The Fuse

Igniting High Growth for Creative, Digital and Information Technology Industries in the UK

CIHE

LEADERSHIP FOR BUSINESS AND HIGHER EDUCATION

Contents

Report compiled and edited by Dr David Docherty, CEO, CIHE

Introduction

"Digital, ICT and creative industries together should be the horizontal platform for growth and competitiveness for the UK in the 21st Century"

Dr Mike Short, Vice President Research and Development, O2

The creative, digital and information technology (CDIT) industries form a multi-trillion dollar market. Digital revenues are set to exceed $3 trillion in the next four years, with entertainment and media reaching $1.7 trillion in the same time scale. UK businesses will have to compete hard for a share of this revenue, not only from established competitors in the US, Japan and Australia, but also from burgeoning digital industries in Asia and South America. In China alone, 100 million new mobile phone customers connected to a network in 2009 - swelling subscribers to 750 million. Add to this China's 105 million broadband customers, and clearly China is already the largest digital market in the world, with all the scale benefits that implies.

The UK's CDIT businesses need the right industrial innovation systems to ignite or continue to power high growth. They require the right balance of fiscal, regulatory and immigration policies, a supply of high quality talent from schools, further and higher education, the right mix of research and development incentives, and access to capital. Central to this is the golden triangle of government, higher education and businesses. Global experience demonstrates that when these relationships are correctly balanced, businesses and universities flourish, and when they are unaligned, growth stalls or fails to ignite.

To review whether these relationships are strong enough to enable UK businesses to compete in this burgeoning market, the Council for Industry and Higher Education (CIHE) established a Task Force on the CDIT industries led by Rona Fairhead, Chair and CEO of the Financial Times Group and Christopher Snowden, Vice Chancellor and CEO of the University of Surrey (for a full list of members see page 31). Having reviewed a number of urgent challenges to UK businesses, the Task Force proposes a series of joint business-university solutions and necessary government interventions. (See page 5)

The Task Force took a broad view of the definition of the industries in its review, confident that high growth in CDIT businesses is increasingly interdependent, and that the fusion of these industries has been the inexorable consequence of the rise of the Internet. As of 2009, the global Internet population has risen to 1.7 billion, with the number of broadband subscribers soaring from a few million to 475 million, and the number of mobile customers surging from 480 million to 4.5 billion. In the wake of this extraordinary growth,

new industries – such as search, personalisation, application development, and ecommerce – have emerged that are simultaneously creative, digital and IT focused.

Global giants such as Amazon, Google, Facebook and Twitter, as well as more traditional businesses, such as the BBC and the FT, no longer conform to pre-Internet industrial categories. The modern BBC is an integrated creative, digital and IT business, as is Google, BT, Facebook, Firedog Design in Hoxton, Spotify, Photbucket, Partygaming, Zaha Hadid Architects, and the vast array of graduate-rich small and medium-sized design, fashion, media, advertising, software, blogging, and ecommerce businesses.

Current definitions are, therefore, unhelpful in identifying our future skills and industrial needs and should be reviewed to reflect the new landscape. Software design, for example, is considered by some agencies to be a creative industry (bundled with computer games and electronic publishing), but by others to be in computing and IT. (See Appendix 1 on the need for a new classification system). So, throughout this report we will refer to the CDIT industries as an interacting whole – the creative talent that develops content and services are as vital as the technologists who deliver them.

Recommendations

The Task Force's recommendations are:

Government and its agencies

The UK government and devolved administrations should acknowledge the CDIT industries as a strategic priority alongside STEM. The fusion of technology with the creative and digital industries is as vital to the UK's economic growth as that of science, engineering and manufacturing and requires the same level of policy focus.

The UK government should understand and facilitate the right environment for successful CDIT ecosystems – in particular by maintaining funding within the arts and humanities, encouraging interdisciplinarity in higher education, and by reducing bureaucracy in university-business relationships.

The UK government should review its procurement policies and R&D tax credits to encourage CDIT start-ups, KTPs and clusters.

The UK government should build on the Technology Strategy Board's interdisciplinary CDIT programmes, and in particular encourage engagement in the Digital Test Bed initiative.

Universities and Funding Bodies

The Funding Councils should give the same priority to technology-heavy CDIT programmes as they do to STEM projects.

Universities must embrace – and be rewarded for – the interdisciplinarity that is fundamental to the development of successful CDIT products, services, practices and content.

Universities must open themselves to more and better ways of working with graduate-rich small and medium-sized CDIT businesses.

Business

CDIT businesses must contribute systematically to the development of courses for the graduates they hire, by working with universities to ensure a broad range of business 'touch points' for students.

Business-HE collaboration should be at the heart of the new Local Enterprise Partnerships.

Major CDIT businesses should build on best practice and work jointly with universities to help develop graduate rich SMEs.

Schools

The ICT curriculum in schools must be radically overhauled to ensure the pipeline to Higher Education and employment is improved.

Why do the Creative, Digital and Information Technology Industries matter?

There are five clear reasons to ensure that the UK has flourishing CDIT businesses.

1. They are among the biggest contributors to the economy

The technology and content industries currently contribute £102 billion in gross value added to the economy (12% of GVA) and are set for above average growth. UK entertainment and media revenues, for example, are set to reach £56 billion by 2014 (3.7% compound growth rate) and software will grow at above 3% a year.

The UK is the largest producer of TV & Radio content in Europe, has the third largest filmed entertainment market globally, has the largest publishing industry in Europe, and of the top 200 global box office successes of 2001–2008, 31 are based on stories and characters created by UK writers. Together they have earned more than $15 billion at the worldwide box office. The UK has the largest number of games development studios in Europe and is the third largest producer in the world.

As well as their specific contribution, the CDIT industries are central to the UK's cultural brand, and therefore to its tourism and export industries. Furthermore, the digital economy permeates all sectors and evidence suggests that continued adoption and exploitation of ICT could generate an additional £35 billion of GVA to the UK economy over the next five to seven years. While, reportedly, 80% of the US's productivity advantage over the UK is derived from better use of digital technology.

2. They are exporting into a rapidly growing and fiercely competitive market

Global entertainment and media revenues are forecast to grow to $1.7 trillion by 2014, while the worldwide IT industry is now worth $3 trillion (services alone totalled $763 billion in 2009).

3. They are major employers

Over 2.5 million employees and freelancers work in the content and technology industries, and UK businesses employ over half a million creative workers in, for example, architecture, the performing arts, crafts and designer fashion. The IT labour market is set to grow from 1,113,000 up to 1,241,000 by 2018, with the largest growth among software professionals.

These are high value industries; the growth in the number of people working in technology occupations has run at twice the UK average over the past eight years and forecast employment growth to 2018 is four times the UK average.

4. They are the digital architecture of the UK's economy and society

By 2014, there will be 25 million UK broadband homes, and the same number will be using the Internet on mobile devices. Design, software development and creative insight will be required not only in traditional sectors, such as media and games, but also in healthcare, transport, education, financial services and any area in which the Internet is a communications and delivery tool.

5. There is a large and growing student demand

In 2008/9 there were around 400,000 students studying creative, digital and IT courses across a range of disciplines.

The CDIT industries are as vital a resource for the UK as traditional science, engineering and manufacturing and require clear policy focus, particularly in the development of the right skills and innovation ecosystems. They need to be a national priority.[1]

CDIT Innovation Systems and the role of Government

The environment for the CDIT industries is changing rapidly under the impact of three powerful forces. First, there is the rise of converged, multi-functional and interoperable mobile devices, such as iPhones and iPads. These enable consumers to interact with content anywhere, anytime—and to share and discuss that experience with other people via social networks. Second, there is a growing dominance of the Internet experience as content and services migrate in some form to Internet-delivered platforms. Third, convenience, flexibility, personalisation, localisation, networking and differentiation will be at the heart of successful business models (and government services). Monetising these new business models is a formidable challenge. (See PWC report on Global Media and Entertainment Outlook)

Because of these fast-moving and unpredictable forces, CDIT industries require the right environment within which to do business, and in particular a strong relationship with universities. Evidence from successful innovation systems suggest that they are characterised by:

- favourable rules of the game established by government that encourage fair competition and sensible taxation (although developments – such as the Dubai Media City, which is pump-primed by Middle East sovereign funds, and the extraordinary growth rate of the Internet in China, despite restrictions on Google, Microsoft and Yahoo – challenge this assumption),
- knowledge intensity, and in CDIT clusters, a vibrant creative and artistic community,
- a high quality mobile workforce,
- a results-oriented meritocracy,
- an entrepreneurial climate that rewards risk taking and tolerates failure,
- an open business environment (some secrets are best shared),
- universities and research institutes that are incentivised and want to interact systematically with business,
- and a specialist business infrastructure that understands and is supportive of entrepreneurship.[2]

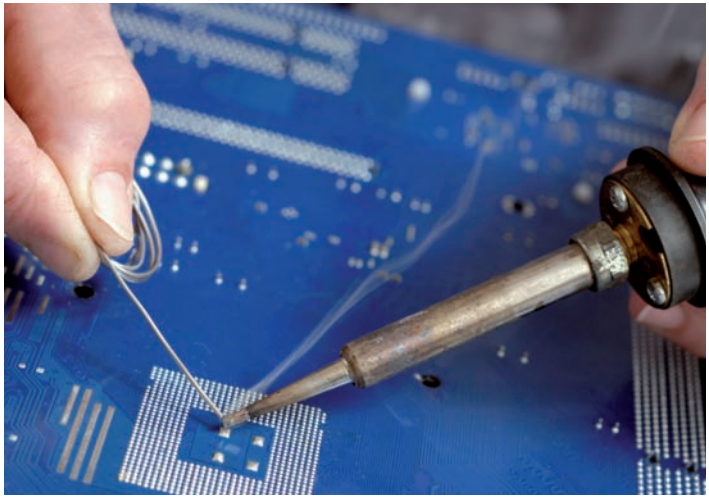
There is no perfect cocktail of an ideal relationship between businesses, governments and universities in creating the right environment for innovation and growth. The two most recent reports on the subject led by Sir James Dyson and Dr Hermann Hauser, are insightful, practical and complementary. We welcome Hauser's focus on future Internet strategies and software, and Dyson's spotlight on grand projects (of which the rapid growth of CDIT should be

one), changes to improve financing for high-tech industries, and refocusing R&D tax credits on new start-ups – which would be of particular benefit to the thousands of CDIT businesses in, for example, design, software, games, TV and radio production, ecommerce and social networking.

There is a risk, however, in assuming that private capital can create clusters without some form of government intervention. Silicon Valley, the most successful innovation ecosystem of all, has benefited at every stage of its development from the Department of Defence and the Advanced Research Project Agency (ARPA), which funded the semiconductor, software, personal computing and Internet industries, and the research at Stanford University that spawned them (see Case Study 1).

Business leaders in the Valley are now urgently calling for Federal funding in order to arrest the severe recession and the outflow of talent that private capital itself cannot stem. Even in this time of fiscal crisis, leveraging private capital by public investment will be crucial[3].

The government and devolved administrations should review their procurement policies, research funding for universities and R&D investment to ensure that the CDIT supply chain has the support necessary to innovate at the rapid pace necessary to compete globally. It is crucial, therefore, that the Technology Strategy Board should continue to support business through its collaborative R&D and knowledge exchange programmes. The £50 million allocated to collaboration across digital industries, and its Digital Test Bed programme which is focused on the



Internet of the future, will support the UK's CDIT industries in their drive for competitive edge.

CDIT businesses in the UK need clear signals from government of their importance to the economy. This should be manifest in embracing CDIT as a strategic priority alongside STEM, and ensuring that funding to universities reflects this strategic importance.

Furthermore, the Research Councils' commitment to the digital economy should be preserved and enhanced, alongside the current arrangements for knowledge transfer between CDIT businesses and universities. In particular, as our businesses become inherently interdisciplinary as a consequence of going digital (see Case Study 2 - Interdisciplinarity – BBC Engineers of the Future), they require interdisciplinary research and teaching programmes that mirror this new reality. The UK government and devolved administrations should encourage and reward this through their funding agencies.

Higher Education and the CDIT industries

In The Wealth of Nations, Adam Smith first pointed to the division of labour as one of the forces powering the new economy. More then two hundred years on, the digital wealth of nations is being created by talent and teams who are fusing their interdisciplinary skills and expertise. The fusion of labour will be a competitive advantage for CDIT companies.

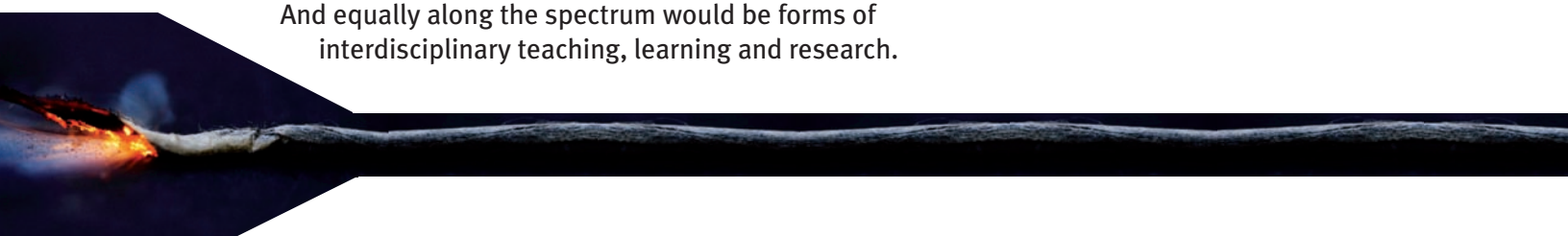
As Anne Morrison, Director of the BBC Academy notes: 'The era where we can afford multidisciplinary groups is becoming unaffordable. We need universities to develop graduates with interdisciplinary skills, or who can lead interdisciplinary teams.' This is echoed by members of the BBC's senior technical team who told us: 'Producers, Engineers and Technologists will increasingly converge into teams working together to deliver interface, service and content – as one product – rather than different teams working in isolation and then hoping to tie the solution together.' (See Case Study 2)

According to e-Skills UK, Skillset and Creative & Cultural Skills – the relevant Sector Skills Councils – a top priority for CDIT industries is the development of hybrid skills – technical, business, creative, interpersonal. These are a vital pre-requisite of monetising content and services for always-on platforms. (See Appendix 2).

There is a spectrum of interdisciplinary needs, of course, ranging at one end from, say, a small pottery business with a limited requirement for ecommerce, through to pure Internet plays. And equally, a small mechanical engineering company may not require the creative thinking of a healthcare company working on chairs for stroke victims. Along the spectrum would sit architecture, journalism, search, social networking, music-making etc. And equally along the spectrum would be forms of interdisciplinary teaching, learning and research.

'The IT sector is characterised by rapidly changing skills requirements. Particular technologies may well be defunct within a relatively short period of time. HE's focus should be on developing young people with the ability to rapidly assimilate knowledge and develop competence on what will be an ever changing suite of technologies that they will encounter during their careers.'

Dr Geoff Scott, Senior Scientist, BT



Universities recognise that they must meet the challenge of creating CDIT graduates with general and specific business skills, but also with the interdisciplinary abilities needed in CDIT businesses, and the creativity to adjust to rapidly changing environments. As Gavin Patterson, Director, BT Group plc, CEO BT Retail plc notes: 'One of the most crucial roles for universities is to enable graduates to learn how to learn. The majority of technical skills being taught in schools and universities will be defunct by the time young people are ten years into their careers. The catalogue of work based providers moves too slowly to truly accommodate the CDIT sector and young people will need to know how to source and learn the skills and competence that they will need in the future.'

Study after study shows that employers value the quality of graduates, but that they lack general skills in communication, team working, entrepreneurship and leadership[4]. This problem will only be ameliorated by a deeper engagement between universities and CDIT businesses. They must collaborate ever more on programmes that enable students to experience the world of work through placements, internships, entrepreneurship programmes, and a range of 'touch points.' No willing student should be left behind.

As well as the ability to rapidly absorb new knowledge and work with ever evolving technologies, there is a range of specific skills required by CDIT industries. For example over half a million new technology professionals will be required in the next five years (see Appendix 2, which summarises the views of the Sector Skills Councils). But, with a dramatic fifty per cent decline in UK applicants for computing degrees, it will be a challenge for UK CDIT businesses to find the best talent to compete globally.

Part of this problem lies with the current school system that fails to prepare children for the needs of the digital economy. The ICT curriculum for schools focuses on using word processing and office productivity tools, rather than engaging children in understanding the computing principles that underpin games, Internet services, and green issues they are passionate about.

Schools should support the integration of creative and digital in the curriculum, and such courses should not be seen as 'easy' or Mickey Mouse (let us recall that Mickey Mouse is worth a fortune!) The Business and Technology Education Council (BTEC) awards show that it is possible to integrate vocational material into school in an intellectually rigorous way. The ICT curriculum in schools must be radically overhauled to ensure the pipeline to Higher Education and employment is improved.

The university sector is gearing itself up at the postgraduate level with the development of seven doctoral training centres (DTC), which are explicitly interdisciplinary (see Appendix 3). For example, High Wire, the DTC at Lancaster is 'seeking a creative fusion between computer science, management and design,' and is looking to generate 'Creative Innovative People for Radical Change.' (See Case Study 3) And the Centre for Digital Entertainment collaboration between Bath and Bournemouth universities is working with businesses to create the leaders of the next generation of film visual effects, animation, and virtual worlds. (See Case Study 4)

As part of the strategic emphasis on CDIT industries and university collaboration, the Research Councils should note that interdisciplinary, high technology computing for the creative industries is as expensive as those for engineering or other sciences. As such, the Research Councils should give the same priority to technology-heavy CDIT research as they do to STEM. The centrality of creativity to the success of CDIT industries means that research into culture and performing arts is a vital component of any healthy business-university innovation system.

With the global challenges facing CDIT businesses in the UK, the pace of change must be accelerated, best practice identified and assimilated, and funding must flow towards successful models of undergraduate interdisciplinary teaching as well as postgraduate education. Universities should introduce design and media teaching into the curricula of those parts of computer science and electronic engineering dealing with digital content and experiences.

All doctoral and research students should have work placement opportunities similar to those in the DTCs, and businesses and universities working together should develop programmes for interdisciplinary leadership. The sector needs to build on initiatives, such as the information technology Management for Business degree, which is a partnership between fifty major employers and thirteen universities organised by e-Skills (see Appendix 4).

Crucially, CDIT students should be beneficiaries of the creative digital industries in the way they are taught, both in blended campus-online courses and online distance learning. The student intake of 2012 will have been born after the birth of the browser. And yet, universities have some way to go to serve this Browser Generation with the web tools with which they were raised.

According to a recent report for the Higher Education Funding Council, despite the excellent work of JISC, which had funded digital programmes from *access* to *identity* to *tools* and *techniques*, most online distance learning in the UK is aimed at post-graduate vocational training.

In the US, on the other hand, online education is powering forward with 12% of bachelor, and 25% percent of masters programmes in business, 7% of undergraduate and 21% postgraduate communications degrees, and 17% of bachelor degrees in IT (see Appendix 5).

UK Higher Education must embrace the new ways of teaching and learning made possible by the CDIT industries in order to feed those industries with its future leaders, but also to enable a broader range of mature students to retrain for CDIT industries and fill its skills gaps (see Appendix 6 for a range of approaches to e-learning, both public and private).

CDIT Clusters and Innovation Systems – the power of collaboration

'The most important contribution Stanford makes to Silicon Valley is to replenish the intellectual pool every year with new graduate students.'

Gordon Moore, Co-Founder of Intel

CDIT businesses must play their part in the development of graduates for their companies. Universities cannot shoulder the task alone. Across the university sector, many business leaders volunteer their services within universities, and more must be encouraged to do so systematically.

Major businesses can play their part by working closely with their supply chain to ensure high-quality innovation. For example, the BBC Academy worked with the ESRC and Goldsmiths, University of London, to implement a comprehensive research project developing multi-platform skills within traditional production teams. This training template is free for all in the UK, and is of benefit to broadcasters and independent training organisations.

BT works alongside SMEs in a consortium with colleges and universities in the East of England that has developed a Higher Apprenticeship programme (which includes the delivery of a Foundation Degree that is able to become a full Honours degree with an additional year study). This is being delivered to SMEs in the region (and in BT's supply chain). Businesses working with graduate-rich SMEs and universities will be vital to the UK's CDIT competitiveness.

There is a strong role for industry bodies – such as TIGA for games, PACT for TV and radio production, BCS, the Chartered Institute for IT for information technology, and the three relevant Sector Skills Councils - to work with universities and promote volunteer schemes for business professionals to work with students and develop the relevant skills needed for the CDIT jobs market. Furthermore, online matching services should be developed alongside these programmes to enable the right student to locate an appropriate mentoring company. This should build on best practice such as at the University of Abertay Dundee's workplace simulation model and Skillset's accreditation for games courses in which there is already heavy upfront investment by employers and which may be a model for CDIT as a whole.

Universities are, without compromising their integrity, more and more willing to enter into dialogue with businesses about the design and development of courses. Unfortunately, businesses are necessarily uncertain about their precise future skills needs in a rapidly evolving market. Therefore, both at an individual level, through their representative bodies and Sector Skills Councils, CDIT businesses must engage directly and systematically with universities to ensure that courses reflect their longer-term needs. And, university academics and research staff should similarly be encouraged by their employers to

engage with local CDIT businesses, and be credited for carrying out interdisciplinary and applied research in methods of research assessment.

As the case studies in our report demonstrate, when universities and businesses work together they can forge new industries, rebalance economies, and revitalise cities and towns. There are powerful examples emerging across the university sector, but we chose five to illustrate different aspects of innovation ecosystems.

The University of Abertay Dundee was directly responsible for the rise of the games and interactive media industry in Dundee, where it has helped create 3,800 jobs and £40 million in annual sales from 385 businesses. (See Case Study 5). Crucially, however, it was the birth of a successful local games business and the initiative of its CEO that led to the university developing its first computer games course. It takes an acorn.

The university's research-informed, multidisciplinary, studio-based workplace simulation, with industrial mentoring based on their international 'Dare to be Digital' competition is the basis of all its courses, including an industry-led Masters in Professional Practices. The accreditation process led by Skillset and with broad industry support recognises the value of this simulation in creating work-ready graduates.

The games industry in general has strongly benefited from close collaboration with universities. The Guildford games cluster, which includes the European HQ of Electronic Arts, one of the world's biggest games companies, was the direct result of Peter Molyneux, one of Britain's most successful games entrepreneurs, setting up his company on the University of Surrey's research park. (See Case Study 6)

Additional support for the games industry has come from across the sector, including the University for the Creative Arts, who established one of the country's first degrees in Computer Games Design. Other examples include the Set Squared innovation partnerships of the Universities of Bath, Bristol, Surrey and Southampton, which specialise in university spin-outs and continue successfully to invest in games. (See Case Study 7)

The digital media cluster in Brighton has grown to 810 companies employing 5,000 staff, the vast majority of whom are graduates. Whilst lifestyle and the success of Wired Sussex, (initially a publicly-funded support organisation for digital SMEs), played a major role in the evolution of the cluster, Brighton University played a significant part by weaving in relevant courses, establishing centres for digital art, and research programmes in digital imaging. Wired Sussex and the University now successfully collaborate on internships and course development in order to send CDIT graduates into the Brighton economy. (See Case Study 8). And the University of Sussex supported digital innovation and entrepreurship in its School of Informatics. (see Case Study 9)

The west end of the M4 Corridor (Swindon to Newport in Wales) has the largest concentration of silicon designers anywhere in Europe – again as a result of businesses seeking and implementing strong, long-term collaborations with universities. This is also an example of a cluster emerging from a failed government 'pick a winner' policy. In the

late 1980s, the government invested £100 million in Wales to develop a global IT company. Although the ambition was never fulfilled, the business attracted designers and entrepreneurs to the area, and researchers in the universities of Bristol and Bath fed the new businesses as well as creating spin-outs. So, the government's investment failed to create a single business, but was instead directly responsible for creating an innovation ecosystem that has spawned hundreds of digital businesses (see Case Study 10).

Digital City in Teesside unites the Institute for Digital Innovation (IDI) at the Teesside University with Digital City Business (DCB), which is run by professionals. Through the DigitalCity Fellowship scheme, the university mentors CDIT graduates through the early stages of business development by offering bursaries, skills training and mentoring in the IDI before they pass onto the Boho Zone run by DCB.

The University seldom takes intellectual property in the start-ups and sees itself fundamentally as an incubator for the regional economy. A new digital business is being created once a week from this process (see Case Study 11).

A crucial aspect of each of these innovation stories is not simply that they create one industry. They are laying the foundations for future CDIT industries such as synthetic environments, optical networking, 3Dtv, informatics, and that sector or company that we know nothing about yet, but which will be a global leader in the future.

CDIT businesses, universities and government must learn from these case studies and others like them, to create more open fora, systematic entry points, adaptive capability to recognise each other's strengths and weaknesses, social networking tools, and open innovation and communication.

What is striking about CDIT innovation clusters is the role of graduate-rich small and medium-sized enterprises. These are simultaneously a challenge to universities because of their volume and variety, but also a major opportunity because their leadership have had experience of universities, unlike SMEs in other sectors.

To facilitate collaboration between these graduate-rich SMEs and universities, the government needs to encourage a move from a transactional model of business-university engagement, with its heavy emphasis on patents, intellectual property, and spin-outs, towards a more contemporary commitment to universities being open institutions, untransactional for as long as possible in their relationships, and focused on start-ups and community consultancy.

For example, universities should open relevant research seminars to local companies, provide industry hot-desks in key research groups, and foster regular interaction with industry contacts to encourage joint understanding and ideas. The evidence is clear that this is the way for new CDIT companies to emerge that will help rebalance the regional economy and contribute to the UK's global success.

The achievement of these regional innovation ecosystems demonstrates the creative force of a properly aligned business-HE-government golden triangle. And Local Enterprise Partnerships, and the Regional Growth Fund must therefore ensure that such alignments are central to their planning, building on clusters that already exist as well as the entrepreneurship of universities in creating new ones. Pilot funding should be made available from these funds to encourage the development and accreditation of multidisciplinary, multi-industry CDIT collaborations.

Conclusion

This report, and supporting evidence, clearly demonstrates the case for our creative, digital and information technology industries to be a national priority, and the Government should make it so. Around the world CDIT industries are the focus for government policy as they seek their share of this explosive market. The UK has been world-class in many creative industries in the last era of mass media, but it has yet to develop its Googles, Amazons, and Facebooks. We must learn from the ecosystems that produced these businesses.

It is imperative that universities and CDIT businesses engage systematically with one another to create virtual and physical ecosystems, that universities mirror the interdisciplinarity of high-growth CDIT businesses in their teaching and research, that students are educated to be innovative employees and entrepreneurs, and that the cost of doing business with a university should drop considerably, both in time and money.

The UK has an historic opportunity to be a global leader in CDIT. There is serious competition and many barriers to success in policy, behaviour and funding. So we must act now, or risk being left behind in the digital explosion.

Silicon Valley and Federal Funding

Case Study One

"The role of the military in driving the development of computer, semiconductor and software technologies cannot be overemphasized. Until well into the 1960s, these technologies were nourished by markets that were almost completely dependent on the defense, energy and space industries."
Vernon Ruttan[5]

Silicon Valley has gone through five phases and at each one public funding was central to success. Hewlett Packard and Varian, the Valley's foundation businesses, both supported by a future Stanford Provost, benefited from the massive increases in demand for electronic products from the military during the Korean War.

In phase two, the Shockley, Fairchild, and Intel semiconductors businesses, who gave the Valley its name by using silicon in their chips, all made their reputations through military support. Personal computing emerged from Advance Research Project Agency (ARPAnet), who funded the first computing programmes at Stanford. ARPA then funded Unix, the first multiple user operating system, and the Internet, whilst also providing the majority of revenue for Silicon Valley development houses.

Currently, in phase five, the Valley is under stress and desperately seeking the kind of Federal funding that has enabled it to survive and thrive through the previous half century. The biggest worry, according to the Silicon Valley Index, which has monitored the health of the Valley since 1995 is that: "the Valley is getting none of the $2 billion federal funds now being disbursed for research in vehicle batteries and only $4 million of a $184-million federal investment in energy storage. Silicon Valley got none of the $3.5 going to smart-grid technology, and just $38 million of the $16 billion going to energy efficiency and renewable energy." Emmett Carson, CEO of the Silicon Valley Community Foundation.

The true story of the Stanford-Silicon Valley relationship is one of private equity leveraging intellectual property created by government investment.

Sources: www.paloaltoonline.com; The Silicon Valley Edge[6]

Interdisciplinarity – Engineers of the Future BBC Academy

Case Study Two

Context:

The BBC Academy was asked to think about skills requirements in the media industry over the coming 15-20 years. We identified a lack of high calibre engineering and technology staff to provide the broadcast, delivery and innovation roles to drive forward the creative economy in the UK.

In preparing this Case Study we spoke with experts across the BBC's Future Media and Technology department:

- Rhys Lewis, Chief Enterprise Architect
- Mark Kortekaas, General Manager, Online Technology Group
- Mark Jones, Head of Technology Development and Delivery
- Trevor Robinson, Senior Systems Engineer

Interdisciplinarity

It is clear that the role of technology within the media sector is playing a highly important role; as both the production driver to acquire, manage and deliver output but also as a way to build new and different experiences for audiences on a range of devices, on-demand, and on their terms.

In focusing on what the future of media practitioners and technologists would look like we have created a number of themes:

Getting the basics right

There needs to be an in-depth focus on the basics: maths, engineering techniques, signal processing, computer science, and the ability to construct a scientific argument to prove a hypothesis - with the goal to drive people to think about the tools they use and how to use them. A great deal of effort and investment is spent in achieving certification in languages and methodologies; whilst valuable to the individual it is more appropriate to understand how to work through problems and how the basics work; how to do X exactly is less relevant, as problem X will change quickly.

Universities and colleges need to give people a solid grounding in technology basics. They need to develop people who can apply those skills in a broad range of areas, in a world where the technology is changing every few years.

Integration of services

As programmes (TV/Radio), the Internet and services start to converge the industry will need a staff base that can creatively understand how technology can empower the delivery of new experiences. The producers of the future will have great ideas but will also understand how to deliver these ideas across a very different UK content delivery network. As we bring more diverse technologies together we will need skilled individuals to interface both hardware and data. The approach to integration should include message buses, service based architectures, and a focus on creating reliable systems with high uptime and fast connections, for networks that will need to dynamically respond to surges in requests, activity and data delivery.

Information management skills will be needed to ensure that we can deal with the growing amount of additional data that will exist to support content. Increased access to archives and associated information will mean taxonomies and segmentation of data are vital skills for service design. These will drive giant information resources and databases; which will need to have clear search and navigation principles built into them, making systems and data both accessible, and readily usable.

Networks and Architecture

Broadcasting has always been linked to a delivery network and chain of technology, whether that was physical transmitter masts on hills around the UK, or a series of servers and computers delivering files for viewing, listening or interactivity.

In order to continue to deliver innovative services the media sector will require individuals with knowledge of networks – both in terms of operations, but also building and maintaining enterprise and beyond networks. These need to be robust, always available and able to cope with a data through-put far greater than we are used to. Greater file sizes, more applications and services running across networks that interoperate between businesses, broadcasters and independent producers mean that technologists will become more relevant than ever before – creating opportunities for collaboration through networks.

Services, applications and data processing will become a vital, delivery critical element of the creative industries. Our approach needs to mirror that of the avionics industry, whilst maintaining the agile ability to deliver solutions to match current and future requirements and striving to drive down energy usage. This highlights the importance of system monitoring and control – building resilience into all networks.

Collaboration Globally

Producers, Engineers and Technologists will increasingly converge into teams working together to deliver interface, service and content – as one product – rather than different teams working in isolation and then hoping to tie the solution together. This requires an agile approach to product development, delivering releases of services that enable functionality regularly. The transmission critical nature of our programme output means that software needs to work at point of delivery. In the future as live transmission becomes less relevant for certain programme categories we may see different 'releases' of programmes, products or experiences that evolve over time like PC operating systems or releases of tools.

The global nature of media production will dictate that our systems and work practices need to adapt to work across virtual storage solutions, designed to hold large files, accessible across a range of connections, that are version controlled. The interchange of information and modification/change history will enable 24/7 productions with any country and company able to support any part of the production chain. Systems will need to operate and interchange data seamlessly.

Summary

Although the pace of technological change is accelerating, we need to concentrate on delivering high calibre individuals with a rounded approach to problem solving. A clear focus should be practical application of theory into business situations in the real world, building it into university courses and embedding that into organisations through placements, internships and practical work experience.

The UK needs to foster an approach that encourages innovation and driving of the media sector, creating disruptive models, collaboration, networks and systems that challenge the status quo. Graduates shouldn't know everything, but should understand how to access, link and assimilate relevant knowledge quickly, and deliver robust, tested solutions on a global scale.

Anne Morrison, Director of the BBC Academy and Andy Wilson, Head, Centre of Technology, BBC Academy

HighWire: A Doctoral Training Centre Focusing on Innovation in the Digital Economy

Case Study Three

HighWire is a Doctoral Training Centre (DTC), located at Lancaster University, funded through the RCUK Digital Economy programme via a grant of just over £5.9m, which supports the training of 50 PhD students over a five-year period.

The aim of the overall Digital Economy programme is to investigate the novel design or use of information and communication technologies to help transform the lives of individuals, society or business. This is a fundamentally multidisciplinary challenge, requiring input from areas including, (but not limited to): the arts and humanities; economic and social scientists; medical sciences; in addition to: computing; engineering and physical sciences; with the potential to have radical impact on many sectors (for example, transport, healthcare and the creative industries) and societal concerns (for example, quality of life, social and digital inclusion and sustainability).

The focus of HighWire is on innovation as it relates to the Digital Economy. In addressing digital innovation, the DTC aims to go beyond traditional multidisciplinary approaches by seeking a creative fusion between three key disciplines, namely computer science, management and design. The emphasis is on producing a new breed of innovative people who understand and are able to advance the state of the art in technical, design and business innovation: innovative people prepared to work in challenging roles in organisations and ready to drive radical change in the digital economy.

The emphasis throughout the programme is on the overlap between the three disciplines. We seek to produce individuals who will inevitably remain grounded in a particular discipline, but who will also have an acute awareness and appreciation of the other disciplines. Examples include the technologist with an awareness of the challenges of design (manufacturability, human-factors, aesthetics etc.) coupled with an appreciation of the business considerations of developing and marketing digital innovations into services and products, for organisational end-users and their customers. To do so, we create a creative space and a living laboratory where the PhD students can work together with other students, faculty and organisations, in clusters to develop and test emergent insights about innovation in the digital economy.

We closely align with the needs and goals of business and industry to ensure the relevance of our programme and to encourage technology exchange and early adoption of emerging technologies, processes and ideas. This builds on the strengths of Lancaster University's InfoLab21 initiative, for example, a recognised leader in technology exchange, to seek a more value-added and marketable pathway from the digital laboratory to the marketplace. Students on the programme engage with a variety of industries from micro-businesses and SMEs through to large companies related to the digital economy. Through this, we seek to have real impact not just on the academic community but also on business and society more generally.

Professor Gordon Blair, Director of HighWire

Centre for Digital Entertainment

Case Study Four

The Centre for Digital Entertainment (CDE) is a new collaboration between the University of Bath, Bournemouth University and a host of industry partners across the computer animation, games and visual effects industries. It will:

- Develop an interdisciplinary and multidisciplinary culture
- Blur the boundaries of disciplines
- Create pedagogic and research innovation in these spaces
- Invigorate demand in engineering and computing
- Develop the economic impact of art and design

The Centre for Digital Entertainment is geared precisely to the needs of this sector, recognising that much of it is world class but typically demands both stronger and wider skills than a typical graduate can supply. Most of our companies are in games, virtual environments, digital film visual effects and post-production and computer animation.

The real job shortage is technological rather than artistic and that is what we address. Our Centre has £6.5 million of the Engineering and Physical Sciences Research Council's (EPSRC) money, to be committed over five years in a project running for eight. University input brings this up to £10 million.

It supports 50 placement Research Engineers (RE) who will be funded for three years in industry and one (for taught material) in Bath or Bournemouth university. We can therefore say that this equates to £200,000 investment in every RE, not even counting the very real 'in kind' contribution from the company.

The aim is to produce Engineering Doctorate graduates with research skills at least equivalent to a PhD but developed in a commercial environment, under the day to day guidance of their industrial supervisor. These people should become industry leaders in mid career. The sector is short of high-skilled staff and recruitment is often by attracting applicants from existing companies, a tactic which all recognise is not healthy in the longer term.

Once companies understand our scheme they find it very attractive and so we are doing our best to bring them strong applicants. It is a very new model (to them) and we are working hard to spread the word around the sector. Our website lists the many companies who we have visited or we have actively been in contact with, as well as the ones who are already willing to take students.

There is a cohort-building mission too. The REs and their industrial supervisors will have the chance to network at face-to-face events with their equivalents in the other companies. This has additional value to newer companies. We also have funding to send the students to international events to enhance their experience.

We are working with Sony Entertainment at one end of the scale and new start-ups explicitly based on disruptive technology at the other.

Dr Rob Head, Director of Research Development and Support, University of Bath

www.digital-entertainment.org

The University of Abertay Dundee and the Games Industry in Dundee

Case Study Five

Eight to twelve percent of the UK Games Industry is based in Dundee, with 3,800 jobs (of which 750 are in development), and £40 million in annual sales from 385 businesses.

Why Dundee?

There is no industrial logic to Dundee being a centre for games design and development, rather than Glasgow, Edinburgh, Manchester or Birmingham. It is a city on the east coast of Scotland and when the games industry emerged its industrial base had been in long-term decline.

The story of the games industry in Dundee is fundamentally marked by entrepreneurship by both businesses and the University of Abertay Dundee and its Vice Chancellor, the development of a shared culture between academics and developers, and an investment by various government agencies to help the ecosystem develop.

1947: National Cash Register (NCR) opens in Dundee and becomes the biggest employer. NCR forms strong relationship with Dundee Institute of Technology, subsequently the University of Abertay Dundee.

Emergent Ecosystem

1983: Sinclair ZX mini-computer mass produced in Dundee Timex factory and a thriving Dundee cottage industry provides software for it.

1988: David Jones, a Dundee Institute of Technology computing graduate, and an employee at Timex, starts DMA, which subsequently launches Grand Theft Auto which has sold over 120 million copies to date. Jones launches Lemmings in 1991, which sells 15 million copies. In 1993, Visual Science spins out of DMA.

1996: The University of Abertay Dundee launches the world's first Masters programme in Software Engineering for Computer Games Technology. Vis Entertainment launches, as does Jack's Hoose, a music company focused on the games industry.

1998-9: Abertay follows the Masters degree with an undergraduate B.Sc in Computer Games technology, and an honours degree in computer arts. Dare to be Digital computer games design competition launched. Subsequently becomes an international competition.

Robust Ecosystem 2000-2010

As more and more successful games industries were created in Dundee, including Real-Time worlds, currently the largest developer in Scotland, various government agencies were attracted by the success of the ecosystem and established Interactive Tayside to co-ordinate the activities of the Scottish Development Agency and the local authorities. These helped provide the right physical spaces and business advice for these young companies to survive.

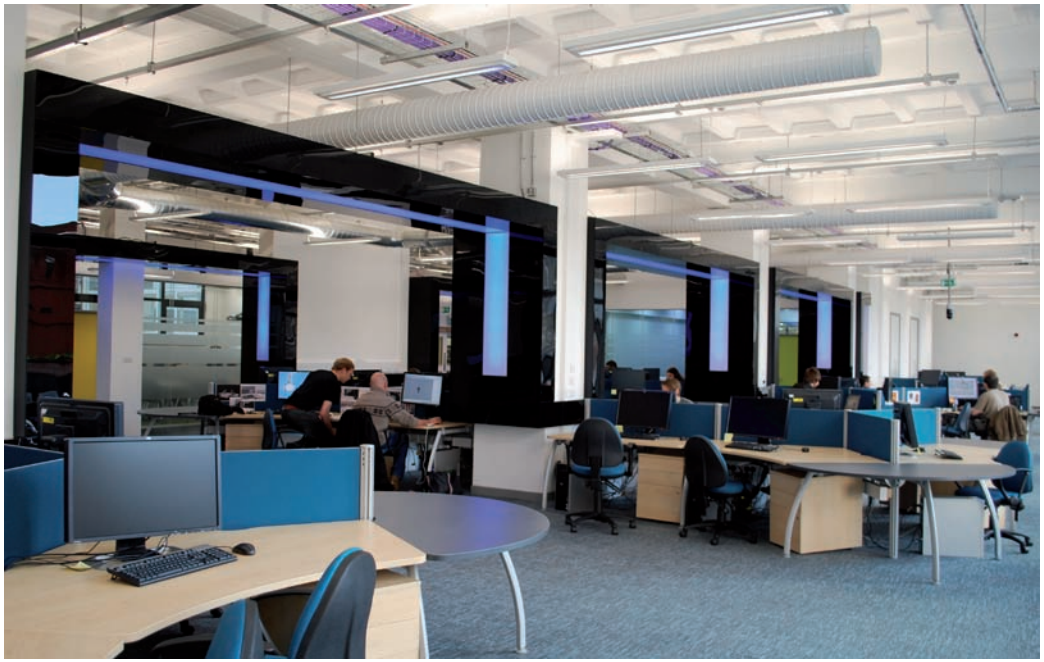
Abertay continued to drive the model by moving up the value chain. It secured European Regional Development funding to create a pre-incubator facility and a parallel Postgraduate Diploma in

Enterprise Development to help their graduates start up new games businesses. These were followed up by further funds, such as GamesHub UK, a £12.9 million pilot project to deliver specialist business support to the development industry. The decade ended with the launch of the Centre of Excellence in Computer Games Education.

"We are really keen to work with students at Abertay because there is such a wealth of amazing talent at the University – industry should be opening up and providing as many opportunities as possible."
Sally Greig, BBC

Source: McGregor, White, Farley, Matthew – Successful Industry-Higher Education Collaboration: The Dundee Games Cluster and The University of Abertay Dundee

"Dundee is recognised as a hub of games development in Scotland and Abertay has been central to this"
Joyce Matthew, Scottish Enterprise



Abertay Centre for Excellence

The University of Surrey and the Guildford Cluster

Case Study Six

The Computer Games industry infrastructure in Guildford is an ideal example of the type of ecosystem that starts with a key player and grows into a significant economic hub. Key developments:

- In the late 1970s, the University established the Surrey Research Park, and one of its earliest tenants was Peter Molyneux who, in collaboration with Les Edgar went on to set up Bullfrog Productions and released Populous – the first 'god game' which became a popular format since emulated in many other games. Bullfrog was bought by EA (Electronic Arts) in 1995.
- In 1997 Peter Molyneux set up his second company Lionhead Studios, also based in the Surrey Research Park, which he sold to Microsoft Game Studios in 2006.
- Criterion Games was founded by David Lau-Kee and Adam Billyard in 1993 in Chertsey and is now based in Guildford having been owned by EA since 2004.
- Media Molecule was founded in Guildford in 2006 by former Lionhead Studios employees, Mark Healey, Alex Evans and acquired by Sony Computer Entertainment in 2010.
- Codemasters (15th in the UK's sales of computer games) has had a Guildford studio since 2007.
- Kuju Entertainment formed in 1998 has its European HQ in Shalford, Surrey and several studios in and around the Guildford area.
- Electronic Arts with sales of $4.2bn in 2008 has had its European HQ in Guildford since 2007, which sealed the town as arguably the games industry hub for England.

Start-up computer game developers have appeared in Guildford attracted by the wealth of talent that already exists there. And other digital businesses - such as Imagineer Systems which specialises in post-production for film and video, and which was started by two MSc students from the University of Surrey based in the Surrey Technology Centre – are beginning to benefit from the cluster effect.

The cluster, having attracted some of the world's biggest CDIT companies, stemmed from the original investment in the Surrey Research Park.

Martyn Buxton-Hoare, Assistant Director, Research and Enterprise Support, Technology Transfer, University of Surrey

University of Surrey Games Spin-Out I Kinema

Case Study Seven

I Kinema is a revolutionary new approach to animation which animates the whole body of any creature, and automatically takes into account gravity and balance to produce realistic, lifelike, fluid movement with minimal effect effort.

The key technology on which I Kinema Ltd is founded was originally developed, with the help of Engineering and Physical Sciences Research Council funding, as a control system for spacecraft by Dr Alexandre Pechev at the Surrey Space Centre at the University of Surrey. However it has a much wider commercial role to improve the animation of computer games, film and video. It also has application in robotics but this is still to be developed and exploited.

In April 1997, Dr Pechev alerted the commercialisation office at the University to his invention and a patent was filed three weeks later. During the next three years; the University funded the patenting process, an early proof of concept award and attendance at Game Developer conferences; the EPSRC Knowledge Transfer Account, won by the University in 2009, supplied £20,000 for further product development work; and Dr Pechev himself funded part of the software development.

By May 2010 the technology had been developed to the extent that it was generating considerable interest from two major triple-A Game Development companies, and resellers to the Games and Film/Video post-production industries. It was therefore spun-out of the University with the initial funding provided by the £40,000 prize Dr Pechev received the previous January when he won the Royal Academy of Engineering's Entrepreneur of the Year Award.

I Kinema Ltd – an academic led spin-out from the University of Surrey.
Martyn Buxton-Hoare, Assistant Director, Research and Enterprise Support, Technology Transfer, University of Surrey

The Growth of the Digital Media Cluster in Brighton

Case Study Eight

University of Brighton Review

In the early 1990s the faculty of art and design at the University of Brighton collaborated with Rediffusion Simulation at Gatwick Airport to create the Rediffusion Simulation Research centre in Digital Imaging. This harnessed the cutting edge real-time image simulation systems developed by Rediffusion to provide flight simulators for training commercial pilots. This was in advance of its time being led by Professor John Vince (who developed 'Picasso' the first digital image manipulation software) and Dr Colin Beardon. This research led to the formation of CADE (Computers in Art and Design Education) an international organisation championing the digital arts along with the winning of a contract to deliver a national CTI Centre (Computers in Teaching Initiative). Both organisations have evolved and continue today.

The success of the 1990s continued alongside the formation and growth of a number of very successful Brighton-based companies. Epic pioneered multimedia learning products and services while Victoria Real rose to success in hosting the Big Brother website, one of the largest most interactive websites of its time. These successes led to undergraduate courses embedding digital technologies in disciplines from graphic design and photography to textile design and delivered many graduates into the city who have established their own studios and workshops.

More recently specific courses have been designed and established. In 2002 the MSc in Digital Television and Production was supported by HP, BBC, Channel 4, Victoria Real and leading consultants. With 23 students it was the first specifically designed course outside the traditional computing area. In the 2009/10 academic year 489 students were studying on 22 specific courses in the digital media area at the University of Brighton.

With the expansion of digital skills and interest across many different areas, research increasingly embraces multidisciplinary work as new markets are created and/or existing ones are serviced differently. Current activities include:

- Exploring the weaving of intelligent fibres into garments or "skins" that can transmit data and so behave in response to the presence of a person;
- Designing 3-D environments such that art (and artefacts) can be created virtually and then transmitted electronically;
- Reconstructing buildings from archaeological materials or historical designs and creating fully engineered and detailed structures (the City Engine project in Zurich and seventeenth century designs for an expansion of the Louvre).

All this suggests accelerating growth and an excellent future for the digital media cluster in Brighton. The emergence of Wired Sussex as a genuinely effective cluster representative is making it easier to ensure that specific degree courses directly increase the employability of graduates entering the job market. This will also lead to an increasingly effective dialogue between the industry and the universities across a wide range of issues.

Source: Colin Monk, Pro-Vice-Chancellor (Business & Marketing), July 2010

Wired Sussex Review

Wired Sussex have played an important role in the development of the Brighton cluster over the past decade. In 1999, it listed 138 digital companies in the Brighton cluster; currently it lists 810. The average size of those companies has grown too. In 1999, nearly 60% of digital outfits were sole traders or 2 person companies. Today 25% of the cluster (202 companies) have 6 or more staff and 75 companies have more than 20 staff. The number of individuals employed in the digital sector has grown from a few hundred at the turn of the century to over 5,000 today. A recent report listed Brighton as having the fastest private sector jobs growth in the UK, driven in large part by the digital sector.

This growth has been delivered through the organic expansion of local start-ups, traditional media companies developing a digital offer and existing digital businesses establishing a base in the city. Overall, the sector is still 100% SME. So Disney, the largest digital media company in the city, employs less than 200 staff in total.

All research consistently points to the growth of the cluster being largely driven by a number of favourable environmental factors. These include Brighton's proximity to major markets, good transport links, established cultural sector, an impressive lifestyle offer to attract talent, strong brand, highly skilled workforce, two universities, large freelance community and availability of residents with native languages. In this analysis, the universities contribute to that environment (through supplying graduate talent, helping underpin the lifestyle offer, etc), but have not been directly causal in delivering sector growth thus far.

The single causal factor which is regularly referenced in our interviews with businesses was the early establishment (1997) of Wired Sussex (www.wiredsussex.com) to provide assistance to the sector, initially with public sector support but, since 2007, on a standalone commercial basis. This has enabled the delivery to nascent digital businesses of strategic support around promotion, employee recruitment and funding / investment, and has also ensured that the sector has a voice to local and regional government.

As the sector has grown, the University of Brighton and, to a lesser extent historically, the University of Sussex have both cultivated strategies to respond (see Case Study Nine). These include a number of new courses, business support and the development of relevant research themes.

Latterly, Wired Sussex has enabled the universities to more effectively overcome the well known challenge for Higher Education of collaborating with an SME cluster. This includes the joint establishment of internship programmes, input into course development and business cooperation with research projects.

The existence of a strong local cluster whose further growth is primarily compromised by the skills challenge presents a clear opportunity to the two local universities. Not only to expand upon their existing offers, but also perhaps more importantly, to innovate, developing new models to support the needs and aspirations of Brighton's burgeoning digital sector and, therefore, to the UK's digital sector nationally.

Source: Philip Jones, Managing Director, Wired Sussex

University of Sussex, School of Informatics and Animazoo UK

Case Study Nine

The School of Informatics, University of Sussex is working with Animazoo UK as part of a £1.4 million Technology Strategy Board Creative Industries project called eMove—Personal Motion Sensing System. This project brings together over 20 years of Computer Graphics experience in the Interactive Systems group with 20 years of commercial motion capture (mocap) experience and product design firm Animazoo to create a consumer level mocap suit aimed at the online gaming industry. Our collaborative work is firmly targeted at producing products for the creative industries, particularly gaming, but also entertainment such as theme parks. In this respect results already emerging from the project include the strengthening of Animazoo's current product line of mocap suits with the replacement of their $25,000 G6 exo-skeleton suit with a much improved G7 version offered at $8,000. (See www.animazoo.com). This is a great boost to the animation industry allowing smaller enterprises in this creative sector to enter the market with cost effective full body motion capture technology at their disposal. But this is not our ultimate target, we are on plan to create an upper body mocap suit in the $300-$400 range, clearly not as professional as the G7, but nevertheless an effective and impressive offering at the consumer level targeting the gaming input device market. Competition in this market is fierce, with Nintendo Wii motion + and the like, however eMove is vastly different in that it offers complete upper body motion sensing, not just a single sensor, and it neatly avoids optical and other problems associated with the recently announced Microsoft Kinect because eMove is an inertial mocap system.

What does this mean?

We think eMove at this consumer level price has the potential to disrupt the motion gaming market (currently dominated by the likes of Nintendo) because eMove measures all upper body motion, without suffering from occlusion, lighting and latency problems. These 'upper body motions' are then translated into all sorts of game play events. Quite literally, a gesture such as mimicking the loading of a gun is used to replace ammo in a first person shooter (FPS), one can think of many other gesture control actions in a game, but more importantly the user wearing the eMove mocap suit can immerse themselves in the game through 'embodied interaction' where their gestures, such as climbing a rope can be used to scale a cliff face. The future of gaming clearly lies in the concept of motion controllers detecting body motion and gestures to effect more interesting and immersive game play experiences. Our system, eMove, is designed and positioned to offer the next generation motion controller beyond current and near future offerings.

Dr Martin White, Reader in Computer Science, Interactive Systems Group, University of Sussex

Silicon South-West Cluster

Case Study Ten

The west end of the M4 Corridor, from Swindon to Newport in Wales, has the largest concentration of silicon designers anywhere in Europe. Whilst 5 years ago this was one of the UK's best kept technological secrets, the Silicon South West Network is providing a distinct identity for this microelectronics cluster. Microelectronics is the latest sector to blossom in a region marked by innovation for well over a century. Starting from the stimulus of a government-backed venture in the late 1970s there is now a thriving ecosystem of start-ups, small and medium sized enterprises (SMEs), research labs and multinational electronics companies.

Early Beginnings

Inmos Ltd was founded in November 1978 by Iann Barron from the UK with two US computer industry veterans, Dick Petritz and Paul Schroeder. The company secured initial funding of £50 million from the UK government via the National Enterprise Board (NEB). The NEB was convinced that the UK needed and could have a leading global IT business.

A design centre was established in Bristol with fabrication facilities in Newport (Wales) and Colorado Springs (US). The company's initial focus was RAM memory devices, but the bigger vision was the development of specialist computer architecture for parallel processing applications, dubbed the 'transputer'. David May, now Professor of Computer Science at the University of Bristol and CTO of Bristol spin-out XMOS Semiconductor, led the project to design the transputer. An important factor was the scale of the investment which meant that the company could attract talent to the region.

Inmos did not become an outstanding commercial success; in common with many British innovations it was ahead of its time. By the mid 1980s the government, strong on privatisation and uncomfortable owning a microelectronics start-up, sold its 76% stake to Thorn Emi in 1984 for £192 million. Against the initial investment this was a success, though by some reckonings the government had invested up to £200 million by this time. In 1989 Thorn sold the business to SGS Thompson (later ST Microelectronics) and in 1994 the Inmos brand finally disappeared. ST Micro is still a major silicon business and still has a base in Bristol on the old Inmos site.

By 1994, whilst the fabrication facilities persisted in a limited way, large scale production in both the UK and US had gone offshore to the Far East. From this time the story of silicon in the South West is about design.

The Legacy

The legacy of Inmos is visible in five ways:

- ST Micro is still a major player;
- Many ex-employees became senior executives in large IT businesses around the globe;
- Many ex-employees formed businesses of their own, staying in the region;
- The philosophy of Inmos has had a major influence on the industry as a whole, with the benefits of parallel processing only now being realised;
- Inmos inadvertently created several key spin off companies and several serial entrepreneurs, some now on their fourth generation of silicon venture.

The South West Silicon story forms part of a group of self formed businesses, who stayed in the region and in turn attracted others to do the same. Meiko, later Quadrics, continued to lead in parallel applications. Division became a leader in the emerging field of Virtual

Reality during the 1990s and spawned PixelFusion, now Clearspeed, which produced a world leading processor architecture. Motion Media is still bringing videophone technology to market, while a team from STMicro left to join Element14 and then formed the core of Icera.

Companies large and small from Hewlett Packard, Motorola, Lucent Microelectronics, Toshiba, Panasonic, Broadcom and Infineon to Element 14, Microcosm, Oak Technology and Brooktree came to Bristol because they could satisfy their core recruitment needs. Microcosm led directly to two world leading Bristol companies, Phyworks and Nanotech Semiconductor, and newer start-ups such as Xintronix, while staff from Lucent, Oak and Brooktree went on to form picoChip which now supplies chips into the vast majority of consumer femtocell roll-outs around the world.

The Universities of Bath and Bristol have played a strong part in maintaining the culture by providing a source of skilled people alongside a rich base in research, development and innovation and creating spin out companies such as Wireless Systems International, Toracomm and ProVision Communications. The establishment of incubations centres in the Universities under the SETsquared brand has provided assistance for silicon entrepreneurs. Many of the new companies have been based in these centres in supportive environments that include enhanced access to relevant skills including mentors, financing and services.

History came full circle when David May formed XMOS Semiconductor Ltd, securing over £10 million of capital to date from the UK and the US and employing around 50 designers locally. Xmos are developing software defined silicon (SDS) architectures that owe much to the original Inmos ideas. They are already shipping product into markets that are now able to exploit these innovations.

Lessons learned

- Inmos did not become the UK's answer to IBM or Microsoft, in the long run the impact has been much more subtle but just as important.
- The rapid growth and overall scale of the activity has been vital, allowing essential staff to relocate knowing that their skills will be still in demand if the first opportunity is not right.
- It has taken thirty years for the legacy of this investment to reach maturity, not surprising with hindsight. Viewed over this timescale the economic benefit has been huge.
- Underlying political philosophies can change much faster than investments in technology infrastructure can take to reach fruition. UK Government investment on this scale (£100 million plus in under 5 years) into a single technology start up business is rare. The return on investment did not come within the lifetime of the government involvement and as such, may colour government views on such interventions.
- A network of experienced management is vital to the continued development of a cluster alongside the key technical skills. This experience comes just as certainly from when serial entrepreneurs try and then fail as when they succeed. This has been the success of Silicon Valley and is an element that the South West is managing to emulate.

James Lancaster and Nick Flaherty, Technology Transfer Team, University of Bristol

DigitalCity in Teesside

Case Study Eleven

From a concept developed in 2003 DigitalCity has become a cornerstone of the regeneration of the Tees Valley and Northeast Region. It is striving to create the most vibrant digital hub in the UK – a successful and self-sustaining digital media, digital technology and creative supercluster based in the North East. This approach is increasingly developing a worldwide reputation for creativity, imagination and daring.

The term 'supercluster' is employed because for a cluster to genuinely work it must contain a complete range of activities including business, culture, entertainment, education, community, infrastructure and finance. These are all being realised by the DigitalCity project, delivered by two joined up organisations – The Institute of Digital Innovation at Teesside University and DigitalCity Business at the Boho Zone in the Tees Valley.

The Institute of Digital Innovation harnesses the resources and capabilities of Teesside University (one of the UK's big three digital media Universities), and is becoming a powerhouse for all things digital, including the DigitalCity fellowship programme which has created over 50 exciting new digital start-up companies.

DigitalCity Business drives the business end of the project. It is run by industry professionals who've been there, done it, and continue to do so.

To accelerate its development, it fully exploits the potential generated by being a leading Innovation Connector. In particular to capitalise on the potential presented by Teesside University's strengths and those of the wider North East economy especially those sectors addressed by the Region's Innovation Connectors and Centres of Excellence.

Further collaboration exists with The Centre for Design in the Digital Economy (d | l a b), also at Teesside University. This adds to capability by being an R&D resource driving the commercialisation of the virtual worlds of the 3D web through partnerships with commerce and industry.

Dr James Terkeurst, Director of Institute of Digital Innovation

Creative, Digital and Information Technology Industries Task Force

Chairs		
Ms Rona Fairhead	CEO and Chair	Financial Times Group
Professor Christopher Snowden	Vice-Chancellor and Chief Executive	University of Surrey
Industry Members		
Dr David Docherty	CEO of CIHE, Chair of DTG Group	CIHE and DTG Group
Mr Alan Jenkins	Managing Director	Kaplan Open Learning
Dr Bill Mitchell	Director	BCS, Chartered Institute for IT
Ms Anne Morrison	Director of the BBC Academy	BBC
Mr Gavin Patterson	Director, BT Group plc, CEO BT Retail plc	BT Retail, BT Group
Mr Peter Phillips	Partner, Strategy & Market Developments	Ofcom
Dr Mike Short	Vice President, Research and Development	O2
Academic Members		
Mr Nigel Carrington	Rector	University of the Arts London
Professor Julian Crampton	Vice Chancellor	University of Brighton
Professor Geoffrey Crossick	Vice Chancellor	University of London
Professor David Frohlich	Director, Digital World Research Centre	University of Surrey
Professor Adrian Hilton	School of Electronics and Physical Sciences	University of Surrey
Professor David Howard	Head of the Audio Laboratory	University of York
Professor Bernard King	Vice Chancellor	University of Abertay Dundee
Professor Elaine Thomas	Vice Chancellor	University for the Creative Arts
Expert Network		
Mr Dominic Casserley	Director	McKinsey and Co
Ms Kate O'Connor	Executive Director	Skillset
Ms Davina Foord	Policy Advisor	Universities UK
Ms Liz Hollingworth	Research & Policy	e-Skills UK
Mr Phil Jones	Managing Director	Wired Sussex
Mr Rick Rylance	Chief Executive	Arts and Humanities Research Council (AHRC)
Team		
Ms Stephanie Scott-Davies	Project Coordinator	CIHE
Ms Alexandra Michael	Programme Manager	CIHE and CFE
Mr Andrew Sargent	Programme Coordinator	CIHE and CFE

The Naming of Digital Parts –a 2.0 occupational classification for the digital age?

Appendix One

Occupational and industrial definitions matter. From them flow an understanding of our economy, of our educational and skills needs, and the role of government and its agencies in helping the market to meet those needs. Software design, for example, is considered by different government agencies to be in the creative category (bundled with computer games and electronic publishing), but by others to be in computing and IT.

Skills and expertise gaps revealed by classification data led to the identification of STEM (Science, Technology, Engineering and Mathematics) as an issue of national strategic importance. This has been a powerful rallying cry for 'hard science' and resulted in the Higher Education Funding Council for England's ring-fence of £54 million for STEM research.

There is, however, a widespread view among technology businesses that the 'T' in STEM is seldom given the weight it deserves. As Dr Bill Mitchell, Director of BCS, Chartered Institute for IT notes:
"Information technology and computing enable almost everything we do in modern society, which is especially true in the creative and digital industries. The incredible advances in computing we've seen in recent history represent some of the greatest intellectual achievements of the human race. Yet within STEM, computing and IT are often overlooked when funds are allocated because they are hidden within the achievements they've made possible in other disciplines."

Crucially, technology – and information technology in particular - is not only a member of the science, engineering and maths family, it is central to the creative and digital industries. Given their major contribution to the economy, CDIT businesses (creative, digital and IT), are clearly a national priority alongside STEM, and require similar levels of policy review and intervention.

Every report on the creative industries begins with a review of definitions, and concludes that whilst unsatisfactory they are a reasonable compromise. As such, e-Skills and Skillset, two of the Sector Skills Councils, are looking to modernise them. But, in truth, traditional definitions are no longer just unsatisfactory, they are unhelpful.

The current Department of Culture, Media and Sport (DCMS) definition of the creative industries stretches back to 1998 when the World Wide Web was still in its infancy. The DCMS identified as creative, "those activities which have their origin in individual creativity, skill and talent, and which have the potential for wealth and job creation through the generation and exploitation of intellectual property."

This covered thirteen industries, including architecture, crafts, performance and broadcasting (most of which were, in fact, marked by collective rather than individual creativity). Some aspects of performance, crafts, fashion, and writing may not be transformed by digital and IT, but for most of the major industries identified in the definition, digital changed them utterly.

Around the same time as the DCMS definition, digital businesses would have been defined as those creating technologies and software for generating, storing and processing data, and IT covered the wider design, development and management of information systems.

These definitions no longer describe our world. When we speak of a digital company, we no longer mean Intel, we mean Amazon, Facebook, and Google.

As the Internet and the World Wide Web matured as means of distributing and commercialising content and services, digital became a portmanteau word describing a group of functions including ecommerce, search and optimisation, personalisation, web design and development, security, and indeed any process that contributes to the online world and the digital economy. But if Digital is the face of the new economy, information technology is its backbone. All of the heavy engineering work that creates, and maintains networks, increases storage and memory, speeds up processors, and ensures that the Internet does not crash, happens within IT.

Any new industrial classification has to capture the reliance of creative, digital and IT on one another. Second, with the rise of social networking, blogging, and user-generated content, IP exploitation is no longer a definitive means of identifying the economic value of creativity. Third, treating them as separate silos fails to capture how digital and creative innovation works and economic value is created. So the fusion of all three industries creates an entirely new field of exploitation, study and expertise. We need a 2.0 classification.

Software and video games are normally the poster children for such fusion, but if we focus on another industry, such as fashion, we can see the startling transformations emerging.

Since the middle of the last decade, Dr Jenny Tillotson of Central St Martin's College of Art and Design has been developing a multi-sensorial living dress as a sensitive 'Smart Second Skin'. The dress mimics the body's circulation system and its scent glands, and as well as being beautiful has powerful implications for healthcare. Similarly, across the university sector in places like the Smart Textiles Network in St Martins, the Smart Clothes or Wearable Technology team in Newport, are fusing ideas drawn from fashion, textiles, biology and IT. The digital and information technology elements are not mere enablers, like scissors, sketch paper or typewriters, they are intrinsic to the product.

The BBC's list of its future challenges (see Case Study two) illustrates this perfectly. The modern BBC is an integrated creative, digital and IT business, as is Google, BT, Facebook, Firedog Design in Hoxton, Spotify, Photbucket, Partygaming, Zaha Hadid Architects, the Financial Times, and the vast array of graduate-rich small and medium-sized design, fashion, media, advertising, software, blogging, and ecommerce businesses.

Key elements of the Creative Media industry sit in broad classifications that include activity outside of Creative Media, preventing any discrete and crucial analysis e.g. Interactive Content Design, Content for Computer Games and Facilities.

- Official data sources to a greater or lesser extent systematically exclude the discrete and increasing freelance labour pool required to create and distribute the creative content upon which our digital economy is becoming increasingly reliant.
- In some cases sample sizes are too small to enable discrete analysis of data contained within SIC (Standard Industrial Classification) that do exist, particularly to the 5-digit SIC level.

The Creative Media industry and DCMS with Skillset first reviewed data available for this part of the industry from the ONS and other sources in 1999. They concluded that additional data are required to measure as a priority the size, shape and specific skills demand of the Creative Media industry, its constituent sectors and large freelance labour pool. As such, they used bespoke methodologies to ensure adequate sample sizes to gain a granular understanding of this sub sector.

In some cases equivalent data cannot be generated eg. GVA and GDP. So these measures exclude contributions from elements not served well by SIC; for example Interactive Content Design, facilities (excl. post production), content for computer games and freelancers. In some cases, the SIC and SOC (Standard Occuptional Classification) systems simply do not provide the level of detail required, as noted above. In other cases within the SIC system, whilst the system itself provides the level of detail required, the sample sizes of surveys prevent this underpinning the key data sources. For example the ABI which measures productivity are in fact too small to offer robust detailed analysis. As well as systematically excluding sole traders, as far as business activity goes, little data are available at 5-digit SIC level and, for example, production and distribution activity cannot be disaggregated.

Just as DCMS led the way internationally with its definition of the creative industries in the early parts of the last decade, so BIS and DCMS combined should take the lead in creating a new definition of the CDIT industries that reflects the economic reality of the converged world.

Sector Skills Council - Employers Needs

Appendix Two

In a recent joint report from e-Skills, Skillset and Creative & Cultural Skills, the three SSCs covering the sector, make the following points:

Content companies suffer from technology-related skills shortages and gaps

There are critical skills in short-supply when recruiting, for example, management and leadership, monetisation of content, production for multi-platform content, broadcast engineering and visual effects. Digital multi-skilling is important across the industries to enable digital media workflow from content creation and production to metadata management

The education system is failing to prepare young people for the digital economy

There are many issues in the education system in relation to Technology, for example: the drop in UK applicants to Computing degrees (down 50% in the last 5 years); the dramatically negative effect of the 14-19 curriculum and teaching skills; and the gender imbalance (90% of A-level Computing students being male). Moreover,there is oversupply in Media courses; too many courses produce graduates with insufficient specialisms to meet sector needs.

Digital industries have little involvement with public providers or qualifications

In terms of the development of those already in the Technology and Content sectors, there are huge discrepancies in levels of training according to size of company. In addition, the qualifications landscape is very complex, the training environment is fragmented, and most training does not lead to awards recognised outside of an individual organisation.

Digital skills are now essential right across the workforce in all sectors

Virtually all positions being recruited for across the job market demand IT user skills. Today, 36% of development need for IT user skills is at 'advanced' level or higher (level 3 plus). In three years time, 53% of the upskilling need will be at this level. In addition, there is a significant need for increased volumes of lower level skills development as workers who do not currently use digital technology at work need to do so.

Future skills needs

550,000 new Technology professionals will be needed in the next five years

The Technology professional workforce will grow at an average of 1.2% p.a. between 2009 and 2019, which is four times the forecast for the UK as a whole. The strongest growth will continue to be in high skill areas. Considering both replacement demand and growth, over the period 2009-2013 an average of 110,500 jobs each year need to be filled by people moving into Technology professional roles. Over half will come from another profession and a fifth from the education system.

The skills to produce and monetise content for multi-platform is a top priority

Hybrid skills (technical, business, creative, interpersonal) will be increasingly important. Existing shortages and gaps will be exacerbated with greater demand for scarce skills. Particular priorities in the Content sector will be the ability to produce content for distribution on multiple technology platforms, and the ability to monetise that content.

The Content industries are at risk of losing talent

The current economic climate is very challenging for the Content industries; the freelance labour pool is set to grow with more people moving into freelance roles as companies make redundancies. This is a phenomenon reminiscent of the 1980s, during which time employees were made redundant when the number of TV channels, and opportunities for broadcasting content, increased. In addition, the representation of women and ethnic minorities in the Creative Media industries is in decline. Some of these people have left or could end up leaving the sector at this crucial time, taking their experience and talent with them. The risks these factors pose need to be addressed to sustain the vitality of this strategically important sector.

In addition, in a recent joint report from Skillset and Creative & Cultural Skills , the priorities for the Creative Industries (a sub-set of Digital and sectors outside including fashion and textiles) are set out in brief as follows:

Changing Skills Needs

Across all Creative industries, there is recognition of the dramatic changes brought about by the digital environment and the need to upskill to make the most of it. The following are of particular importance:

- Multi-skilling: an understanding of different technology and their impact on content development, products and digital work flow, and new approaches to working in cross-functional creative / technical teams within and across companies.
- Multi-platform skills: the creative and technical skills to develop and produce creative content for distribution across all potential platforms, and the ability to understand and exploit technological advances.
- Management, leadership, business and entrepreneurial skills: hybrid skills combining effective leadership with innovation, creativity and understanding of technology, and the analytical skills to understand audience interests and translate it into business intelligence; and project management for multi-platform development.
- IP and monetisation of content: understanding of intellectual property legislation to protect from piracy, and exploiting intellectual property internationally to take full advantage of emerging markets - with particular focus on the ability to deal with the problem of illegal downloading and copyright infringement.
- Broadcast engineering: continuing to be an area of skills shortage.
- Archiving: archiving of digital content being an area which is attracting increased attention as a challenging issue for the future.
- Sales and marketing: being particularly important in commercial radio, fashion and textiles and graphic design occupations, and an emerging need in other sectors.
- Graphic design roles: in short supply particularly in advertising and design, and emerging in other sectors.
- Skilled archaeologists and visitor relations experts are in short supply in cultural heritage.
- Fashion occupations with a combination of both creative ideas and technical skills and major skills shortages include design and textile technology.

There needs to be particular recognition of the Creative Industries' increasing reliance on freelancers in order to succeed which results in increasing competition for already limited funds.

RCUK Digital Economy Programme

Appendix Three

The Digital Economy will link the world-class ICT research base with the other disciplines needed to deliver its benefits and match those with a strong user pull to deliver a programme of multidisciplinary, user focused research aimed at building a base of people and expertise to put the UK at the forefront of the Digital Economy. Through the Digital Economy we will make a step-change in the type of industrial engagement to pursue key research challenges so that the transformational possibilities of ICT are employed to support the innovation cycle. The initiative will concentrate on areas where the management and presentation of information can have maximum transformational impact: healthcare, transport, and the creative industries.[5]

Advances in the Digital Economy should be developed in a way that all find accessible and engaging:

- We need to effect real cooperation and collaboration between disciplines, whilst respecting individual subject culture and practices.
- To develop trust and create flourishing communities in the Digital Economy, appropriate levels of security and privacy must be established for individuals, organisations and industry.
- Digital technologies should be designed to create opportunities for all, both individually and collectively, to shape and personalise their economic and social interactions.
- Capabilities which are developed to sustainably exploit the Digital Economy must be firmly embedded within business and user practices.
- An effective socio-technical infrastructure is essential if we are to reap the benefits of the Digital Economy.

e-skills UK- bringing universities and employers together

Appendix Four

The need to act

e-skills UK's recent research reveals that graduates often lack the broad mix of skills that are essential to business success. Alongside their technical skills, tomorrow's IT leaders need business, project management and interpersonal competences to prepare them for the challenges of competitive, commercial, technology-intensive organisations. An additional concern for universities and employers alike is the decline in uptake of IT degree courses, and the continuing gender imbalance in the IT profession: fewer than 20% of IT professionals are female, and this is reflected in the student body.

Universities are keen to collaborate with employers to develop initiatives that ensure they can attract the best candidates, and meet the needs of future IT professionals. Working with e-skills UK, employers and universities have come together to create two new programmes that provide students with essential skills and experience: the ITMB degree, which links cutting-edge technology expertise with real-life management issues; and the e-skills internship, which gives students an opportunity to put their skills into practice in the workplace.

e-skills UK action – the Information Technology and Management for Business (ITMB) degree

The ITMB degree programme was developed by leading employers including Aviva, British Airways, BT, Ford, Fujitsu, HP, IBM, Morgan Stanley and Unilever, and is designed to equip students for exciting high-level IT professional careers. It is now available at thirteen universities.

More than 50 employers are closely involved in course design and delivery, offering projects, lectures, work placements and interpersonal skills coaching, and hosting events for students of all the universities involved. This backing gives students unparalleled access to employers and insight into the way technology is used within business. They gain a deep understanding of business needs and operations, and the tools to excel in the complex IT management environment.

Results so far

There are now over 700 ITMB graduates from the thirteen universities offering the degree, and continuing expansion is planned.

The proportion of women on the ITMB degree (32%) is more than double the proportion of female applicants to all IT-related degree courses. Students graduating in 2010 have already been offered positions in companies which include Apple, Bain, Citibank, IBM, McKinsey, PwC, Procter and Gamble, IBM and Microsoft. 86% of final year ITMB students at one university have already secured positions in industry or postgraduate study.

e-skills UK action – the e-skills internship

While internships are acknowledged as an effective way of developing 'business-ready' skills, participation has fallen: in 1998 approximately 30% of IT graduates had taken some form of placement

as part of their degree, but in 2004 that number had dropped to 20%, and has continued to fall since.

The e-skills internship has been developed by a wide range of employers including Google, GlaxoSmithKline, IBM, Network Rail and Procter and Gamble. It is based on a management and assessment framework which ensures employers and students get the most out of the internship, and that the outcomes are measured and contribute to the student's degree. Successful students receive a certificate of employability to add to their degree certificate.

Through the e-skills internship, employers can offer high quality placements more easily, benefiting from a cost-effective boost to resources and the capability and enthusiasm students bring to a business. Students, in turn, develop a rich blend of business, interpersonal and technical skills, which are widely valued by employers across the IT sector, and help them perform better in their university studies.

Universities can incorporate or build on their existing placement programmes, offering a motivating and attractive scheme to existing and prospective students.

Results so far

More than 200 employers are now involved in e-skills internships, and over 350 students from 35 universities are taking up an e-skills internship.

Skillset– bringing universities and employers together

Appendix Four continued

Skillset Media Academy Network

Skillset has established a network of Media Academies across the UK to address the opportunities created by the convergence of the creative and digital sectors and to support related business developments. Some are individual HEIs, but others are regional collaborative clusters of HEIs, colleges, arts centres, and/or commercial companies.

A Skillset Media Academy is required to demonstrate not only excellence in a broad range of entry level courses, but also:

- a genuine commitment to collaboration, interdisciplinarity and innovation, bringing together technology, design and business as well as media;
- a proven track record as a 'thought leader' for the industry – for example, in funded applied research, Knowledge Transfer Partnerships, high quality business support and development and technical and production masterclasses;
- a commitment to providing flexible, high quality Continuous Professional Development (CPD) courses for the existing workforce;
- innovation in course delivery – for example, learning in cross-disciplinary project teams, engaging with Advanced Apprenticeships and internships, and providing online and work-based learning courses.

The Media Academy Philosophy in Action

- Birmingham City University Skillset Media Academy's New Technology Institute specialises in delivering externally funded projects to assist local businesses in the entrepreneurial elements of their business, as well as delivering digital media CPD training.
- Middlesex Skillset Media Academy's Lansdown Centre is in the forefront of teaching and research in areas combining computing and creative activity, exploiting the transformative potential of digital technology.
- Teesside University Skillset Media Academy is collaborating with Swedish training innovators Hyper Island to bring their unique style of leadership education into Skillset's Build Your Own MA initiatives. These are a portfolio of flexible short courses offered across the Skillset Media Academy network leading to a post-graduate qualification.
- Also as part of Skillset's Build Your Own MA, Bournemouth Skillset Media Academy and the BBC Academy have jointly launched a group of short courses providing the first industry-recognised qualification in production management. This is being delivered through a combination of face-to-face sessions with leading academics and industry professionals complemented by online study.
- Nottingham Skillset Media Academy has developed a Media Creatives Foundation Degree Internship, as part of the Skillset Media Academies HEFCE-funded project to provide new routes into industry combining higher level Apprenticeships with an academic qualification. The course combines study in design, digital media and business with an extended internship in a commercial media company.
- University of Abertay Dundee Skillset Media Academy's White Space is a purpose-built knowledge environment for students, staff and local businesses. It is a thriving hub of activity, mixing the talents of Computer Arts students, PhD students and lecturers, together with business people, broadcasters and artists, plus Abertay's in-house graphics and digital media teams.

Source: Kate O'Connor, Executive Director of Policy & Development (Deputy CEO) Skillset

Online Higher Education Learning in the US[8]

Appendix Five

	Business	Communications	I.T
Bachelors	12%	7%	17%
Masters	25%	21%	27%

Source: Online Market Update, Online Higher Education Learning Collaborative, Custom Inquiry, Kaplan, Inc.

Public and For-Profit Approaches to e-Learning

Appendix Six

There is a plethora of new approaches to e-learning or e-enabled learning, and the Higher Education Funding Council has established a Task Force, Chaired by Dame Lynne Brindley, Chief Executive of the British Library, to develop the position of UK higher education (HE) as a world leader in online learning. http://www.hefce.ac.uk/learning/enhance/taskforce/ We have drawn on examples from Task Force and Council Members to illustrate good practice.

Pearson MyLabs: Raising the Bar

For over 10 years, Pearson has responded to the increasing demand for technology resources in higher education. Pearson has created a broad portfolio of over 80 robust and accessible online products branded as MyLab and Mastering programmes. These products deliver traditional textbook content as well as self-assessment, personalised study paths, customised teaching resources, and powerful results reporting.

Developed in collaboration with educators in colleges and universities around the world, Pearson's discipline-specific, interactive, online resources can be used independently or in conjunction with institutions' Virtual Learning Environments (VLEs). As such, they provide institutions with high-quality, stable products that are suitable for traditional, blended, and online learning environments. When educators have required and integrated these products into their teaching, they and their students experience the highest success rates and return on investment.

For example, in a recent online poll at the University of Glasgow, 80% of students who responded recommended MasteringPhysics as a useful teaching tool. The class head, Professor Stephen McVitie reports finding a strong correlation between MasteringPhysics performance and degree exam performance. He uses this correlation as evidence that the students get rewarded for the continuous study provided by MasteringPhysics.

In the US, where the MyLab programme began, the use of MyMathLab has significantly improved student success rates at the University of Alabama and many other institutions. At Alabama, for instance, the retention rate for business calculus went from 67.3% before MyMathLab to 81.4% after the product was adopted.

myitlab

Another Pearson product, MyITLab, streamlines the teaching of Microsoft Office applications through the use of a simulated application environment. Students perform tasks in the simulation that are tracked and graded—while giving them specific feedback to guide them to improve their skills. Students can be assigned individual and group projects, allowing them to demonstrate their ability to use the skills they've learned.

KAPLAN Open Learning (KOL)

Kaplan Open Learning (KOL), an affiliate college of the University of Essex, provides university-level education through online distance learning. A student can obtain a foundation degree in subjects such as business management, entrepreneurship, sales management and Internet marketing. Kaplan Open Learning courses replicate a real university classroom environment and give students the flexibility to study from anywhere - work, home or on the move. This enables mature students to obtain a first degree and professionals the opportunity for continuous professional development.

KOL offers online degrees in the areas of Business Management, Criminal Justice, and Financial Services to both UK and international students. Each student has a dedicated academic advisor and a trained online tutor, which enables KOL to monitor a student's level of activity and contact them if it appears that he or she is struggling for some reason.

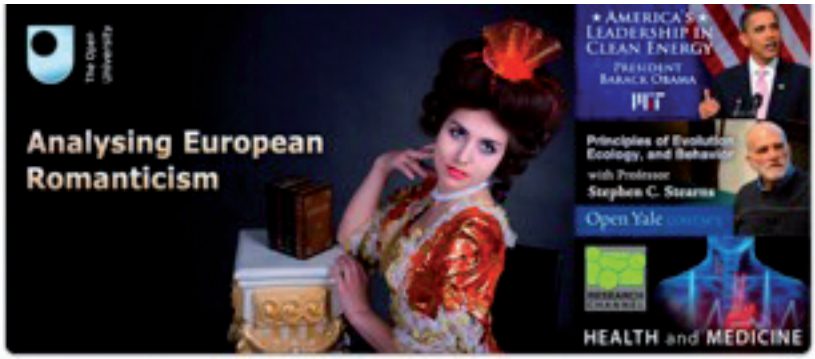
Flexibility is built into the course. For example, KOL recently announced a joint Business and Management degree from University of Essex combined with an Institute of Leadership and Management (ILM) qualification. The online course will offer multiple start dates throughout the year with a continuous 52-week academic calendar, and will allow students to study wherever they have access to the Internet.

The Business and Management Foundation degree will be awarded by the University of Essex with a third year progression route leading to the award of a BA (Hons) in Business and Management by the University. The Leadership and Management qualification from the Institute of Leadership and Management provides a nationally recognised standard of managerial ability. KOL believes that by embedding practical training and development within such a degree programme, they provide both students and employers with valuable and sought-after skills and knowledge, enhancing the employability of those who obtain this award.

Publicly-funded e-learning

The Open University

The Open University (OU), the UK's most successful distance learning institution has been developing new online approaches, such as its presence on iTunes U, where it is the first university to hit twenty million downloads. In iTunes, the OU is pioneering new ways of teaching and learning for the creative and artistic communities.



A 'splash screen' from iTunes U in early 2010 illustrating a new channel connection for learning in the creative and artistic communities. This highlights new mobile and podcast learning channel opportunities.

The Open University in iTunes U showcases a range of OU courses that teach creative, digital and information technology students. One good example is Course A363 'advanced creative writing'.

This is an example OU course that breaks out of the conventional mode to help writers discuss and share working ideas and learn simple techniques to improve their art. Students can meet online to add a live voice to their work and share and critique their work synchronously with others.

In all of our work we are moving rapidly past the book towards a much more interactive model of mobile engagement.

A range of new technical and pedagogical opportunities are currently being explored to use sense-making and remote participation in the digital creative industries. For example, we have a set of studies running in online dance which allows performers and students to make new forms of performance and to visualize and critique it in powerful new ways.

For example:

a. Live shared 'over net' performance
From the e-Dance project -
http://projects.kmi.open.ac.uk/e-dance/

b. annotation and learning in dance performance.

Finally, this research is also helping major industries to connect with a new online world, and to trial new social technologies.

For example, our Knowledge Transfer Project with the Halle Orchestra in Manchester is working on models of new media communication for music. In this case, we are looking at supporting the Orchestra professionals' connection with their audience and with schools.

The OU has a strong track record in Design, and the Design department has developed various ways of providing tools and digital online spaces to accommodate the design process.
http://designthinking.typepad.com/dialogues/2009/10/u101-design-thinking-trailer.html

This allows students to upload a variety of digital objects into a space which can be annotated and connected using Cohere (OU developed sense making software).

A major problem for creative artists is that they may create a variety of digital objects/artefacts in different (often incompatible) formats. Using conventional portfolios students have been unable to locate these artefacts in the same visible space, they have not been able to comment on them, or connect them, as the creative process progresses. Cohere has solved this problem, enabling visual representations of all types (video, audio, photographic, audiographic, animation, text) to be attached to nodes. This allows horizontal connection across objects at top level, and vertical inspection of a particular object in the space.

The OU will continue to harness the power of the Internet and social networking to develop new ways of teaching and learning that remains true to its heritage but embraces the digital future in creative ways.

University of Surrey: Blended Learning, Mixed Models

The University is currently exploring how best to develop and expand its use of online learning, particularly the use of a virtual learning platform with its international collaborative partners. Currently, the University uses a mixed model approach and is looking at mechanisms for improving the quality of provision for distance learners by video streaming and podcasting lectures at the home University. The aim is to enhance the learning experience of its global students by viewing the home lectures and learning environment, as well as the face-to-face learning they receive within the international campus. This allows students from differing cultures and learning settings to view and understand alternative pedagogies.

A key challenge for a research intensive University when delivering online learning and teaching is that of IP. The question remains: how do they protect key research findings that are used within the teaching median, particularly those that are lodged on a virtual site?

Finally, we are still considering how to deliver generic teaching through multiple platforms as a mechanism for increasing the virtual learning skills of students. These types of skills allow learning to become more transportable and thus facilitate a more creative mixed model of assessment.

Footnotes

One

- IDATE, DigiWorld Yearbook 2010: The digital world's challenges, (Montpellier, April 2010)
- PricewaterhouseCoopers, Global Entertainment and Media Outlook 2010-2014, (2010)
- e-skills UK, Skillset, and Creative & Cultural Skills, Strategic Skills Assessment for the Digital Economy, (2009)
- Technology Strategy Board, Creative Industries: Technology Strategy 2009-2012, (2009)
- UKCES, Skills for Jobs: Today and Tomorrow. The National Strategic Skills Audit for England 2010, Volume 2: The Evidence Report, (March 2010)
- Technology Strategy Board, Information and Communication Technology: Key Technology Area 2008-2011, (2008)
- Gartner Inc, Market Share Analysis: IT Services Rankings, Worldwide, (2009)
- Department for Culture, Media and Sport, Creative Industries Economic Estimates – February 2010, (2010)

Two

- ftp://ftp.cordis.europa.eu/pub/ist/docs/ka4/turin_wireless_project.pdf
- The Silicon Valley Habitat - Lee, Miller, Hancock and Rowen, The Silicon Valley Edge, Stanford University Press (2000)
- Europe Innova, Priority Sector Report: Creative and Cultural Industries, (March 2010)

Three

- http://articles.sfgate.com/2010-02-11/business/17872938_1_joint-venture-venture-capital-venture-funds
- http://www.paloaltoonline.com/news/show_story.php?id=15737

Four

- CIHE Developing Entrepreneurial Graduates, putting entrepreneurship at the centre of higher education, CIHE (2008)
- Graduate Employability: what employers think and want, CIHE (2009)
- Believe in Better, creating tomorrow's leaders, CIHE (2010)
- Talent Fishing, what businesses want from postgraduates, CIHE (2010)

Five

- Is War Necessary for Economic Growth, Military Procurement and Technology Development, Vernon Ruttanpage, page 91, Oxford University Press (2006)

Six

- http://www.paloaltoonline.com/news/show_story.php?id=15737
- The Silicon Valley Edge, a habitat for innovation and entrepreneurship, Stanford University Press (2000)

Seven

- http://www.rcuk.ac.uk/research/ccprog/digital.htm

Eight

- Online Market Update, Online Higher Education Learning Collaborative, Custom Inquiry, Kaplan, Inc., Eduventures (2009)

Further Material and Evidence

Weblinks

- http://www.pwc.com/gx/en/press-room/2010/E-and-M-players-seek-new-roles-digital-value-chain.jhtml
- http://news.bbc.co.uk/1/hi/technology/8552415.stm
- http://www.internetworldstats.com/stats.htm
- http://www.pwc.co.uk/eng/publications/global_entertainment_and_media_outlook_2010_2014.html
- http://www.pwc.com/gx/en/press-room/2010/E-and-M-players-seek-new-roles-digital-value-chain.jhtml
- http://www.gartner.com/DisplayDocument?ref=clientFriendlyUrl&id=1361622
- http://webarchive.nationalarchives.gov.uk/+/http://www.culture.gov.uk/images/research/Employment_Table_3.pdf

Acknowledgements

We would like to thank all those who have contributed to this report, including members, advisors and contributors to the case studies. Thanks also to Dominic Casserley, Director at McKinsey, for his contributions to the early development of this report. We are grateful to the Higher Education Funding Council of England for their support of the Task Force. Thanks also for the invaluable contributions from our colleagues at CFE, particularly Alexandra Michael, Andrew Sargent and Thomas Fletcher.

Photo credits: i-stockphoto.com and University of Abertay Dundee

CIHE

LEADERSHIP FOR BUSINESS AND HIGHER EDUCATION

Produced by
CIHE
Studio 11, Tiger House,
Burton Street, London
WC1H 9BY

w. www.cihe.co.uk
e. cihe@cihe.co.uk
t. 020 7383 7667

September 2010

ISBN No 1 874223 86 6