



technology, children, schools and families

Information and communication technology, work and employment

Dr. Matthew Dixon FBCS CITP, Senta Visiting Research Fellow

SKOPE, University of Oxford

January 2009

Abstract

The paper attempts to lay out the key ways in which ICT pervades the world of work, and then explores how future developments might be expected to continue or adjust the major changes already seen. Some implications for related understanding and skill needs from the formal education system are then considered.

Keywords: IT, technology, work, employment, enabling technology

1 Introduction and Context

ICT can be viewed as the ultimate *enabling* technology. The meteoric rise in the deployment of computers since the first appearance of commercial data processing in the 1960s has left few aspects of society, the workplace and peoples' personal lives untouched. And developments in telecommunications, most notably the arrival of the internet, have realised the immense power of the *combination* of information processing and communication that was anticipated in the early days. Of course, as with all technologies, not all aspects of ICT deployment have produced unalloyed good: inappropriate and/or ineffective use has brought its own set of problems, ICT-enabled processes that were apparently both appropriate and effective have sometimes had serious unintended consequences, and the very value and power of this all-pervading technology have been used in support of aims and activities of which few would approve. It would be folly to attempt to summarise and structure the wide range of ICT streams, approaches, technologies and devices that have impacted thus far on the world of work. The all-pervasive nature, and sometimes unexpected impacts, of ICT (as well as its very great complexity and use of jargon), have challenged attempts to 'keep track' of developments and to find consensus at any one time on 'what's going on' overall.

Indeed the complexity and all-pervasiveness of IT have resulted in two major challenges:

- the market for ICT products and services is as close as it is possible to be to a market in which the buyer does not really understand what they are buying (the consequences of which continue to appear), and
- there is a significant, and growing, disconnect between the academic body of knowledge of computing and many of the realities of ICT out in the market-place. This has posed real difficulties in finding structured common ground between the two communities, both in the United Kingdom and beyond. Such common ground is generally crucial for sustaining effective structured innovation.

In short, ICT, while immensely powerful and having brought amazing things, is remarkably difficult to *comprehensively understand* or to *manage effectively*. In addition, of course, attempts to understand, distil and codify good practice suffer from the **relentless waves of change** that continues to characterise the ICT world. The 'rules of the game', on which good practice in development methodologies and management approaches are based, are often tested and found no longer fully relevant when each new tool or approach comes along. The ICT world has been one where maturity is rare, and the effect of this inevitably poses real challenges for reliable deployment in ways which all those involved clearly understand.

Assessing future-gazing in ICT

In the light of this, it is no surprise that ICT developments are far from easy to predict! There have been many attempts since its coming of age in the 1960s to map out what 'the next big thing' will be, and how this powerful enabling technology will affect our world. It is not surprising that, given the immense cross-cutting generic power of ICT, many commentators have easily been 'carried away' with how much it will change our lives. When reflecting on previous 'forecasts', one is struck by the apparent excessive confidence with which forthcoming changes have been asserted (in particular from the - understandably positive - attitudes of those directly involved in ICT developments¹. But also striking is how difficult it is to predict the *timescales* of such changes (even of the more plausible ones) accurately. Many aspects of ICT development have turned out to confirm the more intelligent forecasts, but most major changes have taken longer to occur than expected, sometimes considerably longer.

On the one hand this confirms that existing social and economic 'systems' generally have - for a range of reasons - considerably more inertia than most of us realise. On the other there is evidently variation between technology take-up rates in different societies, communities and countries, and such differences may well play a role in comparative innovation rates in different economies, and of consequent economic advantage. Study of innovation at the enterprise level has taught us that it does not always pay to be an *early adopter* of a brand new technology. Nevertheless, if change arising from new technological opportunities *lags* much behind that in 'competitor countries' this is likely to have an adverse economic effect. In principle, therefore, it seems likely that - for achieving the most globally-competitive UK plc - *economic benefits are likely to arise from greater 'agility' and readiness to improve business/operational processes in response to new technology opportunities*. This will have implications for knowledge and skill needs in people coming from the education system, but - as will be seen - not necessarily the initially obvious ones.

¹ or those with financial or other interests in the ICT industry

2 Ways in which ICT affects the world of work

Given the great complexity and relentless flux that is the reality of ICT, what principles *could* help us begin to get a feel for what the future holds in terms of its impact on the world of work? Certain things can be said. At the very least we need to recognise that ICT can play a role in:

1. what *prepares the individual for work* (through ICT support for education and training)
2. what supports the individual's efforts to *identify plausible work or work areas* (including contributions to the provision of Information, Advice and Guidance (IAG) arrangements)
3. what takes place in the individual's *efforts to find specific work* (in particular the preparation of his/her labour market 'offer' - both cv and other preparations - and the recruitment process itself)
4. then, *in relation to the 'job' itself*, ICT can play a role in relation to
 - a. the content of the job (or set of tasks) we carry out for remuneration
 - b. the processes by which we, as individuals, carry out the task; and
 - c. the processes by which we interact with others in the completion of the task (these others will include both possible *suppliers* of some kind, *colleagues* of some kind, and *customers* of some kind (in most cases, an employer) - including the 'part' of the customer/employer responsible for the remuneration).
5. and, to the extent that the individual subsequently gets involved in the organisation of work (the work of others), ICT can - and generally does - play a significant role in management and operations;
6. and finally, ICT can enable the creation of *new income streams* for the individual. While this is generally not viewed as directly related to work, it is essential to bear in mind, as it represents a 'way into paid work', of which school leavers need to be aware.
7. In the extreme case, this can be through the formal establishment of a new business from which the individual and others can benefit, but there are a range of activities short of this (some *ad hoc*, some extended) that can be beneficial. In all cases they involve the realisation of some asset of the individual to create a 'product' or 'service' for which someone else - perhaps initially the immediate social group - is prepared to pay money (initially often comparatively small amounts).

These dimensions are now considered in more detail.

2.1 The development of the individual's learning for work (through ICT support for education and training)

A considerable amount has been written in relation to ICT-enabled learning (which has had many different emphases and 'brands' over the years), and that is not the focus of this paper (and is covered elsewhere in the BCH work). However, it is important to remember that the individual's learning in the broadest sense will, today, often be influenced by his or her 'exploration of the world' through the internet (whatever such

exploration might consist of, and recognising that not all children will have – or use – such access). Much of what is learned by browsing the web can be of a specific, or ‘factual’, nature, but this element of informal/non-formal learning cannot be dismissed. Indeed the ‘formal’ education system needs to be aware of it and to contribute to guiding young people in how to effectively and sensibly build these explorations in to their overall learning. In fact it could be argued that a growing awareness of specifics in the outside world that results is indeed responding to an important part of the need for young people’s learning to pick up the many realities with which they are going to have to cope in the – sometimes tough – world of work.

It is also worth noting that ICT support for learning is not just important in relation to the young person’s experience when going through the formal (initial) education system. The rhetoric of recent years, that changing skill requirements in the workplace throughout peoples’ working lives mean that Life Long Learning will indeed be important, while perhaps not yet fully responded to, is indeed valid, and ICT will have its role to play in this.

2.2 The individual’s efforts to identify plausible work or work areas (including the provision of IAG);

Information, Advice and Guidance is addressed in depth in Bimrose’s BCH paper². It is, however, worth flagging the fact that, here too, ICT can and will play a role. A powerful pointer to future possibilities was provided nearly a decade ago in the United States, through the ‘*virtual one stop*’ project, initiated in Florida. This developed a rather comprehensive web-based environment that, in principle, supported the user into appropriate work, *all the way through the process*: from identifying online their strengths and weaknesses and finding plausible occupations corresponding to these, to tracking down relevant training to tackle their knowledge and skill gaps, and finding and applying for relevant vacancies (see Annex A for more detail). While early trial versions of the system were most impressive, it is interesting that the approach does not appear in the meantime to have been successfully implemented, either in the U.S. (where there was considerable interest at the State level) or in the U.K., where – after serious consideration - the likely cost was concluded to be prohibitive. It is recognised that the scale of all the databases (to be built and maintained) that would be required for such a single comprehensive system would make it an excessively large undertaking. However, many of the components of the proposition are independently emerging as web-based services, and other advances in web technology may well facilitate sufficient integration to allow implementation of something not too far from the original aspiration. In any case it is to be expected that parts of the process will be able to be carried out (and indeed are already being carried out: certainly, for example, the internet has already made a major impact on – the early stages of – the *recruitment* process).

2.3 The individual’s efforts to find specific work

² ‘Careers guidance, identity and development’. Jenny Bimrose, Institute for Employment Research, University of Warwick

As indicated, the internet has already made a major impact on the recruitment process (see eg LSE/ONREC, 2004). While early developments focused on recruitment for occupations related to ICT, things have moved on from this, and the processes of the recruitment world have – in advanced economies – changed for ever. Only those employment/recruitment intermediaries who have embraced the internet have survived, and many bright young ‘candidates’ would now be concerned if a possible employer did not have recruitment information on their website. As mentioned above, the individual is able (with the appropriate skills) to draw on ICT resources in refining his/her approach to a potential employer, both for tailoring the initial approach (c.v.) and for understanding enough about the organisation to ensure that s/he is sufficiently knowledgeable and ‘up to speed’, at the interview.

2.4 ICT’s impact on the job itself:

Job Content

As with all technologies, ICT has changed the nature of what activities are valued sufficiently to be remunerated.

Some change is small – eg production of paper documents continues (the availability of low cost- high quality printers, and the many advantages of paper as a medium, has so far put paid to the aspirations for the *paperless office* so long heralded).

Other change has resulted in quite new activities/occupations that are commercially mainstream: the emergence of e-business has produced activity of commercial value that never existed before (eg jobs supporting the infrastructure now operating around such businesses as Amazon and e-Bay). The other obvious example would be *Call Centre* work.

Job Processes

This is perhaps the most obvious component of the major impact of ICT. ICT systems are generally powerful new **tools** that enable us to do what we want to do more effectively, quicker, and/or to a higher quality. Thus, while we may still be producing paper documents, the **way** we produce and refine them, as well as their ‘quality’, is now very different to what could be produced on (even) a (very expensive) typewriter. Even more remarkable is the power and sophistication of low cost *design* tools like AutoCAD, which can enable, at a fraction of the former cost, the production of high quality manufacturing drawings in engineering but also a wide range of more ‘artistic’ products (use in clothes design, advertising products). And of course perhaps the most widespread ICT-enabled change has occurred in the world of finance and accounting, where millions of transactions of all kinds now take place through, and are accounted on, ICT systems.

Interactions with others involved in working relationships

Few examples of paid work exist in complete isolation from other people. In particular working tasks are generally undertaken within a context, and that context involves others. In the broadest sense, each person ‘picks up’ work tasks from others and ‘passes’ the outcome of his/her contribution to others.

At the very least, the individual needs to understand – within this ‘value-chain’ - what they are to do, how they are to do it and what is important in what they are delivering, and these specifications/clarification generally come from colleagues, bosses or ‘customers’. ICT can play a range of roles in this context, from being the channel through which the specifications/ clarifications are communicated, to providing the formal organisational environment through which tasks are scheduled, monitored and progressed (‘management systems’ like – in manufacturing - SAP).

In the end, we work in order to earn our livelihoods, and the final stage in the remuneration process, whether it be the HR or Finance department authorisations of an

employer's payroll run, or the sign-off by a senior manager of a payment for an individual assignment, is essential for satisfactory completion of the working contribution. In the context of an employer, this part of the process generally happens through a regular procedure, without the individual having to 'get involved', though if there is any surprise with what is paid, contact does need to be made. This step generally takes place on/through certain ICT systems, and – where problems arise – can be checked and queried with the use of others.

2.5 The organisation of work

As well as having the 'ICT-user' skills to manage their own (individual) work contribution, those who get involved in the management of an organisation – and so the management of others – will need the additional skills of mastering the use of ICT tools and systems that are used as part of organisational management. And, in principle, people need a sufficient understanding to contribute – in some way - to the management of the organisation's ICT itself. This inevitably involves the need for the individual to master ICT tools and systems that go beyond what is necessary for managing the ICT aspects of one's own work. Given that the step into such work is unlikely to come until the individual has quite a bit of experience in a workforce or a sector, such systems are unlikely ever to be able to be taught in the formal education system (with the possible exception of some exposure to it for students at business schools). Thus the implication of what is needed in the formal education system is again the generic skills of *ability to learn quickly* rather than specific ICT user skills.

2.6 The creation of new revenue streams

Most individuals have, or can comparatively quickly acquire, the skills to provide benefits to others. These skills initially manifest themselves in the informal relationships of the early years, as children learn cooperative behaviour and how and why to do 'good turns' to others. While it is essential that the co-operative attitudes engendered in early social settings are not exploited too quickly, and all acts of giving are not seen as potential 'selling' opportunities, there is no doubt that UK society has, in recent decades, become used to 'trading' for things that fifty years ago would have been given or perhaps 'exchanged'. The growth of car boot sales is one example of this, though the arrival, and remarkable success, of e-bay has shown how ICT can make a huge impact in this area. The key factor here, of course, is the (organised) *communication* element of ICT, through which the 'market' of possible buyers of something the individual owns has been hugely increased. The scale of a market has a powerful impact on economic activity, and through ICT-enabled mechanisms, it is now possible for the number of possible buyers an individual can gain revenue from for things s/he owns (**or could make**) to increase a hundredfold.

Essentially ICT is enabling a massive expansion in the ability for the individual to 'sell what s/he has', beyond the comparatively small community within which s/he was previously able to 'market his/her 'goods and services'. In particular, through the mechanism of websites like **Etsy**, making a living out of handicraft work - which suffered from the limitations of being a 'cottage industry' or merely representing 'pin money' activity - has become something many times more feasible. There are numerous examples of small businesses that have sprung up in response to decline in certain traditional sectors (eg agriculture), where ICT (generally through the new infrastructure provided by the internet) has enabled practical diversification. While such 'new ICT-enabled markets' are not immune to economic downturn, the scale of the marketplace can be such that any impact is likely to be less than in many local markets of the past, and it is clear that innovation in e-business is far from finished, and that all kinds of opportunities remain.

The implication of this for what school leavers will need to be able to do includes both the requirement for adequate ICT user skills and the understanding that there could be economic benefit to the individual from being creative with the ICT infrastructure: perhaps ICT classes could include group projects to set up new e-businesses – to instil the awareness, realisation and initial confidence in this area.

In conclusion it is worth noting that the ability of ICT to **remove the significance of place** plays a major role in all of the above. An example of how this aspect developed in the early years illustrates key principles. Initial reviews, in the mid 1990s, of the 'teleworking' that emerged after useful telecomms. links began to be available, confirmed certain limitations on full-time home working. However, refinements in ICT infrastructure and applications, as well as early lessons about the need for both confidence-building in managers and 'physical encounters' with colleagues from time to time, have led to widespread flexibility for home working where this is a) necessitated for some reason – eg commuting problems – or b) beneficial in other ways – eg commuting time used for additional work, as well as lower levels of distraction for periods of work needing high concentration.

It is becoming evident that probably the most significant impact that ICT can have on work, and one that can only be expected to increase, is in overcoming the need for the worker to be physically present in the workplace. This is examined in some depth in the BCH contribution by Felstead³. ICT developments have been the major enabler of this, and can be expected to provide even more opportunities of this kind, as telecommunication bandwidth grows to a point where 'high fidelity' interaction between various numbers of people located in different places will be increasingly possible. In particular, considerable enhancements are to be expected in teleconferencing infrastructure beyond the 'first generation' software and systems evident so far. Current practice tends to assume that collaborative remote working is generally more effective where a group of collaborators has 'got to know each other' through physical meetings beforehand. However, this may represent a transitional practice that will be superseded, as trust builds up in 'un-prepared' collaboration. After all, the internet provides an infrastructure that is global – there is no longer any effective difference between remoteness measured in a few kilometres and remoteness measured in thousands, and many collaborating communities have developed, including those involving real money flows, across national and cultural borders. Considerable amounts of trust are involved in this, and recognising that such working practices have existed in multinational corporations for many years (ie new collaborations being initiated without previous contact) it is possible that breakdowns of trust that arise might be responded to by the establishment of Trusted Third Parties of some kind. These would take the place of the trust taken for granted when working for the first time with collaborators who work for the same company). However, the trans-cultural element of such work might result in certain challenges arising from the absence of a common corporate culture, since they involve making allowances for others' behaviour in the absence of some overall awareness/understanding of the collaborator's culture that would in the past have come from some physical exposure to that different culture (possibly some implications for what needs to be learned by children here).

3 Does ICT create or destroy jobs?

Since the earliest days of scientific and technological development, the changes brought about by the arrival of new technology have brought both benefits and problems to society, employers and individuals. To the extent that technology generally provides new opportunities for doing things differently, it poses both opportunities and threats to the economic status quo. Any process that involves people earning their living may be affected by the deployment of a new technology. In direct terms, this can reasonably be viewed as a threat – after all, for those who benefit economically from an existing process, a threat to the continuation of that process is also a threat to those who currently benefit from it. On the other hand, new technology may – generally would - allow the overall (cost-) effectiveness of the process to be improved, resulting in cost

³ 'Detaching Work from Place: Charting the Progress of Change and its Implications for Learning', Alan Felstead, School of Social Sciences, University of Cardiff

reduction for that element of the economy as a whole. In addition, those who effectively harness the new technology and provide alternative, more cost-effective, processes will (after a transition period) gain both through (in a market economy) 'winning business away' from those still using the older process, and – in principle – gaining longer-term benefits from being a leading adopter, through a greater established 'market share'. However, the replacement throughout the economy of a process by a more efficient one will, initially at least, result in the loss of activity of those operating (and benefiting financially from) the original one. This suggests that, in an age in which the emergence of new technologies is likely to remain a reality (indeed an inevitability), it is beneficial (probably, in the long term, essential) for both organisations and individuals to be open to, and willing and ready to respond and adapt to, such change. The implications for the world of work, and thence for the world of education, are clear: individuals will have better chances for economic success if they are able, and ready, to adapt to new circumstances and new technologies. This will emphasise the need for acquisition, within the formal education system, of skills of adaptation and speed and effectiveness of learning.

The extreme form of this question relates to **automation**. While ICT impacts on organisational processes in a range of ways, in some cases, ICT can provide a basis for the automation of certain processes – the **replacement** of the human previously carrying out the task. The usual analogy is that (mechanical) machines have often enabled the substitution of many of the physical components of human work, while computers can enable the replacement of certain elements of 'brain-power'. It has always been argued that the 'replacement of the human' is only partial, so that the 'physical strength' of the machine has been respected for its contribution for parts of the physical element of a task of role (with the human both having the most strenuous/difficult (boring?) tasks removed) and thus having time and energy freed up to allow the performance of other – perhaps more skilled – physical tasks. In relation to ICT, the argument has gone along similar lines: computers have enabled some of the more routine/repetitive tasks in a job to be taken care of, again freeing up the time of staff using their mental capacities to carry out more sophisticated tasks, improving either overall productiveness of the operation or the quality of the output. However, it is important to realise that, while there is much truth in these arguments, they do not eliminate the fact that certain occupations which provided a livelihood to someone in the past have disappeared (or largely disappeared) due to technological innovation, and for the person involved it was therefore indeed valid to view the technology that has caused that as having posed a threat. In principle, the response to this lies in *re-training* the individual, so s/he can be able to earn a living in a different/new occupation or set of tasks. At the macro level economic evolution has always involved the decline (for organisations) of certain sectors and the rise of others, and (for individuals) the decline of certain occupations and the rise of others. However, the feasibility of achieving sufficient re-training of workers from a disappearing occupation to enable them to make an economic contribution to another occupation can vary considerably. In particular, the chances of this are often limited for older workers whose ability, and perhaps commitment, to acquiring sufficient new – and often very different – skills to earn their living in a completely different world, can be quite low.

However, as seen above, ICT can – and does – enable the generation of revenue for the individual, and the creation of a wide range of new businesses, with accompanying job creation. The massive growth of e-business since the arrival of the internet has provided work – albeit of a different kind – to many millions of people. In addition the rise of ICT as a whole has resulted directly in the creation, since the 1950s, of well over 1 million new jobs in the UK for ICT practitioners. Thus it is evident that ICT both destroys jobs and creates new ones.

Once again, the evident implication of all this on the likely workplace requirements (for the desirable knowledge and skill-sets to be acquired in the formal education system) is one of the need for adaptability and for developing strengths in the ability to learn new and different skills, rather than the specifics of current ICT tools alone.

4 Work or employment?

While there has always been a range of working relationships, the deployment of ICT has - over recent years - provided considerable additional flexibility to the relationship between worker and 'remunerator'.

Clearly employment contracts with a single employer - whether full- or part-time - remain the norm for most people in an economy's workforce. However there has been a growth over recent years in alternative arrangements. The writer is part-time employed (and so receives a regular payment at the end of each month) and carries out, in addition, individual consultancy assignments of varying lengths on a self-employed status (sending each customer one or more 'bills'). There is much to be said for having a steady income, though there can also be some disadvantages. Self employed work has benefits, but also the additional effort of responsibility for ensuring the remuneration part of work: such arrangements therefore bring considerable overhead/transaction costs with them. However ICT can help with this, and through ICT it is possible for 'consultancy' (or 'contract') assignments to be initiated, carried out and completed without customer and contractor having actually met.

There are clearly, for each party, benefits and disadvantages of both *employed status* and *self-employed status* work.

How **employed status** work is viewed

	+	-
Employer	An available resource that can be deployed on different tasks, even in some cases (with training)	Open ended commitment (including on-costs and obligations under employment law) Difficulties to concluding the employment if the employee's contribution turns out not to be adequate for the cost. Un- (or under-) productive cost in situations when business activity is lower.
Employee	Security of work for the duration of the employment contract. A pay cheque every week/month!	Possible frustrations with less interesting or attractive work, and/or with working relationships (in particular with the boss)

How **self-employed** work is viewed

	+	-
Customer	A price for a job – known (limited) cost for an expected output. No on-costs or other obligations (e.g. holidays, sickness, pensions, etc.)	Generally lack of direct control – a degree of trust involved, particularly if little previous experience with a contractor Generally an (apparently) higher price for the same amount of time.
Contractor	More freedom to chose from different projects (providing the contractor has more than one interested customer)	The overheads of initial contracting and outcome delivery. Possible delays in payment. Ever present risk of feast or famine – limited ability to schedule customer demand to allow a reasonable/ smooth workload.

While ICT developments are likely to enable additional, new ways for paid work to take place, these two arrangements will undoubtedly continue, and 'portfolio' careers involving combinations of these will undoubtedly play a part in the future world of work. As productivity pressures grow on all organisations – competitive pressures in the private sector and budgetary pressures in the public sector – the need for effective and appropriate 'outputs' to be delivered per 'unit' human cost invested grows, and this has already led to greater use of contractors and of more flexible working arrangements in today's economy. These factors in turn increase the possibility and, for some, the attractiveness, of portfolio careers involving more than one work relationship at any one time. The infrastructure now possible through ICT can play an important role in enabling the desired flexibility. While the evidence of a major trend in this direction is limited, this may be another example of a change that takes longer than expected to occur on a large scale.

5 Paid Work, other work, unemployment and leisure

The above ideas have focused on work as that which provides an individual's livelihood. However, it is clear – and is considered in some depth in other BCH contributions – that the future world will include people being involved in a range of activities, some of which may be viewed as work even though they do not involve payment, and that ICT will also play a role in handling relationships between the different activities, and the people involved in each, resulting in a steady increase in portfolio careers in the coming years. Most people in the UK now have access to a computer, and use e-mails to communicate and browse the web to find out about things outside of paid work. Thus it will be natural for ICT to support these other activities. Indeed the boundaries between these different activities are likely to soften. After all, contacts made through non-paid work activities (and even through leisure activities) can lead to work opportunities (whether continuing or short term), and expertise developed through hobbies can begin to gain economic value in relation to emerging new sectors or markets. For example, those who become very proficient in enjoying computer games can sometimes become valuable for the 'beta' testing of new games products. Leisure activities that have previously not involved commercial activity can begin to become interesting – fit people who are very active in sport can sometimes earn additional income as personal fitness trainers. And finally the more flexible work patterns possible with ICT-enabling can also provide new opportunities in personal and family relationships. Economic pressures on families can indeed result in long working hours that can reduce time together, but ICT-enabled remote working of one or more parent can ameliorate this. As indicated above, one of ICT's major implications in relation to the world of work has been its ability to enable new revenue streams, and provide an infrastructure by which such activity can be developed into a new business, or at least a new way of earning one's living. There are many dimensions to the transition from small-scale, low-value paid – but 'unregulated' – activity into officially 'registered' economic activity (on which, in particular, certain **tax** is levied for the state). Many of the elements of 'black' or 'informal' economies are analogous here, and Round's paper for BCH⁴ addresses these in some detail. In general, ICT would be expected to *accelerate* the growth of an informal activity into something sufficiently large to be self-sustaining and possibly provide work for others. In addition, of course, an internet presence is something that can be detected and tracked by national authorities, which in turn would in principle result in earlier transition from the informal to the formal economy. Many governments are anxious to reduce 'barriers to entry' to the marketplace for new businesses, and real reductions in barriers to entry may also play a role in reducing the 'transition' duration.

6 ICT skills

The most direct implication of all this on the requirements for young people's understanding as they grow up and begin to contribute to society relates to *their ability to make use of* the wide range of ICT devices, tools and systems, and of their ability to (quickly) learn more detailed, sophisticated and effective use. ICT skills are generally viewed as consisting of two main types: *ICT User skills* and *ICT Practitioner skills*, and there is now considerable understanding of what is needed for each in the workplace (see e-skills UK website⁵). At school level the main focus is understandably around ICT User skills, notwithstanding the expertise of a small number of young people already doing things that would 'normally' be done by ICT Practitioners. Reviews of ICT school qualifications and of how ICT is used by workforce entrants raise the question of what might be the best way for such ICT User Skills to be taught in schools. On the one hand, many (most?) office jobs need adequate familiarity with

⁴ '.....'; John Round, School of Geographical Sciences at the University of Birmingham

⁵ see <http://www.e-skills.com/nvq/1077>

'standard office software' involving word processing, e-mailing, web browsing and some awareness of simple use of spreadsheets, presentation software and databases, and a reasonable exposure to, and adequate awareness of, these things is increasingly considered essential to ensure the young person's employability. On the other, excessive focus on these applications may both prove not very inspiring and may narrow the young person's horizon and so prevent them from being either attracted to work as an ICT practitioner or becoming able to think creatively about ICT and its future potential applications.

Of course the very *dynamism* of ICT poses real challenges for the widespread acquisition of ICT User skills that is likely to be important for its effective use, both in the workplace and beyond. It is understandable that the arrival of new technologies in the workplace can be a cause of fear in working people – fear that they will not be able to understand and learn to use the technologies, and fear that these technologies will so change their contributions that their livelihoods might ultimately be at risk. Such initial fears inevitably colour attitudes to acquiring the relevant skills. As generally older people find it harder to change the way they do things, and a range of subtle factors – including such things as a reluctance for senior people in an organisation to be seen as unable to master things that more junior staff can (like using a keyboard) – can play an important role in how the new technologies are picked up.

It was quickly realised that widespread acquisition of good ICT skills would probably await the penetration into the workforce of sufficient cohorts of 'Digital Natives': the 'next generation' for whom use of ICT devices and systems was 'no big deal', and certainly no threat. However, while this process is undoubtedly happening, the waves of innovation so characteristic of ICT mean that it would be unwise to assume that that the 'passage of cohorts' will solve the problem 'once and for all'. The recent study of 'IT & Telecoms Insights 2008: Trends and UK Skills Implications' for e-skills UK shows the importance of the changes arising from the presence of Digital Natives, as well as the implications of expected trends in the ICT world on ICT users and their skill needs (see Annex B).

New ICT systems bring both new functionality and ***new user interfaces***. The Human Computer Interface stream of academic computing research has, over the years, taught us things about how humans interact with machines most effectively. However, the realities of interactions with ICT devices have generally been driven less by academic research than by what has come with commercial products – the WIMP⁶ interfaces that emerged from the Xerox Palo Alto Research Center (PARC) Labs onto the first Apple Mac are a good example of this. Perhaps the most obvious candidate for obsolescence is the keyboard, and while automating speech recognition in a wide range of conditions and background noise levels is known to be a massively difficult task, and progress so far has manifestly failed to make the keyboard obsolete, it seems likely that that will come.

7 Probable developments in the world of work arising from ICT developments

The most natural assumption to make in relation to future developments in ICT is to recognise that new and creative manifestations of the broad principles articulated in section 2 will continue or increase change. Examples of the kinds of Technological Drivers (ICT and beyond) that would be expected to play significant roles in ICT activity and the world of work the coming years are⁷:

- Major new classes of ICT, applications and styles of use of technology introduced and exploited
- Improved user interfaces widely used

⁶ Windows, Icons, Mice and Pointers

⁷ taken from CEPIS (2007)

- Greater adoption of software engineering (tools) and more disciplined approaches to system development
- Enhanced telecommunications infrastructure and services (eg mobile broadband)
- Maturing of (parts of?) ICT infrastructure/services
- (Significant) improvement in (cost-) effectiveness of e-Learning
- Growing impact of technology convergence on content-related products & services
- New technologically-based threats to infrastructure and business experienced on a significant scale (eg electronic warfare)
- More use of *bio-mimetics* in design (growth of nature-inspired design)
- Impact of more accurate geographical positioning systems (eg Galileo) in terms of more and better services, and new generation Geographical Information Systems generally
- Growth of use of ubiquitous and utility computing – emergence of *Ambient Intelligence* as a social and business platform
- Growth in development and availability of carbon-emission reducing technologies
- Continuing growth in creative applications of ICTs in existing and new areas (eg e-health, spatial and movement tracking systems, e-democracy, leisure)
- Development and deployment of Digital Rights Management (DRM) and related technologies, and
- Shift towards of the use of Open-Source Software.

The implications of these will be significant (generic) impacts on the world of work, and – as noted above – the timing of such impacts will vary. A recent study on the future of e-Skills for the ICT industry in Europe examined the impact of these drivers (as well as others – Societal, Environmental, Political, Economic, and Values-related) on the demand, supply and possible off-shoring of ICT Practitioner skills (see CEPIS, 2007). The European study focused on demand and supply of *ICT Practitioner* skills, and so on the designing, building, operating, and maintaining of software and ICT systems. Having identified some 90 change drivers (including Societal, Economic, Environmental, Political, and Values-related), it concluded that three of these would be likely to have the greatest influence on ICT practitioner activity levels in Europe: *Economic confidence*, the *rate of technical innovation*, and the *amount of 'off-shoring'*, and six scenarios using combinations of these three core drivers were produced to enable possible futures to be explored⁸.

While possible futures arising from different combinations of value of key drivers contain considerable complexity, it is possible to offer qualitative considerations of one or two dimensions of how the future might pan out, in relation to ICT developments and their impacts on the world of work.

- a) The relentless growth in functionality of ICT devices and systems will continue to offer new opportunities for activity of all kinds (some examples would be devices embedded in many new and conventional products as well as the growth of 'fidelity of experience' (remote interactions with others which begin to feel as though they are in the same room), and the improvement of virtual reality environments, at decreasing cost.
- b) Apart from a slowing of ICT innovation arising from significant financial slow-down (now a possibility in 2009+), probably the greatest influence in the opposite direction is security issues. These are of many kinds – from attacks on ICT infrastructure (including the internet) to social reactions against a perceived growing 'big brother' society; and from the impact of loss of significant public sector data to the continuing levels of computer crime.

The actual situation in mass markets may well depend on the balance between all the positive forces motivating for continuing innovation, and the negative influence of security-related problems.

⁸ It is notable that global financial developments during 2008 have created a reality not far from the 2006 study's scenarios based on economic turbulence...

It is important to note that many existing developments point the way to continuing waves of ICT-enabled innovation. Some examples relating to e-business would include⁹: [eBay](#) has lowered the bar for small businesses and individuals to set up virtual "shop". Similarly [Etsy](#) helps people to sell craft wares in a way that was impossible before the internet. Blogging has gone from a niche and hobby activity to a pursuit that many now enter in order to profit from [Google Adwords](#) and product placement. "[Second Life](#)" has started a real debate on the taxing of items and generation of real income from activities conducted in virtual worlds. This has raised some issues of legality (refs. the difficulties faced by [ige.com](#) in making it possible to exchange in-game currencies for real ones). Related to this is the (still contested) notion of the viability of the 'long tail' , niche strategy of businesses, such as [Amazon.com](#) or [Netflix](#), that sell a large number of unique items, each in relatively small quantities).

In addition it is crucial to recognise, when considering the social reactions to ICT and other developments, some of the changing attitudes to the world of work that are already happening. Probably the most significant example is the growing interest in the attitudes of **Generation Y** (generally viewed as those born between 1982 – 2001, who have been coming onto the labour market over recent years). The general perception is that they are comparatively well-educated, particularly 'tech-savvy', are especially tuned to their own value in the job market, have limited loyalty to any particular employer, and, perhaps as a result of reactions against their parents' excessive time commitment to work, insist on working in a stimulating job environment, and, perhaps, accepting lower remuneration levels to achieve this. They are also viewed as likely to move jobs more often than previous generations. While such perceptions will no doubt get refined as more evidence on this cohort emerges, such characteristics do suggest an important shift in attitudes towards work, and probably therefore certain shifts in the employer-employee relationship which may make the best talent more difficult to recruit. The combination of ICT skills, greater expectations and lower loyalty to individual employers would presumably tend to strengthen trends away from 'getting a job' towards 'making your own work' (ie creating income streams or businesses). This suggests a further factor to increase take-up of portfolio careers.

8 Assessing how the implications of ICT developments in the world of work need to be considered within the formal education system

When considering the implications for the formal education system of the skills requirements in the world of work, it is essential to consider the realities of the process of influencing curricula from the needs of the workplace. Much of skills policy in the United Kingdom over recent years has been driven by a desire for the country's learning infrastructure to be better aligned to the skill needs of employers. Leaving aside the fact that education is indeed more than just a preparation for work, the great challenge in this approach lies in the **difficulty of clarifying precisely what those employers' needs are**. There are a number of dimensions of this:

- a) Employers' skills needs vary considerably, since what different employers do and how they do it varies considerably. This does not mean that there might not be *some* common requirements (and it is interesting that most employer surveys include, in their conclusions, the need for recruitment candidates to have good generic-, 'key'-, or 'soft'-, skills as well as positive motivation), but that beyond this the skill requirements cover an enormous range. The differences include:

⁹ unpublished note (Wilson, October 2008)

- i) *differences between sectors* (it has long been recognised to be important for sectoral differences to be acknowledged and investigated – hence the role of sector skills bodies, starting after the Second World War with the original 'Industry Training Boards')
- ii) *differences between occupations*. In fact at skill levels anything above 'unskilled' jobs, the knowledge, skill and competence requirements relate essentially to occupations, rather than sectors. Within a sector there are a wide range of occupations, and the skill requirements for (eg) an engineering company's accountant(s), personnel assistant(s) and cleaning staff are essentially irrelevant to the skill needs for the engineers who carry out the company's core activity. Since most important occupations cross many sectoral boundaries, this becomes important when interpreting different employers' perceptions about the same occupation
- iii) *differences between employers of different size*. It is natural that large employers will be able to recruit people with different skill-sets. This will result in a wide range of expertise being at the employers' disposal through a wide range of people each with different expertise. Many of the same functions that take place in larger employers are required in smaller organisations, but 'Small and Medium-sized Enterprises' must perform them without the availability of the specialist expertise. While certain activity can be (and is) out-sourced, it is inevitable that employees of a **small** organisation generally need to be able to carry out a broader range of activities, in many cases things beyond what their education and training prepared them for. Thus skill-sets in small organisations generally need to be broader, while large employers can sustain a much great number of *specialists*.
- iv) *differences between organisational objectives and work-organisation 'styles'*. Organizations carrying out the same business (eg competing companies in the same sector) can often have different business objectives – for example in terms of their stage of development, growth path and market strategies – as well as very different organisational cultures. The skill requirements for someone seeking work in a very modern, flat hierarchy (heavily delegated) and ICT-enabled company would of course be different from those needed for entering one with a rather traditional, hierarchical culture.

Given these significant variations, employer surveys of skill needs ought to differentiate their findings to take this into account, and if they don't, their conclusions are subject to questioning as to their validity.

- a) few individuals leaving the formal education system can be expected to be particularly competent in the specifics of their first job (except perhaps where the individual has learned a specific job-relevant skill outside the formal system). This means that most employers are likely to have to provide job-specific training before the 'new recruit' becomes productive, and sometimes that training appears to take longer than the employer thinks it should. This can lead to employers concluding that they have to 'teach' young people certain things that the employer thinks 'should have been learned in the education system', 'for which they have paid' through their taxes. While this situation has always existed to a greater or lesser extent, growing pressures on employers (in particular competitive pressures in the private sector) have probably made employers more impatient than in the past with the delay before new recruits become productive.

These experiences and perceptions inevitably get picked up in employers' surveys about skill needs and their views about the 'products' of the education system. Such surveys therefore tend to focus on the *limitations* of new recruits fresh from the education system, rather than any other characteristics. While this is in principle reasonable (it is right for policy to address problems), it tends to result in the skills debate being driven excessively by what is (felt to be) missing. In principle, it is possible to respond to

concerns about 'gaps' by introducing a new element into the curriculum that addresses that particular area of knowledge. However, even if there could be a clear consensus across all employers as to what 'new subject' should be added, there also needs to be a consensus about **what should be removed from the existing curriculum to make room for it!** Since education system leavers have a range of capabilities, some of which employers do value, there is always the risk that employers' concerns could then simply shift to the new gap arising from what has gone from the curriculum.

9 Some Conclusions

What, then, are the conclusions that can be drawn from this brief overview of the likely future role of ICT in the workplace?

- That ICT can be expected to continue to make major impacts on the world of work, and that societies, employers and individuals will continue to receive a range of benefits, though the complexities of ICT will continue to result in certain unintended consequences and adverse effects.
- That the adverse effects will include the loss of work in some activities, so that 'agility', 'creativity', willingness and ability to adapt to new situations and learn new skills will become even more important for continuing employability than they currently are.
- That ICT will continue to provide a range of additional opportunities in relation to all aspects of work, and of all types of work.
- That *confidence*, and *adequate competence*, with using ICT will continue to be important in the world of work and beyond. However, effective use of ICT in earning one's living will depend less on the specifics of the ICT user skills studied within the formal education system than on the generic understanding around it. Thus that system needs to understand that the specific user skills taught form only *part* of the foundations of the confidence and adequate competence of ICT use, so that learning must go beyond this.

References

e-skills UK (2008) *IT & Telecoms Insights 2008: Trends and UK Skills Implications*. Produced by e-skills UK based on published research by Gartner Executive Programs, January, 2008

CEPIS (2007) *Thinking Ahead on e-skills for the ICT Industry in Europe: Harnessing our Strengths and Diversity for the World Stage*. Council of European Professional Informatics Societies for the European Commission, November, 2007

LSE/ONREC (2004) Papers from 'Recruiting in Cyberspace': ONREC (The Magazine for Online Recruitment around the world) Conference on *recruiting on the internet*, 17th June, 2004, London School of Economics

Annex A

Details on Virtual One-Stop (1998 project in Florida, US)

The idea of the project was to produce a system on which any individual capable of effective web access could proceed through a whole series of steps, concluding in getting employment. The system would:

1. enable the user to explore the working environment of an occupation in which s/he was interested (with some richness – eg video clips of the workplace, showing attractive role models and the kinds of activities involved in the work);
2. provide a range of online psychometric testing so that the individual could get a feel for whether s/he was adequately suited to such work, and generally identifying which occupations would – based on the Ψ - test findings – be expected to fit the user's characteristics/strengths (this would then allow the user to browse the working environment of other plausible occupations).
3. Support the preparation of a good c.v.: with the use of templates and various kinds of guidance, the system could help the production of a good 'core' document, which could be subsequently refined as necessary.
4. Allow the user to access a range of other information about each occupation, in particular the state of the local and national labour market in this occupation, and such trends about future prospects for the occupation as have recently been undertaken (eg in future-gazing studies, like Working Futures in the UK)
5. Enable access to more information about the Knowledge, Skills and Competences (and in some cases, qualifications) required for working in that occupation (drawing on work from bodies like – in the U.K. - Sector Skills Councils and Professional Institutions)
6. Drawing on such information in relation to occupations of interest, the user could then quickly a) carry out an on-line 'Training Needs Analysis' to identify the main gaps in his/her understanding/capabilities, and b) track down 'learning offerings' of relevance to these. The learning provision data could be selected by things like geographical proximity, cost, etc.), and then Virtual One Stop would provide access to databases with information about possible funding support for such courses. Once selected, the system would enable a booking to be made on the course.
7. Once the user feels that s/he is sufficiently competent/confident to apply for a job, the system would then provide information (again with filters for things like proximity and remuneration levels) on job opportunities in the occupation. These offers could be compared and – ideally - discussed with others (friends/parents).
8. Should the user desire to apply for one or more of the jobs on offer, the system would provide assistance in a) gaining more information about the

employer (so that the user could carry out an initial consideration of the employer characteristics of interest), b) preparation of a tailored application letter and/or the refinement of the c.v. As with booking relevant courses, the initial stages of application for the vacancy could then be carried out on the system.

Annex B

Extracts relating to ICT user skills from

'IT & Telecoms Insights 2008: Trends and UK Skills Implications' (Gartner/e-skills UK)

Impact of expected trends on IT users and consumers

Enterprise success rests on using technologies to create value for their customers, constituents and stakeholders. The trend toward consumerisation and convergence of IT, plus the entry of Digital Natives into the workforce, are leading to new innovations in the ways users and consumers work – using data, voice, location, image and video information. Being successful in an environment where information is rich and deeply ingrained in processes will require users and consumers to invest time and attention in building new skills.

IT users are also consumers of technology and information-intensive solutions. The need for core IT skills in the areas of *integration, content management, security and data protection* will continue to increase along with the increased consumerisation of IT solutions.

Knowledge workers (high level IT users) - who rely on information and information technology to conduct their jobs - will need emerging skills including:

Use of *information and analytics* to make fact-based business decisions using information provided by IT systems. They need to form and test options using actual performance data

Appreciation of *business analysis*, where IT users may be called on to collaborate with IT professionals to define the business needs, process requirements and information needs of new systems

Understanding of *process and performance modelling*, to assist in defining new ways of working. For example, they may conduct a process simulation to evaluate the effectiveness of new business processes. These skills may be introduced with new IT systems along with new management metrics and targets that support benefits realisation.

Other IT users in the workforce and consumers more generally will need to build their skills and proficiencies in using information technology as it becomes pervasive in the workforce and society. This includes:

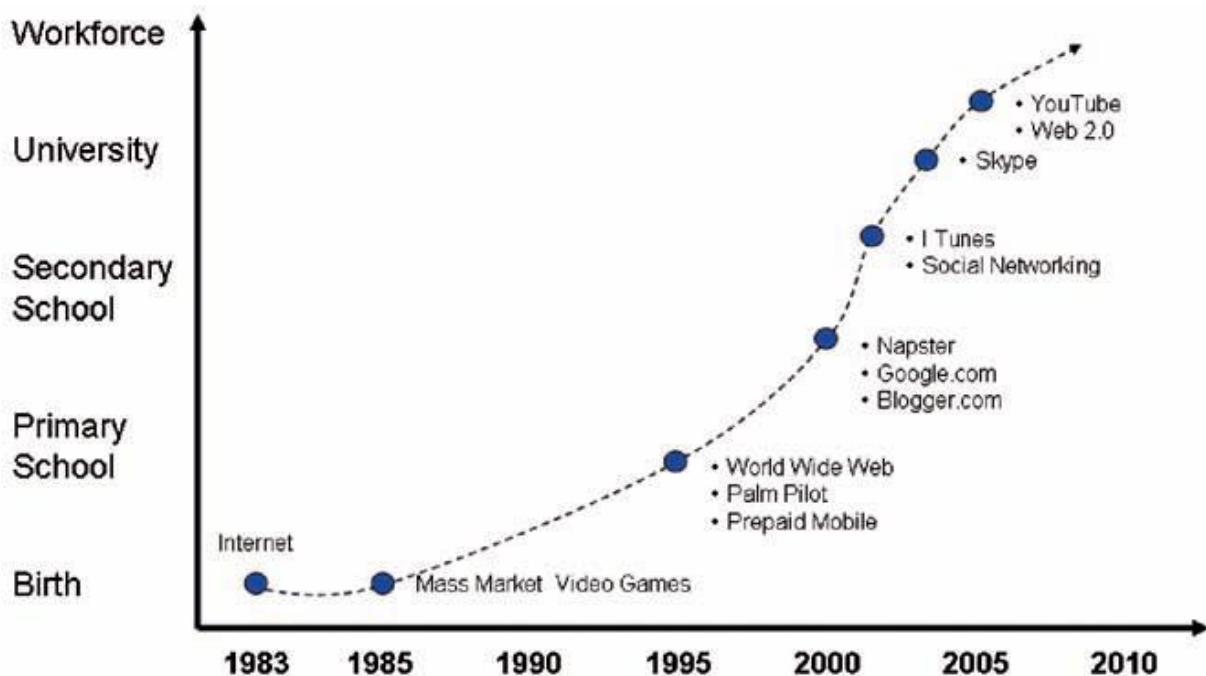
- The ability to use *basic desktop technologies*, including web portals, instant messaging, email, word processing, document management and similar tools
- Understanding of *information security and records management* policies and procedures because business professionals are the first line of defence in securing the company and its customer information
- An understanding of *IT support processes and tools* to take advantage of IT skills and capabilities to maintain the availability of their information and tools
- In manual occupations, how to use dedicated devices that perform specialised business functions (such as payment authorisation and package tracking).

Digital Natives

Time and technology have created a generational shift in the workforce that is now having an impact in the marketplace. Digital natives are 'native speakers' of the digital language of computers, video gaming and the internet. Their parents and grandparents, on the other hand, are 'digital immigrants.' Whilst it would be easy to view this divide as the latest generation gap, business, technology and governmental leaders are changing their structures to attract digital natives to their products, services and to their workforce.

Digital natives are driving future domestic growth. They are also the next-generation workforce. They demand technology-intensive products and services, which drives the demand for *advanced analytic, design and information skills* in product development and service delivery. Enterprises are meeting this demand by raising their levels of technology innovation and agility, thereby increasing the importance of the *technology skills required to manage technical complexity and scale*.

Digital natives have grown up with technology, as shown in the figure below. However, growing up with technology is not the same as knowing how to implement it successfully on an enterprise scale. Enterprises actually will need to build the *technical skills* of their digital native workforce so that they can create solutions that meet enterprise demands, support commercial levels of security, and have the requisite agility to respond to market changes.



Digital natives have experienced significant technology developments at each major stage in their lives. These developments shape their expectations as customers, as a workforce, and as a market

What will the impact be?

The IT Industry is facing the need to evolve its current employee value proposition to attract digital natives. New jobs in *analytics and information, design and presentation content* are needed to develop consumer-driven products and services. Web 2.0 and other consumer technologies will give digital native professionals the collaborative environment they have socially and expect in every aspect of their lives.

Trends	Impact on IT Users
Industrialisation of technology delivery	IT users will gain greater value from industrialized IT delivery by engaging IT professionals in transformational change. This requires IT users to enhance their business process management, performance management, and change management skills to handle more challenging change initiatives.
Digital natives	IT users will need to invest time and attention to understand and participate in solutions created by new technologies. Digital immigrants will need to become comfortable with the more dynamic, collaborative and occasionally chaotic work styles of new employees to avoid being branded as second-tier. Digital natives who have been exclusively on the customer side of products and services will need to recognise the realities of business and the demands of building a growing enterprise.
Social computing and Web 2.0	IT users are participants in these social networking sites and gain insight and social networking skills needed by their companies. Their participation in their private lives or as part of their work experiences provides valuable insight into how to leverage Web 2.0 technologies for their organisation's benefit.
Consumerisation and convergence of IT	IT users will exercise their power of choice as employees and consumers. IT professionals should consider their IT user colleagues as a ready test market for new solutions, products and services development.
Green IT: environmental computing	IT users in general and business leaders in particular will determine the impact of environmentalism through their definition of 'eco-friendly' requirements (power, thermal, recycling, disposal) in purchasing hardware and communications gear as well as requirements for selecting external service providers.
Information and analytics	IT users accustomed to more sophisticated forms of information presentation will increasingly demand greater insight and look to apply information in customer offerings and operational decisions.
The pool of talent and gender balance	IT users recognise the blurring of traditional lines between IT and business activity as many have increased their technical knowledge, largely through non-traditional channels such as internet based courseware. These users face the need to build deeper business and technology skills making them candidates for the future pool of IT talent.
Innovation	IT users and their management face the challenge to change the way they work to raise customer effectiveness and operational efficiency. IT users will need to develop a new appreciation for using information technology to improve decision making, create new sources of customer value and raise operational performance.
Transformation through IT	IT users have traditionally thought of IT as their computer and management reports. This view needs to change and IT users become more aware of the connections between information technology, business process, their business tools and the way they do their work.
Communications convergence and integration	IT users will need to understand their basic device and information security responsibilities as information moves outside of the company's four walls. This is particularly

	important in the light of consumer network devices (smart phones) that have personal as well as professional uses.
Security and data protection	IT users are a significant source of security and data protection risk, and many do not realise it. Enterprises face significant exposure and risk of financial loss when IT users do not understand and follow established security and data protection practices. Basic security skills and awareness of how to handle sensitive information should be part of the job responsibilities of all IT users.

This document has been commissioned as part of the UK Department for Children, Schools and Families' Beyond Current Horizons project, led by Futurelab. The views expressed do not represent the policy of any Government or organisation.