of many factors, and encouragingly change is within the power of the industry itself. The comments above indicate the importance of tackling the issues within schools, as even at this young age there are misconceptions about the subject area.

Organisations such as e-skills UK, industry bodies and the government are taking measures to encourage more young people, especially girls, into IT and software development. For example, The Computer Clubs for Girls (CC4G) is an innovative, award winning initiative created by e-skills UK and funded by DfES^{xii}.

Some universities are also taking proactive measures to encourage more secondary school students onto their computer science courses. As Peter McOwan says, universities do not necessarily help themselves as the marketing literature for computer science courses tends to be dominated by pictures of white males sitting in front of computer screens. The traditional image of computing is just not as exciting as, for example, aeronautical engineering where you can have pictures of people standing around modern aeroplanes. Part of the solution might be to get academics talking in secondary schools and working with students to show how exciting and creative subjects such as software development can actually be.

"Whilst application rates this year nationally for computer science have dropped by 10%, our application rates have gone up by 85%"

**Professor Peter W. McOwan,
Department of Computer Science,
Queen Mary, University of London**

"After the boom of the years running up to the millennium bug and the dot com bubble we, as most departments, saw a cumulative year on year drop off in student applications. Last year we decided to do something about it so we started to go out, do lots of schools talks, sending out the message that computer science is actually quite a fun creative subject. It's not just about sitting behind a computer. We developed something called 'CS4FN' our Computer Science for Fun magazine. We went out and made a very concerted effort to try and get kids aware and interested in the subject. It was a productive, and actually enjoyable, venture, application rates this year nationally for computer science have continued to drop, but our application rates have gone up by 85%"

Professor Peter W. McOwan, Department of Computer Science, Queen Mary, University of London

The trick with engaging with school children is also to show the end result of computer science and not the nuts and bolts of programming.

"Students are forever saying that writing programmes and algorithms are far too difficult. But when you ask them how does 'Who Wants To Be A Millionaire?' on the television work they can tell you. Of course 'Who Wants To Be A Millionaire?' has an algorithm and software development involved in it. We've got articles on how to do very simple procedural programming by using the idea of a new game show like that example in. That seems to be working. People are suddenly seeing the context of it rather than it being a weird and abstract thing that's not applicable to real life."

Professor Peter W. McOwan, Department of Computer Science, Queen Mary, University of London

The tools that help in design and creative industries, the machines that help save lives in hospitals, the engine management controls in Formula One cars are the sort of innovative solutions that will help to interest students in IT related careers. Young people need to be shown that software development is about invention, creativity and highly developed skills, which in turn create some of the most innovative and essential products that drive the UK economy

"You have to in some way offer the end product. So it's not actually what happens at university it's more to do with where students will go after university and making that career path obvious to parents so then you've got them helping to encourage their children."

Alexandria Walker, Director PEVE IT, School of Computer Science, University of Manchester

Encouraging IT as a career choice

There appears to be a dichotomy between the perceived state of IT as a career choice in the UK and the realities of a skills shortage within the industry. The UK needs software developers to not only fill the existing jobs but also to develop the new and world leading software technologies to build on the success of the products that the UK has been producing for the past thirty years. Some commentators see a risk to science and engineering disciplines as a result of the current emphasis on creative and arts disciplines, some predict that this shift may swamp science subjects over the coming years.

“We have to try and promote computing as an exciting thing to study.”

Nigel Hartnell, Chair of the Software Working Group, Intellect

“If you look at the UCAS figures the most popular courses are those in ‘creative industries’, so design studies, fashion, photography, etc. But you aren’t going to run UK plc with vast numbers of graduates coming through with media studies. We have to try and promote computing as an exciting thing to study.”

Nigel Hartnell, Chair of the Software Working Group, Intellect

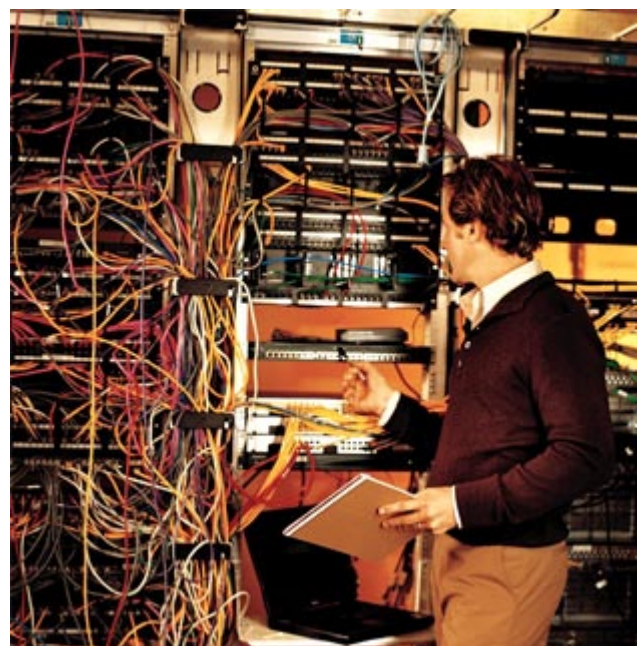
With a dedicated industry, academic and government effort the image of the IT and software development industry can be updated and many inaccurate perceptions changed. Some initial progress has begun at various levels, by all of the key interested parties. Although this action and progress is not sufficiently co-ordinated there are pockets where change is having a positive effect. There is obviously still a lot of work to be done in meeting this most problematic of challenges for UK software development.

“The BCS has accepted the challenge to create a true IT profession and to be the home for the IT Professional. Key to this is that we must produce a picture of what the IT profession actually is. Clearly working with schools on the image of IT is important, but the perceptions of what the profession is can only be achieved by a combination of people, requiring real leadership from government and politicians and involving parents, schools and universities and of course industry. There is a major piece of work to be done here.”

Mike Rodd, External Relations Director, BCS

The industry image is inextricably linked to the complex issues of off-shoring, skills, funding and creativity as well as the overall business environment for software development in the UK. Inevitably it will take some time to resolve many of these issues, however, if all those effected by the industry unite in an effort to resolve many of its problems then it can concentrate on developing successful long term

growth. As it has been noted, the UK has a reputation for creativity and this would help in creating successful software products that change lives and economies.



Commentary

Amicus is the second largest union and the largest private sector union in Britain and Ireland, with over one million members across all sectors of the economy.

Our vision is of a prosperous society in which employers and employees work together to build successful businesses and safe, healthy working environments. All those who contribute to their success receive the rewards, respect and recognition they deserve.

We have an autonomous sector dedicated to serving the interests of IT Professionals, with the expertise and experience of representing members in over 300 IT companies, including Accenture, CSC, EDS, IBM, Fujitsu and many others. In addition we represent people working with IT in Financial Services, Manufacturing, Business Services and many other sectors.

Improving dialogue, upskilling the workforce, sharing our expertise, and developing best practice are examples of the common goals we share with businesses. We work to ensure that people are equipped to the necessary level with the skills needed to compete and prosper, and have championed the role of workplace learning representatives to offer advice on learning opportunities.

Amicus has a substantial Parliamentary presence of 114 MPs at Westminster and 12 members of the European Parliament to provide political influence in employment legislation, representation to government and in Parliament and in campaigning to strengthen rights at work. As well as campaigning on broad issues such as skills, pensions, a level playing field across Europe for business and government procurement, and economic and monetary union, we work closely with industry and individual companies in joint initiatives to government ministers and departments on issues where the interests of our members converge with those of the employers.

Peter Skyte heads up responsibility for the high tech industries. He serves on the Home Office Work Permits Panel that advises government on work permits policy for the IT, Communications and Electronics sectors, is a member of the Electronics Leadership Council, and the DTI round table on Offshoring and Outsourcing. He is also a member of the EU e-Skills Forum.

Amicus

www.amicustheunion.org

What strategic initiatives, policies and data are required to develop a leading-edge industry?

The application of commercial acumen to innovative thinking will attract greater funding and greater prosperity

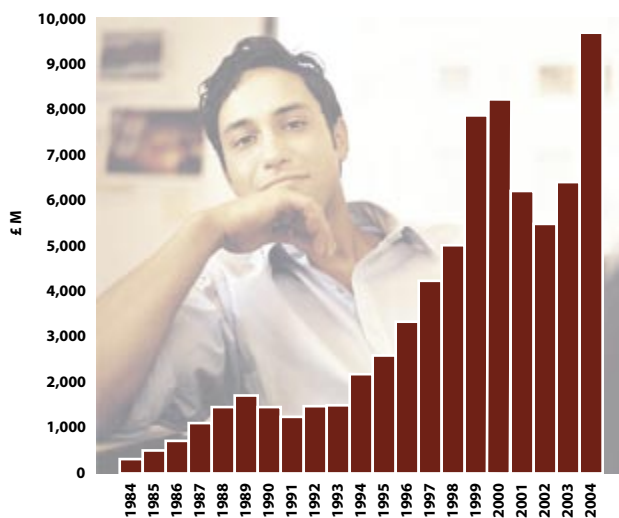
Whilst discussing invention and creativity in the UK software development industry, it was noted that investors and business 'angels' are faced with a huge number of inventive ideas to finance; but maximising investment in these new ideas is often restricted by a serious lack of commercial awareness and entrepreneurial spirit for the innovation proposals placed before the investors.

Technology attracts business funding

The UK private equity industry is the largest and most developed in Europe, accounting for over half of total annual European private equity investment in 2004.

The latest report^{xviii} from the British Venture Capital Association shows that UK private equity firms experienced a record level of investment activity in 2004, totalling £9.7 billion, an increase of 52% in investment levels on the previous year's figure of £6.4 billion. This demonstrates a continuing rise in market confidence and substantial opportunity for software companies looking for funds for further development and growth.

Figure 7 - Funds invested by private equity firms 1984 – 2004



Source: BVCA

The report shows that computer related companies accounted for 38% of all technology companies backed and 33% of the total investment. Software companies were the largest individual category in terms of number of companies invested in, with 198 companies backed, a decrease of 38 from 2003. They were also the largest category (by value invested) with 27% of the total invested in high technology at £180 million, up from a 19% share in 2003.

Investors are backing approximately 200 software companies per annum, many of which are smaller businesses at the earliest stages of their development. The BVCA report shows that 54% of all technology companies backed were at an early stage, up from 45% in 2003, with a further 42% at the expansion stage (50% in 2003). In terms of total investment, expansion stage companies received 59%, up from 33% in 2003 and early stage companies received 28%, a small increase of 1% from 2003.

Forecasting funding

Ignoring spikes in investment activity (notably related to the dot com boom) a general estimate of the levels of VC funding in the UK in 10 years time would be in the region of £15bn a year. Software companies currently account for 22% of businesses funded by VCs but they are attracting only 5% of the total investment capital.

Using the estimated projection of £15bn for 2014 (above) analysis indicates that this will equate to an estimated £750m invested in software companies. However this may be a low figure given the current growth rate of the industry.

Funding opportunities

Analysis of investment activity in 2004 has shown that UK private equity companies showed a record £9.7 billion level of investment, an increase of 52% on 2003.

The NVCA calculates that 24% of US investment (c.\$5bn) was made in software alone, this compares well with the 27% of total investment (c.£2.6bn/\$4.2bn) made in the UK.

Although these levels of investment are not wildly different it is clear that most of the world's largest and successful software companies are American. There is not a single company in the UK that is comparable in terms of market capitalisation, revenue generation, and number of employees. The largest, including Microsoft, IBM, Google, Dell and Apple are all USA businesses with vast global reach.

The culture of risk taking and entrepreneurialism in the USA when compared to a traditionally more risk averse and less entrepreneurial culture in the UK may be a significant factor that stimulates growth and success.

"All the biggest software companies in the world, with the odd exception, are US companies."

Benjamin Davis, Associate Director of IT merchant bank Interregnum

"All the biggest software companies in the world, with the odd exception, are US companies. So something is going wrong in the UK. Software companies in the UK tend to be small and essentially act as feeder companies that are acquired by larger US software houses. The culture of the EU and UK is one factor. The US tends to be risk taking and impetuous. In the EU we are more subdued and don't feel the constant pressure to continually achieve."

Benjamin Davis, Associate Director of IT merchant bank Interregnum

Davis' comments are levelled both at the software companies and at the VCs themselves. Many VCs in the UK, he argues, are only interested in the big deals that carry minimum risk. Smaller software companies are, it's argued, too risky to offer solid and substantial returns, a view, exacerbated perhaps, by the losses made from poor investment choices in the 1990's.

"The anecdotal evidence points to the fact that the venture capital industry appears to have moved away from being really concerned with venture capital. Effectively, it has become concerned mainly with leveraged buy outs of underperforming divisions in large FTSE corporates where they can do a quick turn and make a billion. VCs are not saying: 'I'm going to put £10 million in this small company and £10 million in this one and £5 million in this because that's hard.'"

Nigel Hartnell, Chair of the Software Working Group, Intellect

Funding from business angels

Business 'angels' are an alternative source of investment capital, albeit on a small scale to venture capital investment. The British Business Angels Association estimates that 25% of private funding in the UK comes from wealthy private investors.

The investment company, c2 Ventures, which provides business advice to companies seeking to raise their profile in the investment community, concluded that^{xiv} the level of business angel there are 18,000 business angels in the UK actively looking to make investments. It also believes that these angels invest around £500m a year in the UK in around 3,500 companies.

C2 Ventures also finds that nearly 80% of all business 'angel' funding in the UK in 2003 was for sums of less than £50,000, the sort of levels of funding that are required by small start up business but would not be of interest for venture capital backers.

The areas for growth for business 'angel' investment are led by the software industry with nearly 15% of respondents questioned citing it as the hottest sector for funding. The research shows that the top 5 sectors for future growth in investment are:

- 1. Healthcare**
- 2. Bio-technology**
- 3. Software**
- 4. Professional Services**
- 5. Electronics**

Therefore there is a strong funding base for software start-up companies in the UK from the 'business angel' network, but small software companies need to balance inventive ideas with commercial acumen and the right skills base to secure funding.

Further analysis may show the real weakness is not the ability to generate new ideas but a weakness in business development or sustained marketing and sales. The data collected here points to the fact that investment is available for 'start-up' businesses. However given that there are very few large UK software development companies it suggests that there are barriers to growth and perhaps this indicates that an issue exists in securing 2nd or 3rd phase business development funding.

Government incentives

Private equity is not the only source of funding for software development in the UK. One of the most important incentives in software development are the research and development tax credits first introduced by HM Treasury in 2000^{xv}. This is a 150% tax credit for small and medium sized businesses and a cash element of up to 24% of R&D expenditure payable to non-profit making companies. In 2002 the scheme was extended with a 125% tax credit for large companies.

HM Treasury published an update^{xvi} on progress made with tax credits in 2005, showing that in April 2005 around 17,000 claims for R&D tax credits were made with around £1.3bn of support claimed. Only 2,000 of these claims were made by large companies, and in general people interviewed for this paper agreed that the scheme worked better for smaller companies rather than large enterprises

"There are two different systems, one for SMEs and one for large companies. The system has largely benefited the SME sector. For large businesses the amount available is barely above noise level. What we'd like to be doing is attracting the Microsofts and IBMs and Motorolas to do R&D over here in software. But tax credits for large businesses are only worth 3 or 4% of the total cost of any development project. It's nice to have, but it's not going to change a large company's mind on where they are going to invest in R&D"

Tom Wills-Sandford, Deputy Director General, Intellect

The tax credit system has proved useful, but there have been some problems related to the allocation process. There are examples where tax credits have been denied because developers reuse code to create new applications, yet this technique has been used in software development for years but has been disallowed by the rule of the tax credit system.

"We really, really, really have to change the attitude of the Revenue. No-one is going to argue that designing a new molecule isn't R&D, but a molecule is made up of building blocks called atoms. And they're probably not going to argue that designing a new microchip isn't R&D because moving around 10 nanometre wires is all impressive stuff and it's tangible. But software is difficult to visualise."

Tom Wills-Sandford, Deputy Director General, Intellect

Some of the issues highlighted in this report are already the subject of review, with efforts underway that are aimed at standardising the processes (Intellect are involved in Inland Revenue staff training.)^{xviii} This example confirms the need for all those involved in the industry and concerned about its development to work together to ensure that all investment and commercial opportunities are optimised.

Overall Tax Credits appear to be relatively successful and there are plans to extend it. In its R&D update^{xviii}, HM Treasury reported that claimants have said that applying for R&D tax credits is getting easier. The budget of March 2006^{xix} announced that the government is considering rolling out tax credits to medium sized companies. However, this proposal is subject to state aid clearance by the European Commission which could take up to 2 years.

In summary, funding from private equity as well as R&D tax incentives are essential to support development of the software industry. The picture is complex and it would be benefit from further research and analysis.



Commentary

We clearly all have a mission, and an important one.

Almost everything now and in the future that entertains us, let's us communicate and do business involves creative, wonderful software, it lets new ideas come to life and it's these facts that we really need to get across to all the stakeholders, particularly school kids.

We are all in this together, we all need to inspire and inform the next generation of software engineers. We need to gather information to make our case, change perceptions, highlight successes and make the software engineering career look enticing and worthwhile. Universities and Industry need to continue supporting each other, while respecting the others concerns. Software is about more than programming - it's about people too. We must continue developing the wider business and people context as part of University degrees if we are to encourage more students to enter the field and find gainful employment afterwards.

This move forward needs to be on multiple fronts. History shows many students will often select a subject based on their perception of future job prospects and pay, we need to get the news out that there is a good career waiting there for them. But we also need to make them want to study the subject because it's something they will find relevant, challenging, creative, sociable and enjoyable. I believe getting across the concept of 'serious fun' lies at the heart of any renaissance, and if we can put the 'people' into programming then many of the media stereotypes will fade.

Large scale initiatives by Industry and Professional bodies are vital and will provide the authority to convince students on the future employment front which will go some way to help, provided the message is communicated in a form and forum that is appropriate to the audience. Changing the image of the subject is more challenging; it will involve both large-scale national effort through success stories in the media, events, and positive role models, just think what the TV show *Silent Witness* did for forensics! This needs to support small-scale local effort in schools with kids, teachers, parents, LEA's and school clubs. It will be a long slog, but it's not a mission impossible.

Professor Peter W. McOwan
Queen Mary University

Ideas alone do not make for a commercially successful industry

Invention, the creation of cutting edge software, and products driven by software, is vital to the prosperity and continued growth of the UK software development industry.

A quotation from Deloitte Research, included in the recent BCS report on offshoring, lays out the challenge. It is currently not possible to accurately measure the unique selling points, key skills and economic contribution of the UK software development industry to the UK economy. As a consequence it is difficult to identify what types of innovation occur in UK software development.

"It must be acknowledged that the UK has been unable to produce many, if any, global software brands, with Sage probably being the honourable exception. In addition, there is also very little good data on the industry; in fact there is probably little agreement within the industry as to the definition and size of its constituent parts, let alone their other key measures. It is therefore little wonder that the industry is misunderstood by legislators and government, or even by its peers within the business community. Investors retain a considerable scepticism for the sector resulting from the dotcom boom and bust."

A Possible Agenda for Intellect's Software Working Group, Intellect^{xx}

Without the ability to analyse the industry at a fundamental level, the effect of new initiatives designed to strengthen and develop the industry will remain unknown and impossible to measure. Without an analytical means to evaluate the successes and failures of the industry it becomes virtually impossible to devise policies that will have the right impact; policies that facilitate growth and innovation.

There are certain factors which affect the industry which are well understood, one of these is the reasons why the UK is an attractive location for software development. English is the language of business throughout the world, the UK is a prime geographical location, with innovative software development clusters in the Thames Valley Corridor and around Cambridge, with a very strong historical track record in software development. However the analysis becomes more difficult when trying to establish what sort of development is being undertaken in the UK.

Qualitative evidence^{xxi} suggests that the banking and financial sector develops huge amounts of proprietary software for use in house, here the data handling and customer relationship needs are some of the greatest. Likewise, telecommunications companies have strong development pedigrees and are some of the largest employers in the UK.

The ONS' recently revised approach^{xxii} to valuing software investment has highlighted the importance of software development to the UK's

"Information Technology is at the heart of the UK economy and is a key source of competitiveness for all sectors, opening new markets, increasing performance and driving productivity."

IT Insights: Trends and UK Skills Implications, e-skills UK, November 2004

economy. It has revised the contribution to the UK economy by 'own account software' (i.e. software developed in house for in house use) from £2.5bn in 2003 to £13bn in 2005. In turn this recalculation raised Gross Domestic product by 1% and revised annual growth rates for all years since 1992. It is accepted that Information Technology is a key driver for UK economic prosperity. Furthermore, the importance of innovation in software is not only being realised by government statisticians:

"Information Technology is at the heart of the UK economy and is a key source of competitiveness for all sectors, opening new markets, increasing performance and driving productivity. The United Kingdom has established a vibrant IT industry and many of the critical conditions to be a world leader in its exploitation of IT. The UK's IT industry alone produces an annual Gross Value Added (GVA) of £30 billion. IT intensive industries represent 45% of the UK's GVA."

IT Insights: Trends and UK Skills Implications, e-skills UK, November 2004

Figures such as £30bn and 45% of UK's GVA are significant, in fact e-skills UK and OECD analysis rank the UK IT industries GVA higher than all G7 developed countries apart from Germany.

In summary, although it may not yet be possible to dissect industry data as well as is required, it is certain that the software development industry is vital to the growth and health of the UK economy and that its development is an essential for the future.

Investing in the future

The DTI report (June 2004^{xxiii}) illustrates that although software is a key contributor to the UK economy, the US still leads the world in the number of large software companies it produces.

It states that this is due to the USA mastering the commercial requirements of producing successful software. The USA performs well in terms of product development, as it recoups initial investment in development through the sale of large volumes of software licences with

very low marginal cost of production. The US also performs strongly in terms of concentrating commercial activities on sales and marketing. Therefore their business processes successfully merge all activities from initial R&D to sales and marketing, into an efficient mechanism generating substantial profits. When US software companies exhibit innovation, they do so not just in terms of product development, but also through commercial innovations in marketing, and higher investments in research and development. Although the UK has considerable strengths in innovation it is weaker in some of the commercial aspects of the business process.

A quotation from Deloitte Research, included by Sparrow's lays out the challenge to the UK technology industry as two fold. Firstly, the IT workforce needs the specific skills and training to ensure competitiveness. Secondly, putting that training into producing commercially viable products, such as software, will be where the UK really adds value to IT.

"The UK needs to provide technology training and education that allows the workforce to generate significant value add, partly through understanding the technology itself, and partly through understanding how to deploy, manage and commercialise it. The UK should focus on creating individuals who have an unrivalled capacity to turn science into technology, and technology into specialised, commercially viable products, services and solutions."

Deloitte Research, 2005^{xvii}

Combining talent with entrepreneurial spirit

It is almost impossible to argue that the UK is lacking in terms of inventive ideas, software development needs to go hand in hand with commercial development if invention is to be turned into commercial innovation.

Benjamin Davis, Associate Director of IT Merchant Bank The Parkmead Group plc (formally Interregnum) says that the traditional UK business culture may have something to do with placing barriers in the way of turning business ideas into successful commercial propositions. He cites an historical lack of entrepreneurialism in the UK and a cultural divide between old and new wealth; where self made, successful business people are looked down upon, even though he says, this attitude is beginning to change.

Jeremy Beale at the CBI, echoes Davis' concerns that a lack of entrepreneurialism is one of the UK's major impediments in technology development.

"I believe that there is enough money in the world but it is about attracting investment into the UK and having a system that is attractive for them to want to come and invest here. Additionally I think that there is an issue that relates to risk taking in the UK, moving from the invention stage and into the innovation stage. If we could boost that transition, which Gordon

Brown has been trying to do, it would certainly help to attract funds."

Jeremy Beale, Head of e-business, CBI

Commercial acumen and entrepreneurialism are key to securing funding from venture capitalists, and consequently establishing new businesses that meet the challenge of innovation.

The business advisory company, c2 Ventures, which provides business advice to companies seeking to raise their profile in the investment community, has undertaken some analysis of the level of business angel funding in the UK and the opportunities and challenges for funding small start-up businesses.

Its research shows that almost 84% of business plans received by the 'business angel' community are rated as average or poor, with only 16% of plans meeting an above average score. Not one of the respondents rated a business plan as excellent. The report suggests that this fact, along with recent market conditions probably accounts for less than a 2% funding success rate.

It also finds that more than 25% of early stage companies spend over 90% of their funding on product development, with fewer than one in five companies spending more than half of funding on market awareness activities.

These challenges suggest that start up companies developing software need to spend more time and effort working on effective business plans in order to receive funding. Additionally they need to allocate a larger proportion of their funding to building market awareness for products; development activities on their own do not guarantee commercial success.

Applying commercial knowledge to support innovation

University 'spin outs', where one would assume that many of the most innovative and ground breaking pieces of software are developed, face many of the same problems of securing funding.

"Supporting start-ups and research is an issue. We have an example from this school of a company that was spun out from research at the university but it took many years to actually find the funding to take that company out, but that company is now flourishing with over 70 software engineers. This is the company that have supplied the technology for Apple's Rosetta capability, the software that has enabled Apple to move to Intel X86 chips. Transitive have based themselves in Manchester, they recruit from our school every year and it's a very exciting company to work for. But it took 3 years before that idea could get funding, and a further 3 years to get a product to market and a lot of people can give up in that time."

Alexandria Walker, Director PEVE IT, School of Computer Science, University of Manchester

One of the major problems, according to the British Venture Capital Association, is that 87% of investors surveyed view the typical university 'spin off' as a relatively immature prospect for the VC community; this is reflected in lower levels of investment. It says that equipping 'spin outs' with more of the commercial attributes of other early stage innovation companies would be beneficial. It goes on to argue that the ability to attract experienced entrepreneurs would be an important step in this direction. Crucially, the lack of commercial entrepreneurialism is a key factor in preventing good ideas becoming good products.

There is certainly no shortage of money spent on R&D on software in the UK. The DTI's R&D Scoreboard 2005^{xvii} highlights that software companies dominate the R&D intensive companies in the UK. Many of the other sectors (figure 1) will also make huge investments in software developed in house for in house use.

But what is this R&D budget being spent on? Is it in the creation of new innovative ideas, the marketing and sales of these ideas, or simply on the process of developing the software itself?

The consulting firm McKinsey outlines that below, often 50-70% of companies' total software budget is spent on custom application development.

"Companies in many sectors spend well over half their applications budgets on custom software, used largely to enhance, support, and operate customized systems. For large companies in competitive, fast moving industries such as telecommunications, financial services, high tech, pharmaceuticals, and media, those outlays can run into hundreds of millions of dollars. Banks, for instance, frequently build custom applications to support new financial products or to manage risk. Pharmaceutical companies regularly build custom applications to support R&D and marketing activities.

An approach some companies have used to turn elements of custom applications support into packaged activities involves standardizing the

maintenance, support, and software management activities that groups of applications share... The upside of this approach is now quite clear. One company that adopted these support and maintenance principles reduced spending on applications maintenance by 30 percent—amounting to 60 percent of the entire applications budget—and speeded up the deployment of new applications, thereby completing in two to three weeks what once took two to three months.

In essence, such companies have taken the writing of reusable code, an idea as old as computing, into a new era. The task is to create software that performs a particular function—calculating an interest rate or targeting a customer, say—and then to reuse it in any new application that might need this functionality. In the past, locating such code and deciding how best to use it were difficult because this knowledge could be shared effectively only within a tightly knit team."

McKinsey Quarterly on Information Technology, March 2006^{xviii}

McKinsey highlights that applications need to be designed, developed and tested more quickly. At the same time, these applications also need to be robust, scalable and meet the needs of the business or end user, whether in packaged or own account software.

Invention in terms of software development, it seems, is not just about coming up with the ideas in the first place. Whether software developers are individuals, research spin outs, the smallest start-up or the largest enterprises, invention needs to be supported by commercial acumen. Commercial knowledge and good business planning are skills which will help software developers secure business investment.

Numbers of UK companies with R&D intensity > 4% and sales over £25m and up to £500m

Sector	Total	UK-Owned	Foreign-Owned
Software	35	31	4
Pharmaceuticals	22	8	14
IT Hardware	18	14	4
Electronics	14	11	3
Chemicals	13	5	8
Support Services	7	7	0
Health	6	5	1
Aerospace	5	3	2
8 other sectors	18	14	4
Totals	138	98	40

Source: R&D Scoreboard 2005, DTI

Commentary

Higher Education establishments are faced with the challenge of providing courses, which appeal to students and provide them with the knowledge and skills that make them attractive to future employers. The 3–6 year lead-time from course development to the time when graduates become effective employees makes it imperative for Higher Education establishments to understand emerging trends if their education programmes are to achieve results [1]. This challenge is particularly acute in a faculty where the core subject, Computer Science, is undergoing rapid change and where anticipating long term trends and industry requirements are demanding. For example, in 1994 only a few organisations anticipated the impact that World Wide Web technology would make on industry [2]. Those institutions that were able to recognise the significance of these were well placed to attract students as public awareness and demand for graduates with Web skills grew in the late 1990s.

Referring to the above the example, educational establishments are also faced with a critical timing issue. By 1998-99 awareness of the Web and demand for these skills from industry had started to soar, however, students commencing their studies at this time would find that on completing their course three years later the industry had become saturated and demand for Web skills had fallen.

Given this rapid rate of development, what strategies can educational establishments adopt to ensure their curriculum provides students with the technical knowledge to meet the needs of industry after graduation and have the skills to recognise and adapt to change over the course of their career? Many authors suggest that a Deep approach to learning is more appropriate, [3] and [4]. Such an approach poses the practical problem of defining the base on which this learning is built. For example, an understanding of the World Wide Web technology is based on TCP/IP networking and SGML [5]. While these technologies had been in use for over 30 years, before the emergence of the World Wide Web, few people considered their importance as an educational base. If these base skills can be defined successfully then the student can be provided with a foundation that will ensure they can adapt to the dynamic environment that is prevalent in the field.

In addition to the rate of change of the base technology, the issues surrounding its successful deployment are changing. Today, when the majority of people use Information Technology both in business and at home, cultural and business issues dominate the successful deployment of systems rather than the availability of the technical solutions. Increasingly business take-up of technologies is becoming demand lead due to tight budgets and greater accountability; it is this business demand that is driving products, techniques and services through to maturity.

The rapid development of core technology, new working methodologies and change in emphasis in business systems deployment pose the challenge to Higher Education establishments when developing appropriate courses for their students. It is essential for Higher Education and Industry to work together on two levels, firstly to promote an understanding in young people making course choices as to the skills that are imperative for their long term future career's and secondly to work with the Higher Education partners to develop curricula that serves both academic and industrial needs now and in the future.

Paul Ireland The Utilities Exchange Ltd

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The need for inclusion within the knowledge economy

The concept of 'inclusion' within the Software Development industry sector is complex and encompasses people with disabilities as well as several socio-economic groups that are for one reason or another excluded from working in the sector. The research for this paper has highlighted three main areas of concern:

1. Exclusion due to disability and lack of technology to support the disabled
2. A significant gender bias that leads to a male dominated industry
3. A significant age bias that indicates that skills retraining is piecemeal or not delivered in the mainstream FE/HE sectors.

These are addressed below

Disabilities and inclusion

There is little complete UK research related to disabilities and the need for inclusion within the knowledge economy. However research undertaken by Forester, in the USA alone, can be used as a proxy to gauge that the UK has similar problems. This research has shown that half of the computer users in the primary working age group (18 – 64 years of age) could benefit from accessible technology; with one in four experiencing visual difficulties and a similar ratio that experience pain in their hands and one in five with hearing difficulties.

Initial reviews of similar data, from other countries, indicate that a significant proportion of the working population could increase the growth of the global knowledge economy if they were included.

Indeed, if these people are provided with the tools and systems to help them become valuable, skilled contributors to the growth of software development industry as a whole, they could make a significant impact on total economic growth and well being.

Gender bias and inclusion

One of the largest areas for concern is that the UK software sector is not attracting significant numbers of women. This problem has been highlighted by several professional bodies (BCS; Professors & Heads of Computing etc.); the issues relate to perception and image; it really is the case that the industry is male dominated and is therefore mainly attractive to young males.

These issues are reflected in the statistics that also show a significant decline in university acceptances for informatics based courses. In 2004, alone, analysis of UCAS data for these courses shows that there was an 80% male, 20% female split in both applications and consequently acceptances.

Additionally, analysis of UCAS data over several years shows that the primary group from which the UK HE sector draws its students is male; under 20 years of age. Therefore there is a significant job to do in order to include women, providing them with the qualifications and skills within the largest potential employee pool that software development job market draws on, graduates.

Age bias and inclusion

Further analysis of UCAS data indicates that the UK HE sector overall, is doing a relatively poor job of including people that are over the age of 20.

In 2004, analysis shows that the total market size for these courses was approximately 22000 full-time places (UCAS classification, G5) with 17,698 acceptances for places in the <20 year-old band. The total UCAS acceptances for individuals older than 40 years of age, was only 273 in 2004; with over 100 HE institutions this gives an abysmal average of less than three per HE establishment.

The skills gap analysis discussed previously in this paper indicated that there was a quantifiable requirement to provide retraining and continual professional development to meet the demands within the UK software economy over the next five years. The UK HE sector is doing little to help solve this problem and there is potential for providing alternative modes of course delivery that could overcome the problems (part-time, distance learning, work based learning and professional development.)

Dealing with inclusion

The conclusions are stark; there are several groups within the UK working population that are excluded from playing a significant and important role and thus having a dramatic impact on the overall growth of the UK software economy.

The analysis has shown that the issues are compound and non trivial with some being endemic in nature. There are two obvious areas where significant rapid impact can be made to address the issues highlighted in this report:

- The software industry helping itself by developing tools that can go a long way to helping overcome disabilities (tools for visual or hearing impairment; alternative methods of human computer interaction to aid other physical disabilities etc.) This would percolate through to aiding those currently excluded from working directly within the software economy.
- The HE sector achieving a substantial impact on the issues of gender and age bias for HE courses (including: degrees and professional development/ short courses.) Two routes present

themselves for immediate consideration:

- a) Image and appeal of courses to attract more women
- b) A systematic approach for providing relevant and accessible courses for older students (including re-training, more flexible and innovative teaching and learning, industry sponsored qualifications etc.)

With issues based on disabilities, gender, and age this section has highlighted one of the most significant challenges to the software industry as a whole; inclusion. The UK is well placed to accept the challenges and provide a lead in transforming the industry with supportive legislation, insightful and relevant changes within the HE sector and substantial innovation from the software industry to help the transition for those currently excluded from the industry.



Commentary

The interactive entertainment - computer and video games - industry is one of the UK's most creative and innovative sectors, peopled by highly skilled IT professionals and gifted with some of the world's most original thinkers. As with the higher profile and currently better known UK music and film industries, Britain is a hot bed of games talent.

This new white paper, *Developing The Future*, reflects several of the challenges that the interactive entertainment industry faces both in the UK and worldwide.

ELSPA, whose members include all major UK software publishers, welcomes this contribution to policy and debate. Understanding our sector's challenges, harnessing UK talents and opportunities, and supporting sensible regulation and continued inward investment in the UK to deliver growth, wealth and pleasure are the key driving forces behind much of what we do.

We welcome the growing partnership with other sectors, public servants and of course our customers to improve the status of, and increase knowledge about, interactive entertainment and its wider benefits.

The games business is a net exporter; fiscally it is a success for UK PLC. The opportunity to encourage investment, relieving competitive pressure the UK faces from other territories would only serve to create a more favourable climate for those leading the funding of new interactive entertainment content and IP.

Our objective is to curtail job export and continue to stimulate our own skill sets and talent retention. Our great games designers, programmers, artists, musicians and producers are so often attracted by US, Japanese, Canadian, and increasingly, French owned businesses.

Investment by Skillset is doing a great deal to assist in the training of young people in creative game development education. This follows much work done by the industry to create an accreditation programme resulting in many Universities now offering specific degree courses. This requires a climate in which jobs are then available in the UK for our trained and talented creative workforce.

Games are now a part of new thinking on methods of learning. The DfES is now working closely with the interactive entertainment business. It sees the value in interactivity and learning under its Personalised Content initiative.

The creative games business has other challenges too. The industry continues to invest in Crime prevention. Criminals currently earn in the region of £540 million a year from the counterfeiting and piracy of computer and video games. Government through its law enforcement agencies needs to do more to prevent this illegal trade.

The games business has become a sophisticated business, spearheading much of the move towards digital content, broadband uptake and acting as a cross roads for many industries as technology convergence brings creative industries together.

The opportunity is there for all to see. If Britain is to see all its creative industries thrive, it needs to think globally about the role of games at a time when interactivity is at the core of much of the world's leading investors' thinking and planning.

**Michael Rawlinson, Managing Director
Entertainment and Leisure Software
Publishers Association
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Conclusions and Insights

The Developing the Future report concludes that the UK software industry is a significant contributor to GDP and projections indicate that there are substantial opportunities for continued growth. However, in order to ensure future prosperity there are major challenges that lie ahead. A core theme that this paper uncovers is the need for Government, academia and commerce to collaborate more closely to meet these challenges; an integrated approach to develop an agile software economy.

The report has uncovered a complex picture of the reality and perceptions of UK software development and discussed the changing economic pressures that are having an impact on its growth. The five challenges with recommendations for each are:

1. How can the UK meet the opportunities and challenges for globalisation?
2. How can the industry attract new skills and talent for the future?
3. What can be achieved to create a modern image for sustainable competitive advantage?
4. What strategic initiatives, policies and data are required to develop a leading edge industry?
5. How can we ensure that the UK is at the centre for European software development and innovation?

How can the UK meet the opportunities and challenges for globalisation?

The research confirms that software development uses a global business model. This is a model which allows for design and development by teams of people collaborating across international borders. It has been noted that there are already some visible signs of shifts in the way in which UK businesses are adapting to take advantage of the real benefits that can be accrued by off-shoring. This report concludes that:

- Off-shoring is seen as generally beneficial for both the UK as well as the overseas supplier of services. The impact on job losses in certain sections of the software development industry needs to be well managed by Government, academia and industry. It is generally accepted that there will be some job losses in the UK industry as a result.
- All UK stakeholders need to recognise that the software development industry is now part of a global economy.
- In a global economy the UK skills base has to move higher up the software development value chain and seize the short to medium term opportunities whilst simultaneously building on longer term business strategies.
- The UK software development industry should be prepared to take advantage of overseas skills to fill the gaps in demand created by skills shortages.

- Off-shoring and a global model for software development will have an appreciable effect on reducing the cost base for software production and thus have a substantial impact on UK GDP for the next 10 years.

In summary the transformation from a manufacturing based economy within the UK to a services based economy is accelerating. Cost pressures drain profitability from activities that can readily be automated, outsourced or off-shored. Competitive advantages will be gained by organisations that generate value from intellectual property, process innovation and strategic insight

The UK software industry needs to determine how skills in software development, that are being off-shored, are to be supplemented by high end, high value skills that will augment the capability of the UK. This is a core element for supporting an agile software development model that will maximise the contribution to UK GDP over the longer term. The recommendations are to:

- Initiate a rolling research programme that measures the extent of off-shoring effects on the UK software development industry and provide vehicles to ensure that UK businesses take advantage of these opportunities.
- Create an industry standard certification for Software Architecture and other 'high level' software development roles to supplement CPD and hone the UK skills base.

Bring industry and academia closer together to devise strategies for sustainable growth in the sector within the UK that takes advantage of the opportunities presented by globalisation.

How can the industry attract new skills and talent for the future?

The qualitative and quantitative research carried out for this report concurs with the UK Government view on the IT skills shortage. It concludes that there are a number of critical areas within the software development industry that have substantial skills shortages. When coupled with the decline in admissions to tertiary education for computing and STEM subjects it is predicted that the skills gap will worsen in the medium term. This report concludes that:

- Research estimates that between 150,000 and 179,000 extra employees are needed in IT each year, but only 20,000 graduates in computer science and STEM subjects graduate from UK universities a year; this number continues to fall.
- Software architecture and design and other higher level business oriented roles are the key skills in demand for UK software development.
- There has been a decline in applications to study Computer Science at UK universities with a 50%^{xxxv} decrease in applications in

the four years to 2005. Within the more specialised Software Engineering courses, the drop has been 60% over the same period.

- E-skills research^{xxxvi} points to a significant labour shortfall that will require both a massive re-skilling of the existing UK workforce and an influx of IT and software professionals from abroad. There is widespread concern that this issue has not been adequately recognised and that the UK is not prepared for such a significant re-skilling initiative.
- Companies developing software are still looking for experienced personnel, but the number of developers with experience is decreasing. Further skills exiting the profession could be problematic over the next 20 years as many senior developers retire.
- It is generally accepted that software developers require more business skills. While these skills can be taught in some part at universities, businesses need to realise that graduates always come out of university with little or no experience of business. General and transferable skills taught at university may be more important than meeting an immediate and specific requirement for business and technology.
- The relationships between academia and industry are sensitive and communication links need to be strengthened. While industry may feel it is not getting what it needs from graduates, academia is often less than satisfied with how Industry articulates its requirements.
- There are concerns within some university Computer Science departments that their basic research activities will be eroded by the pressure to become “skilling shops” for the most popular software products of the day.

In summary, there is a tangible skills gap in the UK and the current decline in the student base for Informatics and STEM subjects within HE will make the problems worse. The recommendations are to:

- Develop more rigorous certification at every level for software developers to increase the professional image of the industry (not just at the graduate/postgraduate level.)
- Address the wide variation in quality of tertiary education courses in computer science and affiliated subjects.
- Develop initiatives that closely align software development with the career aspirations that young people have.
- Institute an education programme amongst young people that tells them about the realities and opportunities of a career in software development.
- The DfES and other stakeholders should help to devise a strategy that reverses the current decline in popularity of the ‘at risk’ subjects within secondary and tertiary education.

What can be done to create a modern image for sustainable competitive advantage?

The current image of software development and IT in the UK has a major impact on many areas, such as; recruitment, potential business

investment, and inclusion. This report concludes that:

- Poor image is offered as one significant reason why the software industry attracts only 20% women.
- Along with skills, image is a genuine issue for the future of software development in the UK, when asked to identify the one thing that should be tackled to ensure the healthy future of IT in the UK; most stakeholders independently cited the image of the industry.
- Image problems are two-fold: both the image of IT within business and the wider image of IT for those deciding on a career is problematic.
- It would benefit the overall image of the industry if potential students were encouraged to see that software is an all pervasive technology and has application in the world that they are passionate about (e.g. medicine, ecology, engineering, bio-sciences.) Academics, government and businesses need to work together to raise the profile of the software development industry in the UK.
- The report suggests that the software development industry lacks a clear and unified voice; a fragmented community that finds it difficult to lobby for effective changes in policies.

In summary the image of software development, the perceptions and the difference of that from reality needs to be adjusted such that investing in a career in software development becomes attractive, appealing and rewarding. There are substantial success stories within the software industry that could be used in a positive way to enhance the reputation and image of the industry as a whole. In effect, these successes need to be used as the basis for defining what the software industry aspires to and how it makes fundamental and hugely impressive differences to our lives, the economy and the world in almost every aspect. The recommendations are to:

- Create an education and industry partnership initiative to work with children at an early age, communicating the ‘magic of software’ and how they can have a role in developing a future world that meets their aspirations by selecting a career within the software industry.
- Convert the innate enthusiasm of hobbyist software programmers into a desire to work in the industry professionally
- Move the focus of discussion about software from the software itself to what it enables and the experiences it allows.
- Use the key success stories from women elites within the industry to promote the benefits to women joining the software profession.
- The software development industry needs to consider whether there is a requirement for a single or unified voice and what shape that might take.

What strategic initiatives, policies and data are required to develop a leading-edge industry?

Underpinning all of the issues discussed, is a general lack of centralised, up-to-date and relevant data on which to begin to base line the economic position of the UK Software Industry. This report concludes that:

- A substantial quantity of all data in the public domain related to software development is out of date by approximately two years.
- Economic data that is available does not allow for fine or detailed analysis of sub-sectors of the industry.
- There are no current Government policies or mechanisms to address the issues of base lining data and much of its analysis is focused on IT Services or Software Professionals, neither of which is granular enough to draw conclusions about software development specifically.
- The impact of intellectual capital and similar intangible elements of software development do not seem to be wholly accounted for. This lack of data has a direct bearing on understanding how to define strategies for crucial elements such as knowledge transfer, skills development, technology 'spin-offs' and policy formation.

In summary the software development industry in the UK (both in terms of in house own account software and purchased software development) is not currently measured accurately or in sufficient detail. In order to undertake measurement effectively there is a requirement to isolate the impact of software development in the UK as opposed to IT services which is a too general classification to inform policy formation and decision making. The recommendations are to:

- Revise the UK taxonomy on IT job codes to describe roles in software development
- Ensure the ONS has better access to the software development industry, to allow more accurate data collection and analysis
- Determine better data on overseas sales of UK developed software to calculate whether there is a net software debt or software surplus
- Track the inflow of foreign software developers and outflow of UK software developers
- Track the tax revenue generated by the UK software development effort
- Measure the UK supply and demand for software solutions and analyse the resource profile required to create the products.
- Predict the high value skills requirements to meet the needs and formulate an integrated policy to reduce the skills gap (see sec: skills gap.)

How can we ensure that the UK is at the centre for European software development and innovation?

The track record for invention and creativity within the UK has world-wide recognition; with a history of substantial intellectual pursuit that has resulted in significant developments within all areas of technology and specifically within software technologies over the last 40 years.

- There are substantial pockets of research excellence within the UK centred on key universities and indeed these have resulted in clusters or technology hubs⁵.
- This report finds that there is little shortage of creativity among UK software entrepreneurs, particularly within university spin-off operations.
- Not enough small companies grow into successful, large businesses.
- Business angels and venture capitalists argue that far too many of these operations have great technology but unfocused and poor business plans, which leads to a lack of investment.
- Software entrepreneurs and academics, in turn, argue that UK funding sources are more risk averse than their Silicon Valley counterparts.
- The challenge is to accelerate the rate of UK invention by increasing the success rate of software entrepreneurs receiving early stage funding. UK software entrepreneurs need to match their invention and innovation skills with business acumen.

⁵Technology hubs: the largest, most substantial of these is based around Cambridge & the M4 corridor.

In summary the consensus of those interviewed for this report is that while the spirit of entrepreneurialism in the UK has improved in recent years, it is still not competitive with other national economies such as the USA. This report concludes that:

- R&D incentives from the DTI appear to be favourable for smaller companies but are not significant in encouraging large software companies to undertake R&D in the UK
- There have been some widely publicised issues surrounding the award of tax credits but progress is being made in making these a reality within a framework that supports innovation
- There are hundreds of companies developing software in the UK, but apparently, it seems, there is limited seed funding for early stage business ventures.
- There is a feeling that UK VCs are relatively risk averse and focused on large deals that make solid returns, rather than smaller, more risky businesses.
- University spin-offs are seen as too immature for VC investment and hence receive less funding than equivalent small companies.
- Business angels are a good source of funding for small software developers but business plans need to improve to secure this funding and more expenditure on sales & marketing is needed to ensure commercial success.

- There are few UK companies among the world's largest software developers. Investor funding can have a role to play in changing this.
- UK software companies often act as feeder companies once they reach a certain size for larger global software companies. There is an opportunity to be gained from second and third round expansion funding to support the growth of businesses within the UK and reduce the amount of merger and acquisition activity that results in these companies moving to other economies.
- There are cultural barriers between commerce and academia that create challenges for more private sector funding of university research.
- This report shows that by combining invention and creativity with a sustained model for financing business start-ups (based on taking IP to market) can result in significant wealth generation. Consequently the model of forming industry/academia clusters could pave the way for providing the foundations for the new software economy. The key findings are:
 - Innovation is at the heart of UK competitiveness in a global economy, but invention and creativity alone do not constitute innovation. Innovation is invention, IP and R&D with investment and a robust and agile business model.
 - US companies have been more successful than UK companies at marrying inventive ideas with commercial acumen. This could be why many of the world's largest and most successful software companies are US based and not UK based
 - Private equity firms are more likely to fund sound business plans than great ideas
 - The UK software development industry needs to strike a balance between the creativity of the industry and the practicalities of securing funding in order to launch successful commercial products. Sales, marketing and business acumen are as important as invention.
 - Develop an economic climate that supports innovation through sound investment policies in which invention and R&D are supported by incentives and investor support.
 - Establish a more radical tax benefit structure to support IP creation but force a link between invention and creating successful innovation and business growth. Reward Invention that results in substantial innovation and wealth creation.
 - Provide a means for supporting a vibrant IP market place that maximises opportunity for the investment community and holders of IP alike. In essence make it easy to succeed, make the capitalisation of IP less of a mystery, simplify processes for start-up businesses to protect and develop IP.
 - Lobby the EU member state of France to ratify the London Agreement (signed by 11 EU member states) at the earliest chance. This will significantly reduce the cost of protecting IP across Europe and result in encouraging smaller businesses to protect and develop their innovations.
 - Provide support (via UK Government departments e.g. DfES, DTI

- etc.) for turning IP into business successes (via a UK business network focused on innovation) underpinned by incentives to innovate rather than undertake R&D that goes nowhere. This could encompass alternative Tax Credits and grants.
- Provide a robust, cheap means to allow SMEs to understand what it will take to innovate (e.g. education programmes.) This will have a positive effect on limiting IP wastage (much IP within the UK is ignored) and provide beacons for those wishing to make the transition from pure research to innovation and sustained business growth.
- Educate Universities to understand how to attract higher levels of early stage funding
- Use the combined resources and experience of the successful software community in the UK to provide real and tangible business acumen advice to UK software entrepreneurs
- Research the differences in regulatory environments between the UK and other more successful software development economies to see if governments can do more to encourage success



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Endnotes

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- ^{iv} *The Impact of Global Sourcing on the UK Economy 2003-2010*, a study by Evaluserve, sponsored by Indian IT trade body National Association of Software and Service Companies. http://www.globalsourcingnow.com/gsn_reports.asp
- ^v *ICT Inquiry, Q2 2005*, e-skills UK. www.e-skills.com
- ^{vi} *IT Insights - Trends and UK Skills Implications*, e-skills UK with Gartner Consulting, 1 Nov 2004. <http://www.e-skills UK.com/cgi-bin/go.pl/%7BReferer%3Dx%7D/newscentre/press/press.html?uid=353>
- ^{vii} *ibid*
- ^{viii} Rotibi, Bola, *Application Lifecycle Market Analysis*, Ovum, 2004. www.ovum.com
- ^{ix} British Computer Society Working Party on Offshoring, *Offshoring: A Challenge or Opportunity for British IT Professionals*. BCS, 2004. www.bcs.org
- ^x Rotibi, Bola, *Application Lifecycle Market Analysis*, Ovum, 2004. www.ovum.com
- ^{xi} *IT Insights - Trends and UK Skills Implications*, e-skills UK with Gartner Consulting, 1 Nov 2004. <http://www.e-skills UK.com/cgi-bin/go.pl/%7BReferer%3Dx%7D/newscentre/press/press.html?uid=353>
- ^{xii} www.cc4g.net
- ^{xiii} *A Possible Agenda for Intellect's Software Working Group*, Intellect, www.intellectuk.org
- ^{xiv} Many interviewees for *Developing the Future* referred to sectors such as banking and telecommunications as strong areas of UK software development, but no hard data is available to support this
- ^{xv} *Economic Trends 627*, Office For National Statistics, February 2006.
- ^{xvi} *Sector Competitiveness Analysis of the Software and Computer Services Industry*, DTI, June 2004. <http://www.dti.gov.uk/about/economics-statistics/economics-directorate/page21976.html>
- ^{xvii} British Computer Society Working Party on Offshoring, *Embracing the Challenge, Exploiting the Opportunities: Building a World Class IT Profession in the Era of Global Sourcing*. BCS, 2006. www.bcs.org
- ^{xviii} *InvestorPulse 2003 Business Angel Survey*, www.c2ventures.com
- ^{xix} *The DTI 2005 R&D Scoreboard*. http://www.innovation.gov.uk/rd_scoreboard/

An R&D-intensive middle-sized company is defined by the DTI as one with an R&D intensity of at least 4% and sales in the range £25m plus to £500m

- ^{xx} *McKinsey Quarterly on Information Technology*, March 2006. www.mckinseyquarterly.com

^{xxi} *Report on Investment Activity in 2004*, BVCA, <http://www.bvca.co.uk/publications/ria/ria2004summary.pdf>

^{xxii} *InvestorPulse 2003 Business Angel Survey*, www.c2ventures.com

^{xxiii} The HM Treasury documents and guidance on R&D tax incentives are available at <http://www.hmrc.gov.uk/randd/>

^{xxiv} *Supporting Growth in Innovation: next steps to the R&D tax credit*, HM Treasury, December 2005. <http://www.hmrc.gov.uk/randd/>

^{xxv} Intellect's material on tax credits is available at www.intellectuk.org/policy.

^{xxvi} *Supporting Growth in Innovation: next steps to the R&D tax credit*, HM Treasury, December 2005. <http://www.hmrc.gov.uk/randd/>

^{xxvii} http://www.hm-treasury.gov.uk/budget/budget_06/bud_bud06_index.cfm

^{xxviii} UCAS figures as analysed in *Developing the Future*, page xx

^{xxix} *IT Insights - Trends and UK Skills Implications*, e-skills UK with Gartner Consulting, 1 Nov 2004. <http://www.e-skills UK.com/cgi-bin/go.pl/%7Breferer%3Dx%7D/newscentre/press/press.html?uid=353>