Innovation, skills development and labour
A European perspective

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Preface

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If we can believe the trends, Europe is facing an e-skills shortage just as firms are attempting to cope with a persistent productivity shortfall relative to the US. Governments and educationalists approach the problem from a supply side perspective, focusing on increasing the number of ICT capable people, and certified or accredited training facilities. Solutions, however, are more likely to emerge from employers due to their demand for, and direct utilisation of e-skills. In the process, they provide feedback to the labour market that ICT capabilities are both required, and rewarded.

The first step on a labour-driven path to greater innovation is for European firms to make better use of skilled personnel. Where this occurs, and the supportive organisational conditions exist, greater productivity can ensue, with the benefits, financial and otherwise, accruing to the participants and the surrounding social milieu in which the firm operates. When that prosperity becomes more ubiquitous and is translated into increased salaries, the labour pool will respond to this signal by migrating to employers who make the best use of skilled personnel and reward them accordingly.

European firms that consistently engage in such practices are more likely to be *innovative*. The starting point in achieving this aim is the enhancement of European businesses' ability to utilise their ICT capable employees effectively, in order to boost productivity. The two principal means by which they can undertake this include:

- *Promoting self-learning and in-house training and harness the benefits by fostering more extensive utilisation of developing skills*
- *Emphasising the coordination, co-invention and multiplier effects of ICT in adapting business routines.*

Fears of widening e-skills gaps may seem misplaced if rapid technology-driven workplace changes are facilitating an efficient and productive use of the workforce, which is undergoing equally accelerated changes in adjusting to, and utilising ICT. An optimal solution will emerge from *greater flexibility* in the development of e-skills, in order to allow their supply to adapt to changing market conditions and the expectations of employers. When a balance between these factors occurs, firms can better coordinate, manage and utilise ICT for productivity gains and in the process be more innovative.

Introduction: Organisational practices and the management of e-skills

Innovation in business and services, and the resultant productivity gains, bear an indirect relationship to the availability and quality of skills in information and communication technologies within the labour pool. Throughout the European Union, the proportion of people with e-skills continues to rise and employers claim that they will go on rising into the foreseeable future. However, despite the signs that the supply side is not now badly off,[i] productivity gains still do not follow.

In this study we consider what European skills development policies need to take into account in order to ensure that the e-skills within the labour pool are best utilised for the promotion of innovation. Our focus is on how we use e-skills and what it is about the organisation and management of European business that inhibits us from even better utilisation of such skills. We address the questions: Why, when supply and demand are reasonably close to maintaining balance, do we still see the persistence of dramatic variation in productivity from firm-to-firm, and, in aggregate, differences between the US and Europe? Why do our measures of innovativeness show a persistent disconnect between the utilisation of e-skills and expected flexibility

Industry focus: Aerospace

Let us consider the aerospace industry and its myriad of SMEs in Europe, prodigious users of ICT-trained personnel, to see what we can learn about these differences in productivity. As one would expect from this leading-edge high technology sector, advanced e-skills are pervasive. Their interests in enhancing e-skills are well expressed in their push for ever more attention to standards, accrediting and certification. But their own behaviour is typical of other high technology sectors in that they expect employees to engage in self-learning and in-house training.

Their emphasis on standards does something else for them, in addition. It provides them with the confidence to be able to shift their operations more easily into areas where they have competitive advantages, and to source goods and services wherever advantageous. As they increasingly rely on the comparability of standards and skills of all kinds, plus excellent logistics services, they are able to put together supply chains of greater intricacy, and concomitantly hold lesser allegiance to traditional suppliers. Nevertheless, in this industry as in most sectors, we still see more agility in the US as opposed to EU firms. [ii]

So now we can begin to see how the equation looks: firms that are able to manage resources imaginatively, to utilise e-skills by organising procedures to enhance their competitive advantages will increasingly leverage the skills base available to them. They absorb supply, but don't press demand.

What e-skills are needed and how does society acquire them?

Economic prosperity everywhere rests on some combination of the ability to exploit natural resources, invest capital into industrial capacity to produce goods, and the delivery of services ranging from those that make better use of resources and goods to those that enhance our lives through cultural attainment. Europe, along with most advanced service-based economies, is able to sustain and increase its welfare through ever more effective utilisation of the application of knowledge. This has been the case for well over one hundred years; what has changed in that period has been the types of knowledge that have been held in high premium.

While these can be seen as translating into very specific e-skills such as production modelling using spreadsheets or integrating product supply data with accountancy software or designing web-based applications for customer support, we should not lose sight of three underlying features. The first is that the applicability of these skills defines their value, and such applications frequently change. The second is that the particular functionality of the associated spreadsheet software, the details of accounting standards, and the expectations of customers about web interfaces, for example, change very rapidly indeed. Finally, we can observe that most organisations that rely on the routine application of such tools and processes expect their employees to be flexible and master new skills rapidly, depending on brief training sessions, self-teaching, and undisruptive in-house learning.

This brings us to the link between skills and innovation, which we can now see lies in the ability not only of skilled people to have high expectations about the value of changing practices, but also of their ability to accommodate and encourage the effect those changes have on organisational strategies and structures. It is not their technical competence in one thing or another that links their skill to innovation, it is their confidence that when change is apparently advantageous they can adjust themselves to new kinds of work and imagine the organisational changes that foster those advantageous conditions.

This linkage, however, is not as strong as one might expect; it requires interpretation. The country with the highest measurable capability to innovate (based on patents granted, start-up firms introducing new products, total spending on research and development as well as its return on investment), the United States, apparently has a considerable skills deficit of all kinds. The shortfall, a matter of constant self-criticism within the US, is especially evident in the relatively low levels of attainment by American secondary school students in tests of quantitative skills. Countries with the highest such measures do count among those with high per capita patenting outputs, such as Hungary and South Korea, but are generally not considered among the most innovative.

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Drawing from intermediate results of the LSE/McKinsey study of management practices in 4,000 firms across 10 countries in Europe, Asia and the United States, we see that the best run firms, and implicitly those that are most capable of generating innovation, are US-based firms that have invested heavily in ICT and associated e-skills. They also seem to be disproportionately capable of leveraging those assets. This new study clearly indicates that there is a difference between similar firms in different countries in their ability to exploit similar ICT assets. That difference derives from managerial and organisational features and not from either the availability of a skills base in the economy or differences in the functionality of the technology employed.

All standards setting activities constitute a compromise between creating the conditions within which investments can be exploited and the encouragement of the continuous search for novelty. The same compromise is implicit in the process of credentialing and issuing certifications, as with those offered by educational standards setting bodies. The clear danger arises when there is an underlying static notion of which skills are worthy. ICT abounds with examples, such as the denigration of those skills associated with computer gaming in favour of more commonly taught subjects, such as software package use or web design.[iii] A static notion of technology, evidenced in the constant effort to freeze our view of what constitutes the main features of technical systems and their associated skill requirements, is a serious inhibitor to more proactive policies.

What concerns most analysts is how we can plan for the future, as expressed in the Rand Europe report as well as the Accenture report on “Skills for the future” [v], i.e. whether the capability of European institutions is sufficient to meet the presumed ever increasing demands for skilled labour.

There has been a proliferation of studies of ICT skills in the European Union over the past twenty years, all of which are predicated on the notion, or fear, that an e-skills gap will soon open up. These are apparently well-founded fears, but also ones that are susceptible to a variety of special interests. Policy planners respond to their assumed responsibilities to enhance e-skills by seeking the means to extend provision. Employers have a clear incentive to support those who would extend the skills base of the labour market to ensure that competition for scarce skills doesn’t push up wages beyond the level of productivity returns on those investments. The public have an interest in extending the skills base because they see businesses advertising for skilled employees and because they fear being marginalised. There is also an enthusiastic attitude towards novelty in ICT within Europe, with rapid uptake of new products ranging from mobile telephones to computer games and new operating systems.

Policy planners see the increasing pervasiveness of ICT in the society and note that traditional educational institutions are unable to provide every child with the training assumed to be requisite. They are also sensitive to the many groups in society that typically benefit from assistance additional to the normal education provisions, such as people with disabilities, recent immigrants, and those who live in impoverished areas. Other groups are assumed to be so severely at a disadvantage in relation to ICT skills as to appear to be disenfranchised from activities that are increasingly becoming part of our institutional fabric. This includes access to on-line social services, sources of government information and feedback mechanisms, and presumably soon other democratic rights including voting. Recent studies support these fears by pointing out, for example, that a disproportionately low proportion of the elderly feel comfortable using on-line systems and other computer-supported tools. They also show that women are not well represented in software engineering courses, and that ethnic minorities are marginalised in this realm as in so many others.

Employers are assumed to have a clear idea of what skills they require, and for some firms this can reasonably be said to be the case but the normal three-level classification of e-skills attainment hardly captures these requirements. A market research company needs the kinds of e-skills that are required to perform data analysis using spreadsheets and statistics programmes, and a logistics firm will hire people with the e-skills associated with operational research functions. However, most employers assume a baseline of skills in document production, presentation design and basic spreadsheet usage, in addition to using e-mail, on-line forms, etc. They do not want to pay a premium for those employees who bring in only capabilities near that baseline, and so it is in their interest to ensure that there is a ready supply of job seekers with that degree of e-skill. Credentialing and formal education, however, does provide two other valuable services for employers. One is to act as a sieve and quality control mechanism such that employers can differentiate among job seekers based to some degree on the assessment mechanisms of others, namely educational institutions. The other, as expressed by the economist Mark Blaug, “is not so much to train workers as to make them trainable.” [iv]

What concerns most analysts is how we can plan for the future, as expressed in the Rand Europe report as well as the Accenture report on “Skills for the future” [v], i.e. whether the capability of European institutions is sufficient to meet the presumed ever increasing demands for skilled labour. Some of this concern is focused on lifelong learning, some on the quality of educational provision and the mix of specialisms. British secondary schools, for example are criticised for failing to meet high standards on a large scale, and American universities are criticised for the disproportionately low numbers of US nationals studying for engineering degrees. Europe is faulted for having too few world-class universities where leading-edge research in areas such as software engineering can flourish. If we are to suppose that the labour market is sufficiently flexible to accommodate emerging skills demands, our criticism should perhaps not rest so much on the current shortcomings of these institutions as on the limits of their capacity to adjust flexibly to changing demands in terms of scale as much as in terms of technical character.

With such constant attention on the relationship between skills and employment, one dimension usually falls into the background. That is the significance of mass e-skills on consumer behaviour. We can break this part of the argument into two features. On-line shopping provides the opportunity to take advantage of lower prices, relegating those with inadequate skills or poor access to on-line computers to higher cost goods. The other feature is that consumer demand for increasingly novel and functionally advanced products provides considerable incentives for manufacturers to market ever more sophisticated products.[vi] The point is simple but of great importance. Where people’s skill levels are inadequate to exploit higher levels of functionality they will be less willing to pay a premium for products that offer more than basic functions. This seems to be the case not only for consumer products but also importantly for users of tools and intermediate products.

The relationship between e-skills and innovation is especially strong here, but it is an indirect one. A mass skills base does not, in this case, offer the means to develop new products and services, but it makes all the difference in providing the incentives for innovators to pursue long-term goals. Investments in innovation are repaid by the size of the potential market and, unlike novel pharmaceutical products that require specialist training of professional physicians before they can be widely distributed, electronic products can be appreciated by a wide range of skilled people who utilise their knowledge of how to operate information and communication technologies as general purpose technologies. [vii]

Skills benefit the economy through coordination and application in organisations

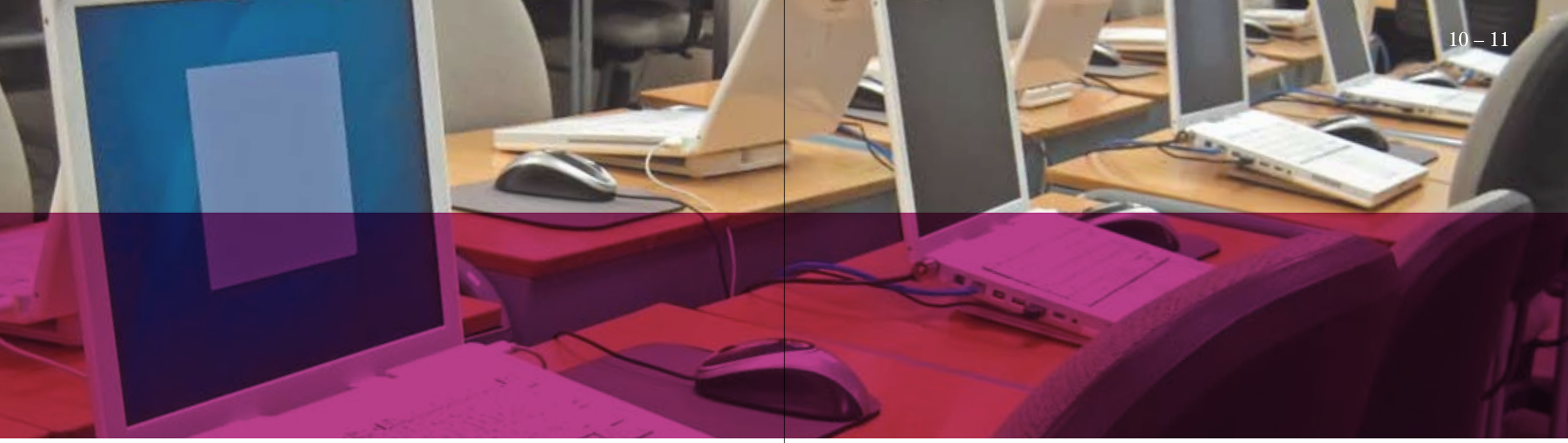
In almost all cases, skills are applied to tasks within organisations and their beneficial impact is dependent on the ability of those organisations to harness the specific resources that those skilled personnel bring. In this section we consider what the dynamic characteristics of that transformation are, how the utilisation of skills affect organisations, and how improved organisations enhance economic growth.

Whereas skills are embodied in individuals, they make sense only in their application to business functions. Indeed, aside from routine tasks associated with commoditised information handling, innovative activities are frequent and common in the use of ICT and they require flexibility on the part of the organisation as much as by the individual. As one highly respected group of analyst of the economics and management of ICT put it:

"Firms do not simply plug in computers or telecommunications equipment and achieve service quality or efficiency gains. Instead they go through a sometimes lengthy and difficult process of co-invention. IT sellers invent technologies; they do not imply, but only enable, their application; IT users must co-invent applications. Co-invention, like all invention, has both process and product elements. On the process co-invention side, the effective use of IT often involves changes to organisations." [viii]

The incentives that individuals feel to acquire skills, then, is also a function of the opportunities to work within the sorts of flexible organisations that value those skills. This relationship between the capabilities of organisations and the incentives of individuals stands behind the more superficial phenomena that get measured: numbers of skilled people in the labour force and hiring practices of firms. This implies that not only will people wish to acquire more appropriate, and higher level, skills if they have reasonable prospects of working in such an organisation, but firms that can better exploit those skills should be able to offer higher salaries and better incentives for innovative work. This is something that emerges quite clearly from data on comparative wage levels.

This perspective on the problem is quite different from the normal approach to the application of technology and the source of skills. We will be misguided if we think of science and technology as a resource that stems from a disembodied logic of natural law and efficient design because we will not appreciate the role of interpretation and the "co-invention of applications" within organisations, as Bresnahan, Brynjolfsson and Hitt put it.[ix] Similarly, we should think of skills in the labour market as inherently linked to the ways in which organisations use them. This might be implicit in the common notions of the supply and demand of skills, but there has not been sufficient attention paid to the way that the demand side actually works. This rest on the ability of firms to improve their performance with the imaginative, flexible, productive use of skills and their willingness, concomitantly, to raise wages.



ICT Learning

In 2006, the European Commission reported that a strong increase in ICT use has occurred over the past five years in EU schools, facilitated in part by increasing broadband penetration: 67 per cent of schools in EU25 countries now have broadband internet access, as do 72 per cent in EU15 countries. This lags the US where 95 per cent of schools have broadband access, largelyas a result of its e-Rate programme.[x] A shift has also been occurring with where ICT has been located in schools. Between the millennium and 2006, computers moved out of computer labs and into the classroom, with a three to five fold increase occurring at EU15 level. Although ICT indicators across EU schools vary significantly, the trends are in the same direction: ICT is being deployed more frequently, almost ubiquitously, and is central to the teaching syllabus. New EU member states currently lag established ones, but mirror their trends.

The pedagogical benefits of ICT use in schools will continue to drive its increased use, coupled with EU directives to improve the e-literacy of students as a pre-cursor to their migration into higher education, employment, or other forms of social participation. As ICT related activities continue to move from the margin to mainstream, demand for related skills will continue to increase. The proliferation of information processing software such as word processing, spreadsheet and graphics packages is likely to continue driving their acceptance and use by ever younger users.

The majority of ICT investment in the EU is occurring in high schools. Primary schools are not currently receiving the same level of attention from policymakers. Only in three European countries (Germany, Luxembourg and Malta) do primary schools display a level of ICT investment comparable with some EU high schools.[xi] EU and national ICT policies focus on secondary schools, although pressure will exist for this to alter if the current accelerated rate of ICT familiarisation by pupils continues outside of the classroom. The reduction of the age at which this is occurring will be driven by tacit and informal knowledge creation which ultimately may precipitate an increased programme of ICT hardware and software investment in primary schools in a formal curriculum-driven manner. The pressures of broader technological change will also put renewed emphasis on increasing the level of ICT competence of this younger audience. The acquisition of e-skills is not a static process however; they must be kept current if they are to maintain their relevance. Their acquisition does not guarantee a productive and innovative economy, as compulsory schooling only represents the first formal step of ICT learning on an intricate route that transitions an individual into our social structure, a higher education institution, or an employment environment that is relying increasingly on tacit knowledge of ICT and information handling generally.

One of the most noticeable observations in the drive for e-skill learning in firms is the “SME effect”. These smaller companies, representing 99 per cent of the 19.3 million enterprises in the EU, provide over two thirds of all employment (65 million jobs).[xii] In contrast to the majority of larger firms which view ICT strategically and as productivity enhancing, the majority of smaller firms perceive it as “a cost”, and something that will not necessarily enhance their business. This factor inhibits the establishment of an innovation culture in the EU, in contrast to the US where ICT is generally embraced as a core element of a firm’s productive capacity and where SMEs constitute a smaller proportion of industrial structure.

One result of this is that venture capitalists seeking to minimise their risks and maximise their profits engage in greater activity in the US. Addressing this requires EU firms to reverse many of their attitudes towards risk aversion, hierarchical structures, status, rewards, and embrace creative, entrepreneurial and open access to information, supported by reward structures that promote competition and best practices. A recent study as part of the LSE and McKinsey Consultants analysis of 4,000 firms’ managerial practices across the EU, Asia and the US highlighted that these were characteristics that belonged to the more productive and innovative firms. E-skills learning that commence in compulsory schooling need to be maintained in the firm, or enhanced if EU firms hope to close the productivity gap with their US counterparts. [xiii]

99%

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Social programmes

With the political priority of the European Commission being "an information society for all", a priority for policymakers is to bridge the "digital divide" to overcome failings of social inclusion wherever they are found. Articles 136 and 137 of the Amsterdam Treaty are directed at diminishing social exclusion and poverty with recognition by the European Commission that Europe's information society continues in large to be exclusive.[xiv] A key aim of EU policymakers is to balance the inclusion of citizens in ICT learning, which in the long run will positively affect employment, economic prosperity and productivity. This is manifested in the European Commission's eEurope programmes that promote information society participation.[xv] With only four per cent of low-income earners having ever received any employment funded ICT training, significant scope exists to improve this. [xvi] One of the worst faring groups is women, with only three per cent having received funded ICT training. Only one in four workers in the EU currently receives any job-related ICT training, [xvii] with many firms still expecting their workers to have undertaken their own ICT learning. Social policies targeting the delivery of ICT learning to the first two groups face considerable challenges, for they must firstly successfully reach these groups. They must subsequently offer an incentive that is based on relevance, confidence building, opportunity cost mitigation and self interest, in order for the person to undertake any training subsequently become integrated in a social and economic framework.

In order to be inclusive, the pendulum of training and education cannot swing too far in one direction or the other. That is, too little training is ineffective, but so too is an excess where it is irrelevant or unfocused and occurs in an overly codified form that might inhibit creative applications. To be effective in creating knowledge in as inclusive a manner as possible, trainers increasingly see that training should be tacit, involving cooperation and learning by doing. This takes on greater relevance when including marginalised community members who may not have had recent exposure to explicit forms of knowledge. The final stage in the process of inclusion occurs when these individuals are 'coaxed' out of membership of their disenfranchised group and begin contributing socially and economically.

This is a precursor to successful innovative activity occurring, which requires not only the acquisition of ICT skills, but also a level of organisational accommodation. E-skills development programmes are most effective when they promote the evolution and flexibility of both individuals and organisations. Where this occurs, marginal groups will utilise and enhance their new-found ICT skills, filling entry-level and other organisational roles, with this releasing those already possessing ICT skills to develop these further and undertake more complex tasks. The road to learning new ICT skills most often commences with information software and hardware, but the ultimate aim should be a holistic one: social programmes delivering ICT training across segments of society should improve the lives of all EU residents.

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4%

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The paradox of IT productivity is that despite organisations investing in the latest technology to increase efficiencies and profits, the failure to redesign, reorganise and develop the appropriate skills, delays the return on that investment.[xviii]

ICT can only be productive if it is properly embedded in the organisation as a function of appropriate managerial practices.[xix] Where these are inadequate or absent, ICT is often operated in a "low-tech, low-skill" equilibrium, which can result in sub-optimal productivity. [xx] The skills required and acquired are affected by a firm's practices, as is the type of ICT and its utilisation. The interplay of these with other factors of production affects a firm's productivity and ultimately, its ability to innovate. [xxi]

The relationship between ICT and firm performance is multifaceted, and mediated amongst other factors by company strategy and managerial practices. The need for firms to fuse ICT "into the fabric" of business processes and business networks is becoming increasingly recognised as a key tenet in the drive for productivity with a concurrent process of change often required that identifies, acquires, or nurtures the skills to complement this. [xxii] The traditional position that ICT is *primary* and practices are *secondary* is being increasingly challenged [xxiii] with recognition that productivity results not from ICT, but from management methods underpinned by ICT. The maximisation of ICT-driven productivity and innovation occurs when computer investment is coupled with other complementary investments, such as skills, new strategies, new business processes and new organisation forms. [xxiv] The growth in US productivity in the 1990s led to it being dubbed "The New Economy", with the development of new forms of working in a globalised context, significant increases in ICT investments encompassing both hardware and software, and the adoption of knowledge based work processes. These factors drove firm-level changes in the way that managers and employees carried out their duties, and contributed to a growth in productivity.

Without the appropriate awareness of the mediating role of ICT in productivity, organisational leaders often neglect the recruitment and maintenance of the required levels of e-skills. Different CEOs interpret the same external environment differently, with these interpretations leading to the formulation and enactment of distinctive technology policies and different innovative actions, with these differences ultimately affecting organisational performance. [xxv] Greater competition yields both higher productivity and better management practices amongst younger firms,[xxvi] whilst ineffective monitoring, targets, incentives and skills result in lower productivity and the inefficient use of ICT, irrespective of location. The combination of effective deployment of ICT coupled with appropriate skills constitutes a far more significant determinant of productivity growth than ICT expenditure alone. In order to get the most out of their ICT, companies will need to continue making more sophisticated use of it whilst managing the process of change required to embed it within the company organisation.[xxvii] The OECD[xxviii] has highlighted the benefits of firms making a complementary investment to ICT in skills and the supporting organisational structure. ICT driven productivity gains can occur when firms work "smarter" by utilising their assets more effectively. This requires strategic guidance from the decision makers of organisations who must firstly recognise the benefits of a combined approach and secondly, who act upon it.

"Communities" and "communities of practice"

Members of a community are brought together through common values and culture, with each community the product of historical factors involving interaction among its members. The process of learning occurs against the backdrop of a community, but in an increasingly internationalised stage. Whilst some segments embrace learning or are embraced, others are excluded, or choose to opt out. As the modes of learning have evolved over time, influenced in the past 20 years by the infiltration of ICT and demographic and social changes, levels of participation have also altered. Learning is not always closed ended, or separated from 'what people do' or where they live. It is situated within a community and often involves an active level of participation and a process of altering identity within a system of social relationships. This community of practice encompasses work, education and leisure, within which individuals engage in learning and shared activities, which can be formal or informal, in an active or passive manner. [xxix] In acquiring 21st century e-skills, individuals will most likely participate in a community of practice at various stages, commencing for most with early education. During this time collaborative programmes facilitate the process of learning and build on an interest in learning.

Knowledge acquisition within a community is as significant an issue for those excluded as it is for those included. Disenfranchised or marginalised members often have no access to a community of practice, or a disincentive to participate. This may be economic or social, with the opportunity cost of participation being the individual's ability to work, care for others, or undertake other activities that require assistance if they are to be substituted. In the increasingly encroaching information frontier, where activities can be solitary and divorced from day-to-day relevance, marginalised members of a community are likely to only consider the acquisition of e-skills if they are relevant and in the majority of cases, include a point of contact who can guide and encourage them. The accelerated changes in information and communication technologies such as the Internet, wireless networks, virtual offices, and digital media are diluting the boundaries between work, entertainment and social interaction, with ever wider communities being created. Participation requires confidence, e-skills, and a basic familiarity with 'everyday' information processing such as word processing, data management and increasingly, presentation and web authoring software. It may also mean sacrifices in the form of unwanted mobility, or alterations in family structures and values.

Learning can occur in a manner that abstracts information from a member's community and diminishes its situated characteristic. When this occurs, the community may be the conduit for the acquisition of

knowledgeable skills due to the absence of participation in a community of practice. This may occur without public policy initiatives or private sector participation, with e-skills acquired through either accessible programmes or sponsored intervention. The latter often represents the sole means for marginalised or disenfranchised groups to acquire new e-skills, with the digital divide otherwise excluding their participation in an ICT-centric environment. Where e-skills have been embraced, positive externalities can result in the creation of learning organisations which are comprised of informed individuals who can apply these. The resulting increase in social capital benefits both the employee and the firm, with long-term organisational memory developed alongside an enriched individual who possesses higher levels of motivation. [xxx] This can lead to an improvement in the performance of the firm, its ability to innovate, and the incorporation of a more informed and confident individual into the community. Increasingly, this community is located online as ICT continues to accelerate knowledge sharing in virtual networks and create an environment where "everyday" people utilise the Internet as an embedded part of their lives. The depth of human capital, defined by the degree of advancement or sophistication that it possesses, reflects the vertical difference of knowledge that workers possess. Higher quality human capital can improve the absorption of existing ideas and the creation of new ones,[xxxi] particularly where this occurs through close interaction. Since Alfred Marshall promoted the notion that human capital externalities eventuate from the interaction between individuals and between firms, clusters have gained considerable attention. They offer potential factor-based advantages in addition to learning-based and innovation benefits due to the contact between individuals, both in a social context and when ensconced within a firm that is concentrated with other firms in a specific location. The spatial agglomeration of firms is often linked by input-output exchanges on the basis of their production complementarities, with "Marshallian externalities" resulting from the technological spillovers between co-located firms. These can result in strong productivity effects but with mixed evidence. This appears to be due more to disagreement on what definition of productivity is used, including input factors.

Empirical work on aerospace clusters in the UK reveals that some of these have extracted benefits above those achieved by comparable non-clustered competitors. These include more efficient supply chain management, economies of scale from factor input deliveries, collaborative bidding, and learning and skills transfer through the local concentration of workers in the same occupation and industry. This can lead to an improvement in ICT and other skills as co-located workers observe their peers enhancing their skills.

A competitive culture fuels the acquisition of skills for these workers. This cycle continues with benefits accruing to the employees, their firms, and their community. In a paradox however, the increased use of ICT has not resulted in "the death of proximity". Clustered firms in traditional manufacturing and high technology in Europe have replaced some communicative aspects with ICT-driven initiatives, such as file sharing and automated stock ordering, but these reflect commoditised tasks and do not replace in-cluster relationships or the socially cohesive networks of informal and formal institutions that have been established. Evidence from European clusters suggests that the acquisition of knowledge by these produces more innovative SMEs that are more likely to form intra-regional linkages and produce a greater number of innovations. [xxxii] The sharing of knowledge in this environment is supported by the establishment of communities of practice in which ICT is embedded and complements physical interactions.

The increase in social capital benefits both the employee and the firm, with long-term organisational memory developed alongside an enriched individual who possesses higher levels of motivation.

Skills, innovation, productivity and policy

Industrialists, investors, policy analysts and researchers are increasingly concerned about apparent inadequacies of the European economy as expressed in measures of relative innovativeness and rates of productivity growth. Attention rightly turns to challenges on the supply side and we frequently express concern about the quantity of skilled people in the labour force, the quality and level of their skills, and the demographics that affect Europe.

Despite the frequently expressed assumption that Europe lacks sufficient e-skills, the labour market overall is far from a state of crisis. There is some excess demand, but also a significant level of unemployment among e-skilled job seekers, and wage pressures are not severe. Most projections, however, are pessimistic and caution us that the rate of growth of demand will exceed the abilities of European educational and training institutions to meet the expectations. This would result, we are led to believe, in a rapidly deteriorating situation with regard to the competitiveness of European economies.

In this study we have considered these claims and turned our attention to the organisational and managerial dimensions of the problem. We show that the major differences between innovative and highly productive firms on the one hand and those less able to compete on the other hand lie in the structures and procedures of organisations and their ability to utilise skilled personnel. We believe that the labour market is highly likely to respond to demand better when employees know that the personal investment they make in gaining skills is appreciated. To appreciate those assets, firms need to be able to see that e-skills enhance their productivity, and the key to that is the ability of firms to multiply, or transform those skills such that they make a difference in the way the organisations actually work. ICT enables applications and organisations that are flexible and able to change as they develop opportunities to enhance their practices are the ones that benefit disproportionately from those enabling features.

Firms that experience these benefits will prosper. Where they use that prosperity to reward skilled personnel, they contribute most powerfully to creating incentives that are felt throughout the labour market. That incentive will generate the impetus for people to gain and upgrade e-skills.

Policy makers, educationalists, standards setters and others need to focus on creating the environment in which that impetus can easily be acted upon. This includes of course continued attention to educational institutions, especially at the lower-levels where basic e-literacy should be taught. It also includes ensuring that flexibility is built into the systems of education, certification and standards setting.

Firms, however, should be influenced by recent studies that have increasingly emphasised the importance of self-learning and in-house training for the development and utilisation of e-skills. Where firms take on most responsibility for keeping their employees updated and provide career incentives for enhanced skills, they are better able to attract and retain skilled personnel.

The most significant link between innovation and e-skills, however, is to be found in the ability of organisations to harness the transformative affordances of ICT. This defines the underlying purpose of our report. If improved qualities and quantities of e-skills are to enhance the innovative capacity and improve productivity, we need to ensure that the organisations that are investing in them are better able to change work practices, adjust structures and even shift corporate strategies. Innovation cannot be reconciled with conservative, hidebound, inflexible organisations.

The report shows that the issue to focus on will increasingly be in the realm of organisational practices and the ways in which knowledge is managed, especially as organisations adjust to network structures and more abstract "communities of practice" that both redefine and leverage skills utilisation. It is from that foundation that the link to innovation can be explained, and the culmination of the report is an analysis of the relationships among the skills base, innovative business models and institutional change. Improved skills and innovative capacity affect productivity. Here we have provided the background to those policies that will get us to that point and stabilising and thereby sustaining the advantages gained.

Footnotes

i We take the European Commission definition of e-skills and its usage in relation to other skilled labour, as well as evidence of balance in supply and demand, as expressed in: Rand Europe, "The supply and demand of e-skills in Europe", September 2005, http://ec.europa.eu/enterprise/ict/policy/doc/eskills-2005-10-11.rand.pdf

ii Grous, A. (2008), "Managerial Practices, ICT and Productivity in Emerging Business Organisation Forms: the effect of managerial practices on ICT-driven productivity in aerospace business clusters", PhD thesis, London School of Economics

iii There are a small number of higher level courses that recognise this situation with regard to computer gaming, including those at Teesside and Coventry universities in the United Kingdom and at the University of California at Santa Cruz, Worcester Polytechnic and Carnegie Mellon Universities, and others in the United States, as described in the Boston Globe: http://www.boston.com/business/technology/articles/2004/12/21/tenets_of_academic_rigor_spread_to_computer_games/

iv Blaug, Mark, "Education and the employment contract." Education Economics; 1993, Vol. 1 Issue 1

v Accenture, "Skills for the future" April 2007; http://www.accenture.com/Global/Research_and_Insights/Policy_And_Corporate_Affairs/Skills_Future.htm

vi This has been well argued by Danny Quah, in various papers, see: http://econ.lse.ac.uk/staff/dquah/index_own.html

vii The concept of general purpose technologies [GPTs] is useful in explaining the difference between those technologies that underlie mechanisms and functionality. We will consider the role of GPTs and innovation in our fourth in this series of reports. The concept is well described by R. G. Lipsey et al. *Economic Transformations; General Purpose Technologies and long term economic growth* Oxford U. P., 2005

viii T. R. Bresnahan, E. Brynjolfsson, L. M. Hitt, "Information technology, workplace organization and the demand for skilled labor: firm-level evidence," MIT Industrial Performance Center working paper, 1999.

ix Economists generally see science and technology as disembodied, and formally refer to it as "exogenous", or originating from outside of the organisation, as might be the case with the weather. On the contrary, we regard technology to be "endogenous", or a feature of the organisation, just as we would consider a work routine such as weekly staff meetings. Both acquire meaning and value in their application, and they are shaped by and have the power to shape the strategies, structures and operations of firms.

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xi eLearning, eLearning Papers, Vol 2 No. 1, January 2007

xii European Commission, 2006; http://siteresources.worldbank.org/CGCSRLP/Resources/SME_statistics.pdf

xiii Nick Bloom, "Management practices: the impact on company performance" CentrePoint, Summer 2005 cep.lse.ac.uk/centrepiece/v10i2/bloom.pdf

xiv European Commission 2000, Strategies for jobs in the Information Society COM(2000)48.

xv European Commission (2001a). e-Inclusion – The Information Society's potential for social inclusion in Europe. Commission Staff Working Document SEC(2001)1428, with the support of the High Level Group "Employment and Social Dimension of the Information Society" (ESDIS); European Commission (2000a). eEurope Action Plan – An Information Society for all.

xvi European Commission. Final report of the ICT Skills Monitoring Group: "e-Business and ICT skills in Europe, Benchmarking Member State policy initiatives", December 2002.

xvii European Commission 2000, Strategies for jobs in the Information Society COM(2000)48.

xviii Brynjolfsson, E., and Hitt, L., (2000). "Beyond computation", *Journal of Economic Perspectives* 14(4)

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