ICTs and employment in Europe: Outlooks to 2010

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This article presents some clues to the future evolution of Information and Communication Technologies (ICT) and their implications for employment. It draws on results of several finished and two ongoing projects within IPTS (DUCATEL, BURGELMAN, HOWELLS, BOHLIN & OTTISCH and DUCATEL & BURGELMAN).

The article first looks at some key ICT trends identified by the ICT and IS Panel of the Futures Project. These are then discussed in relation to recent debates on skill shortages for ICT professionals and their implications for future employment patterns. Second, we provide a short analysis of trends in the new media content sector and their implications for employment. These two steps provide a basis for raising some research issues on employment and ICTs, which we do in the third section.

■ ICT Trends

The next few years are likely to continue to be driven by issues of capacity and pricing. These for the moment are the key bottlenecks to a fully-fledged Information Society, because they affect the take-up of telecommunications by smaller scale private and commercial users. Digital

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subscriber lines are likely to obviate the need for a widespread introduction of optic fibre into the home until demand levels have built up to a level that will make such investments more cost-effective. However, developments on the horizon such as Next Generation Internet (expected around 2002) will support voice and video (i.e. digital multimedia) will raise demands for rapid and reliable downloading of bandwidth hungry video images.

Bandwidth demands will also undoubtedly rise with a growth in the use of information appliances or ubiquitous computing. Ubiquitous computing is predicated on the strong expectation that long term falls in price-performance ratios (Moore's Law) will continue for the next ten years. Probably the major impact will be the possibility to manufacture complete computers (including input and output controllers) on a single chip at a cost of a few eurocents. This will greatly enhance the proliferation of computer control and interconnection. As a result it will permit chips to be embedded in all sorts of artefacts and devices which are today not computerised (clothes and furniture for example). For example, although Desktop PC markets still drive semiconductor production, current fast growth markets for "small footprint" non-PC systems include personal digital assistants, mobile phones, smart cards, chips embedded in pharmaceuticals and embedded networks in automobiles. In the near future non-PC devices will include set-top TVs, interactive, "magic glasses" for portable information display, and computers embedded in clothing particularly for special purposes, such as the monitoring of the physical condition of sports people or out-patients, for the tracking of workers in hazardous occupations or environments and battlefield information systems for soldiers.

Due to their low cost and wide usability, computer-based devices will be ubiquitous, so cheap as to be almost disposable and virtually invisible by dint of being embedded into products. Actually, computer chips already surround us. But there will be at least three differences from today’s embedded chips:

• Ubiquitous computing means computing in all products and affecting all industrial sectors. (Will wearable computers be products of the computer industry, consumer electronics or fashion clothing?)

• These devices will "think" - the complexity will be on the inside not (like today’s PCs) in the user’s (inter)face. This implies the need for very good design engineering skills (a possible European competitive strength) and that we need robust systems that we can trust (again not like today’s "feature" laden PCs) (2).

(2) This is a reference to the MIT Media Lab project Things that Think whose leader, Mike Hawley, argues that all sorts of everyday devices will have intelligence designed into them, http://www.media.mit.edu/ttt/.

• These devices will talk to each other - today's hardwired embedded chips are increasingly operating in LANs and already there are trends towards linking them to external network control for updating, maintenance and control (although so far not real-time control).

The abundant processing and transmission power implied by the age of embedded computing will also be soaked up by the high processing power demands of high density display devices (flat panel and head-up portable displays) offering colour, animation and innovative knowledge representation techniques. A key issue will be to develop user interfaces which are much more user friendly that those we have today. The driving aim should be to make systems transparent or intuitive. This implies both the development of very clear and easy to understand user pricing systems and much work on the interface technologies we use for inputting and outputting information. Ubiquitous computing will also feature autonomous and self-learning devices (using artificial techniques) in all sorts of areas where they are not found at the moment based on the growth of small, cheap and commonplace sensors, actuators, controllers, storage devices, and so on. Some analysts thus expect the emergence of a microsystems industry based on the exploitation of these technologies (BELL & GRAY, 1997).

The ever-widening use of ICTs will force a rapid growth in demand for systems development. Here, it seems to be the case that a transition may finally be underway in information capture and transmission and transaction processing that will lead to full-blown knowledge management techniques. Software engineering and components-based techniques are also expected finally to yield productivity gains. The encouragement of more open developer community based approaches may help to apply more effort, more rapidly to solving technical problems. But given the sheer scale of the potential expansion implied by ubiquitous computing, they will probably not solve the software bottleneck. Rather, what will be needed are self-generating and self-updating software systems. Already some software is being designed with develops capacities (known as "reflection" and "introspection") of automatic inspection and modification of system performance, even whilst the system is running. In essence, the result is a software system that can offer, for instance, automatic updating of a set of interlinked records. This automatic signalling or changes can also operate through universal addressing systems (such as area used in the World Wide Web) to make sure for instance that logical changes in one device are echoed elsewhere.

Self-customising will be both an important building block and a result of developments in expert systems and artificial life techniques (based on genetic and evolutionary algorithms), that provide the rules for artificial learning and adaptation. These developments signal a shift in systems design challenges away from handling structured data towards the facilitation of communication and the processing and manipulation of symbols. Software agent developments tend to follow two strands, the simplification of complex distributed computing and the overcoming of limitations of current user interfaces - i.e. making computers more user friendly (BRADSHAW, 1997).

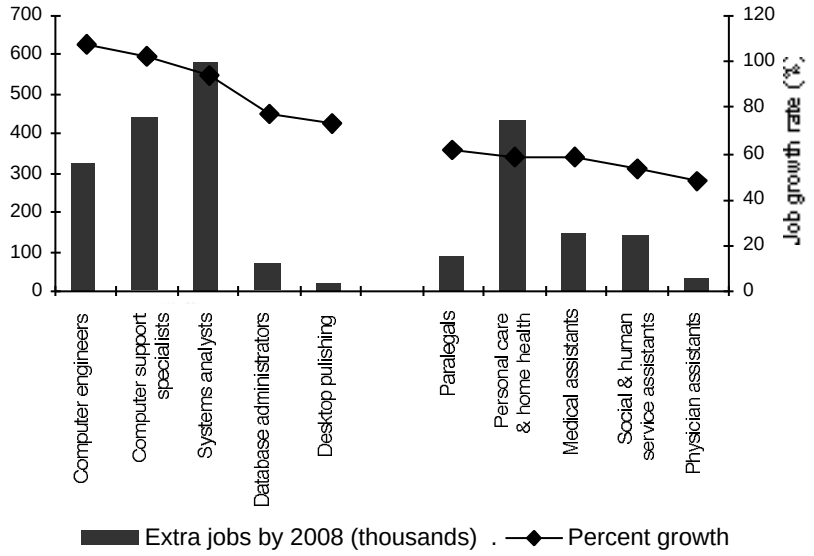
One main aim of software agents is to get devices to interoperate in a seamless fashion, notwithstanding the fact that the network brings together independent systems based on quite different principles. Such "middleware", i.e. software that will permit interoperability between widely divergent systems. In principle, they will allow different people, teams and networked devices to share resources and work together without all the problems of incompatibility and lengthy set-up procedures that typify network operations today. Networks of information appliances will require real "plug and play" compatibility and robustness of an order that exists neither in hardware, software nor systems today. Software agents will also be important in the direct interfaces of knowledge management - with people. One of the critical areas of development for the next period is to develop software interfaces that appeal to ordinary people. They must be reliable, intuitive, predictable, safe, private and present complexity in a way that is amenable and interesting to ordinary human users.

Artificial intelligence is being used to pursue these objectives by building learning abilities into personal assistant systems. Some software agents such as "knowbots" can be instructed by the user to perform tasks. For example, ‘shopbots’ are used to search out the bargains by lurking on the network looking for offers that match a predetermined user interest. On-line retailers, such as Amazon, use these kinds of developments to make book recommendations to readers. Instructing software agents can be hard work, and many also learn from "looking over the shoulder" of the user and copying their actions. They also prompt for direct and indirect feedback on suggestions that they make and offer to automate oft repeated processes and so on. Anthropomorphic techniques (cartoon like representations of faces or moods and humour) are used to provide these agents with personalities, with the aim that people invest time and into tutoring the software agents. Development of analogous representations of software

agents can help to clarify the place and purpose of such agents, Negroponte for instance likens their role to that of a digital version of his sister in law (someone who knows his film preferences and what is showing in the local cinemas) or a Digital Butler (who guards access to your time and reminds you of obligations) (NEGROPONTE, 1995).

However, from the present perspective, performance gains in software lag seriously behind the eight orders of magnitude improvements that have been achieved in hardware. Software remains a craft-based industry, with very little standardisation. For example, US sources report that 73 percent of software projects are late, substantially over budget, cancelled, or outright failures (PITAC, 1999). There is a lack of ability to describe large-scale systems, which makes them very hard to update and to modify, as it witnessed by the enormous scale of the Year 2000 problem. And techniques for testing software remain under developed.

Figure 1 - The ten fastest growing occupations (United States, 1998-2008)



Source: BRADDDOCK (1999)

Software engineering techniques have long aimed to increase the productivity of programming but they have never achieved the widespread use that would be necessary to match the kinds of gains achieved in computer hardware. Recently, the US President's IT Advisory Committee

(PITAC) put investment into basic software at the top of their agenda for government research with the following typification of the problem:

"The demand for software has grown far faster than our ability to produce it. Furthermore, the Nation needs software that is far more usable, reliable, and powerful than what is being produced today. We have become dangerously dependent on large software systems whose behavior is not well understood and which often fail in unpredicted ways. Therefore, increases in research on software should be given a high priority" (PITAC, 1999., fn. 17).

■ Employment Implications of ICT Trends

The trends towards seamless networking, ubiquitous computing and knowledge systems have serious implications for the further growth of ICT professionals. The rise of the Internetworked economy directly raises the demand for telecommunications personnel because activities that were not previously on the Net will now be passed over the network as a matter of routine. Indirectly, the sheer complexity of linking together multiple media and multiple channels (wired and wireless) and many more clients will put a further upward pressure on network skill demands. The shift to ubiquitous computing will of course dramatically raise the number of clients on global networks.

The implications were that the coming ten years will be one in which the continual expansion of new uses of ICTs will drive forward demands for professional workers. Given that the price of physical devices seems set to fall and that there is considerable further scope for automation of manufacturing processes, the key bottlenecks are likely to be the labour intensive ones: designing new devices, installing capacity, programming systems, maintaining systems and supporting end users.

It is not surprising then to see that detailed occupational forecasts produced by the US Bureau of Labor Statistics (Figure 1) [(3)] project the top five occupations in terms of rates of growth to be computer specialists. Indeed, systems analysts are expected to yield the highest growth in absolute terms, with computer support and computer engineers also figuring strongly. These forecasts translate into 1.6 million new core ICT workers [(4)] being required up to the year 2008, 1.5 million of which will be needed for newly created positions.

(3) Such detailed level results are not available for Europe as a whole, but corroborative results are found in occupational projections for the Netherlands.
(4) Core ICT workers are: computer engineers, computer support specialists, database administrators and other computer scientists.

These jobs are being created by the driving growth of the so-called "digital economy", which is now attributed the role as the motor of growth in the US economy (5). It is thought to be the main generator of new jobs in the United States (6).

The fast rates of growth of these sectors are already apparently already causing skill-shortages. In the US, a survey carried out by the Manufacturers Alliance (7) found that around 55% of firms are experiencing some problems in recruiting technical ICT talents. The US shortage was estimated to be around 350,000 vacancies.

The employment effects in Europe are so far more muted. The Internet in Europe does not yet match US levels, although it is now in catch up mode. Even so, there are already serious shortages of core ICT workers in Western Europe. Several recent empirical studies have tackled the issues:

• In 1998 it was estimated at 500,000 unfilled vacancies and this could reach 1.6 million equivalent jobs by 2002 (EITO, 1999). It is especially the growth in net technology (Internet, intranet, extranet) that forms the background for this expected growth. At present rates of investment in ICT training, IDC estimates a growth in ICT work force of 6% per year.

• A further IDC study of the networking professionals suggested a shortfall of 600,000 by 2002 in Western Europe, with particularly pressing shortages in countries that have a combination of high adoption rates and existing shortages and inflexible skills (these include the Belgium, the Netherlands, Denmark Germany and Finland) (BOYD & RAJAH, 1999).

• A UK survey found that of the 90% of IT companies that recruited new staff in 1997, 83% experienced recruitment difficulty (8).

• A Danish survey estimated an immediate nationwide need for 13,000 employees projected to 40,000 within 4 years with three year or MA level computer skills (i.e. "in the study design, implementation, management and support of computer based systems") (SHAPIRO, 1998).

(5) Department of Commerce (1999) The Digital Workforce: Building Infotech Skills at the Speed of Innovation, US Dept of Commerce, Office of Technology Policy, Washington, June.
(6) Center for Research in Electronic Commerce (1999) University of Texas Internet study, http://www.internetindicators.com/
(7) Economic Report, ER-448, 1998.
(8) Department of Education & Employment, London, Research Report No. 71.

Such figures, of course, beg the question where the new recruits are going to be found. For most countries there appears to be a large training gap opening-up. For example, the US figures imply an average growth of 137,800 jobs per year. The 10-year trend of graduate and postgraduate awards had been downwards from a peak of 50,000 to 36,000 in 1994 - reflecting significant gloom about job prospects due to the downsizing and defence cutbacks of the early 1990s. With the pick-up in the growth of the ICT industry enrolments in computer-related bachelor degrees doubled between 1995 and 1997 before levelling out in 1998 at around 20,000 per year (data from PhD awarding institutions only) (9). Even with similar rises postgraduate enrolments, there is still a substantial gap between the forecast growth of demand and the supply. Similar considerations motivated the IDC White Paper on networking skill shortages where they calculated a ten per cent gap between growth in demand and the growth in output from educational establishments and from the reskilling and redeployment from other industries (BOYD & RAJAH, 1999, op. cit.).

Clearly, core-ICT skills can be acquired from non-educational institutes as well as by training graduates from other disciplines and around one quarter of all computer science workers have always lacked formal qualifications. In the US, the Manufacturers' Alliance survey revealed that the majority of the new hires came from other companies and not from training institutions. While in the UK there is convincing evidence that having computer skills provides a substantial boost to earning potential - with 20% more being paid to such workers than those with no computer skills at all (GREEN, 1998) (10).

■ New Media Trends

The media industry is a key growth industry in its own right and within it digital content production is emerging a bellwether of the "e-conomy" and will for the coming years be one of the pillars of growth. The main drivers of development of the new digital media are:

- industrial restructuring around the search for economies of scope and scale related to features such as globalisation, industry concentration and mergers, liberalisation and convergence;

(9) Computing research news, March 1997,1998 &1999, http://www.cra.org/CRN/
(10) GREEN, although the causality is unclear here whether computer skills are an indicator of higher waged work roles or vice versa.

- cost reduction of the production process in mass media, due to digitisation;

- technological change reducing entry costs for net presence and thus leading to new media, especially Internet based , the emergence of online version of existing media or new media linking communities (the e-zines), new forms of media based on WAP technology and aimed at fast and short information delivery, all including the creation of new firms and occupations (see below);

- new types of content creation across a wide variety of sectors (from health care, through museums to local governments) promoting new forms of electronic democracy emerging from the convergence of multimedia;

- changes in patterns of demand specifically related to factors such as increases in income, rising educational achievements, demographic growth amongst the active elderly, a greater differentiation of tastes and changing lifestyles such as the growth of single person households;

- many of the opportunities for the new media derive from the advantages of being omnipresent and continuous. A lead example is the market for "information on the move" especially as endemic congestion in the mobile society expands opportunities for content providers. Americans currently spend 500million hours/week in their car (Wired, 1999). Likewise, Oracle has created a new company OracleMobile.com to deliver web based content optimised for small displays GSM terminals via a special portal (CNET, 24/2/2000).

Issues include:

- uncertainty over the rate of growth of the overall media sector and its different sub-sectors (Pay TV, Digital TV, Cable, Internet broadcasting, ...) especially as regards investment patterns, market growth and regulatory responses;

- uncertainty over the growth potential and limits of individual media consumption and thus about replacement effects (new media replacing traditional products);

- implications of convergence, i.e. the blurred boundaries of the sector for the shape of the industry in the future (e.g. most print and non print news sites work on the basis of a common or vision);

- media concentration (globalisation and the move from megamedia firms to gigagiant content services?).

Uncertainty is clearly the rule rather than the exception. On Music, the MP3 music compression format has been hailed as potentially delivering a deathblow to the "dinosaur" traditional labels in the recorded music industry. Jerry Silver (VP of new media at EMI) projects that even by 2005 80 percent of the company's revenues will come over the retail counter (John Gartner, *Wired News*, "Digital Music Will Cost You", 8 Dec. 1999). On newsprint, in the USA the past four years, the number of people who say they learn about current events primarily from the nightly news has fallen from 62 to 52 percent (Gallup, 1999). While circulation for newspaper are relatively stable, Yahoo, AOL and other portals have grown rapidly and the first stop for breaking news stories. Internet only sources have become important place and some self-publishing sites are breaking major stories and attracting renowned columnists from the established news world. Broadcasters are responding by streaming news events and producing made-for-the-Net content.

One habitual corporate response to uncertainty is acquisition, in order to get a stake in an emerging market. Thus, many of the existing music business giants have been out on the prowl for acquisitions: see for example MTV's purchase of SonicNet, Time Warner and Sony buying CDnow and Universal's acquiring digital downloads. Just as the reverse has happened with the acquisition of Time Warner of AOL.

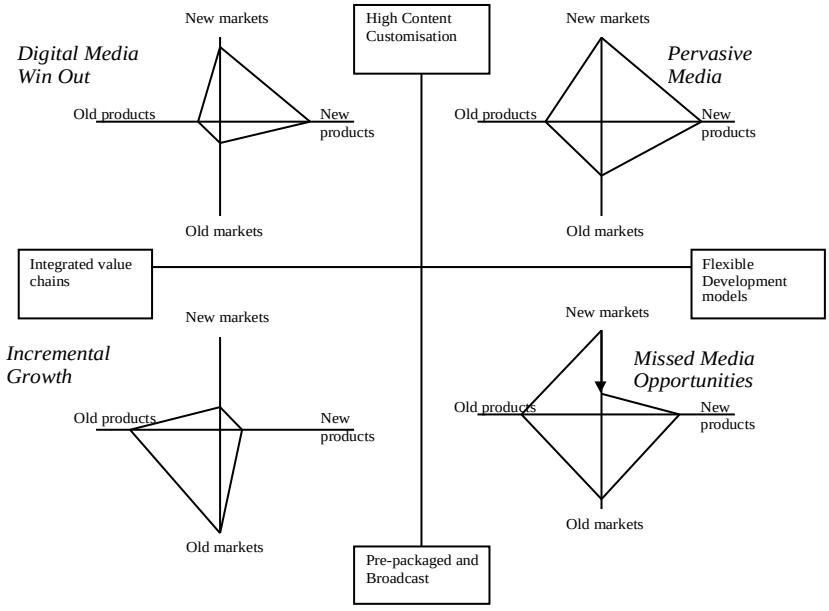
As part of a joint action with DG Employment and Social Affairs, the IPTS held an expert workshop in Brussels in December 1999, specifically to try to make sense of these trends (and their implications for employment). Six industrial drivers were identified that affect the relationships between the traditional and the digital media industries.

1. Everyone becomes a content producer
   - all firms are in media production
   - all people become content producers
2. Customisation of content
   - on demand design - user selects
3. Co-existing development models
   - co-existing horizontal & vertical integration
4. New types of content demand
   - niche markets
   - local
   - special interest
   - Mosaic living - people on the move- 24 hr society

5. Flexible delivery strategies -
   - flexible content - multi-channel (print to WAP)
   - Uncertainty of change in “content” to 2005
6. Deficit of good information now
   - high change but unpredictable (growth curve?)
   - Impact of policy action (access and inclusion).

The drivers were ranked in rough order of quotient of importance and uncertainty (top ranked are the most important and least certain). The first two drivers were merged to create an axis on the degree of customization of content varying from more broadcast and packaged media to high interactivity and customization of content. A second axis is based on the degree to which the existing vested interests (i.e. today's big employers) "get the message" and move towards the third driver "flexible development models" (i.e. horizontal and vertical integration) with large firms acting as the hubs to smaller subcontractors and independents. The axes used here for the scenario are based on the extent to which new firms take-off and take-over the new media markets and whether there is high growth in demand for interactive and customised content. In the diagrams below, the scenarios are illustrated through the use of a model for new business models (in terms of old/new markets and old/new products) that was proposed in the workshop.

Media Content Industry: Future Scenarios



From this schema, four draft scenarios were drawn

• *Incremental Growth*

Large vested interests retain market power offering pre-packaged audio-visual services with little customisation interactivity. Whether this is due to demand-side or supply side conservatism is unclear. The take off small new media start-ups and new flexible organisational structures is slower than the workshop participants mostly seemed to anticipate. For working conditions the changes are relatively slow. New skill and training demands come through slowly.

• *Missed media opportunities*

This basically a demand failure model. Firms make an attempt to promote the new digital media by putting innovative products and services out, but there is a lack of consumer acceptance (due perhaps to a lack of interest, inappropriate pricing strategies, or a lack of skills on the part of consumers). Here working patterns probably change rather more than the "incremental growth" scenario, because there is a lot of experimentation and new start-ups, which destabilise many traditional structures. Firm failures also may have an effect. But, the lack of take off of the market means that new skill demands do not become generalised. Again, cause and effect are difficult to separate. Perhaps, the lack of demand is due to a lack of skills or the failure of producers to stimulate interesting new demands.

• *Digital media win out*

This is the Internet freaks dream scenario. New media start-ups triumph because the vested media interests try to maintain traditional integrated vertical structures through acquisitions and mergers probably based on size rather than value or fit. The result is a high growth of new markets and products but for specialist interactive services industries - because of consumer demand for media content. Perhaps even a new industry and major new players will emerge (i.e. the Netscape or Yahoo, Hotmail Internet growth model). For these reasons work organization changes quite a lot. In the start-up firms there are completely new models of work organization. With probably fast but precarious growth of employment. These would be separated from traditional work patterns in the traditional industries. New skill demands in the new growth area are likely to be chaotic, due to the generally turbulent market structures.

• *Pervasive media*

This is a "highest stage of development" scenario. The big firms move wholesale into the flexible production structures. They go multichannel

(WebTV, mobile, Digital Television) so that the medium no longer is the message. New approaches to content are widely accepted by consumers and as a result there is a lot of innovation at grassroots level. Work patterns change radically and fast in the majors with new "intrapreneurial" start-ups based on digital media claiming a large slice of the corporate attention. Traditional occupations, skills and patterns of work are under threat, while new hybrid, technology and business know-how skills are ascendent.

Table 1 - Employment in the audio-visual industry in European countries

Country	Employees Audio Visual industry (DGX and DGV 1997/8)
Austria	3 681
Belgium	20 889
Denmark	14 699
Finland	7 025
France	177 108
Germany	200 760
Greece	10 134
Ireland	6 086
Italy	144 023
Luxembourg	2 320
The Netherlands	57 186
Portugal	8 918
Spain	88 523
Sweden	10 907
UK	198 543
Total	**950 802**

Source: Employment and the audio-visual industries (1998) (11)

■ Media jobs and Skills

Even without the Internet, the media industry is a significant industrial branch that has been in a growth phase over the longer term. Historically, the overall culture industry (including performing arts, heritage and education, cinema and audio-visual, publishing and recording, press, crafts)

(11) Pre-report to Working Group 1 of the European Audio-visual Conference, *Challenges and Opportunities of the Digital Age,* 6-8 April 1998, Birmingham, p. 21. Also in OUAIJ (1999).

is substantial representing 2 per cent of the workforce and more than 3 million people in the EU (1995) (2.5 million if art and crafts are excluded). It is also growing strongly. In Spain it grew 24% between 1987 and 1994. In France, it grew it by 37%, ten times the average rate of employment expansion, between 1982 and 1990. In Germany, jobs for producers and artists grew by 23% between 1980 and 1994.

A more narrow look at the audio-visual sector (broadcasting, radio at local and national levels) again at the national scale for Germany confirm this image of strong growth (Table 2).

Table 2 - Impact of New Media and Communications Technologies in Germany within the next 10 years

Jobs directly created by New Media and Communication Technologies	500,000
Jobs that will have ceased to exist because of the new technologies	300,000
Rise in number of jobs in communications (2005)	1.3 to 1.47 million
Increase in turnover communication sector (2005)	€148 billion to 286 billion

Source: Polytechnic University Düsseldorf, the Bulletin, 3/96, EIM.

There seems to be a process of creative destruction taking place in the sector. On the creative side, broadcasting channels, due to better and cheaper transmission techniques like satellite, cable and very soon Internet, continue to expand in number. However, not only is broadcasting increasing its presence via traditional media systems, it does so as well via "net-presence. In particular radio stations are very active on the net, but more and more web sites are set up to support the programs as such.

This entails new jobs, just as in the written press. A 1998, world wide survey, found that most online sites of newspapers – 4925 in total (of which 60% are US) – employ on average 8 full time people, with a growth rate of 40% per year. Whereas in a 1997 study on American online newspapers 20% of them claimed that at least half of their daily offered content was original (12). However, pervasive net presence not only leads to parent sites and thus more employment. It also implies a considerable growth in the creation of new content (not just replication of printed or audio formats) and

(12) Both quoted in DEUZE (1999), p. 374.

hence again jobs. Overall pictures for growth in Net-based content are difficult to give. The only comprehensive study available is the Australian ICT map in which Information content (including software) is about half of the ICT equipment market (in annual revenue).

Revenues from Network content (including online publications, news services, and database content, multi media) are as important as software revenue and doubled from 1994 to 1998 to total 5.660 million-dollar annual revenue. Employment in information content rose (between 1993 and 1996 with one quarter too (from 15.557 to 20.904) (HOUGHTON, 1999).

The overload of information available on the net – due to the reduced entry costs of producing online news, web casts etc. also leads to the creation of new demand for selection. At the moment this is largely done by software companies or telecoms, offering portals that “guide” the user. Apart from the BBC, there is no other media company in the top 10 accessed UK sites (HIBBERT, 1999).

Finally E-commerce will create new content jobs too and already more and more journalists move to this new outlet to write tailor made content, e-mails etc at a significant higher salary than in "normal" journalism (13).

No doubt that, given the dynamics of e-commerce and the foreseen increase at the consumer level of T-commerce (interactive TV based electronic commerce) this will only increase.

Characteristic for the e-conomy is indeed the need for vendors of whatever product or service, to attract the attention of the user. Personalised content, in whatever attractive form, is one of the instruments to do this and media professionals are certainly very well placed to "know what will trigger the attention of the surfer". The more media, brands will become in logic of attention economies, the more jobs will probably follow.

However, the growth in new areas will have to compensate for declines in employment in traditional areas such as print and postal services. For example currently around 80% of workers in the production and distribution of mass media in Germany work in print and publishing. Projections from DIW/Prognos suggest that this sector will decline by 10% by 2010, soaking up and displacing much of the gain in employment in "new media" (SCHRAPE & SEUFERT, 1997).

(13) In 1997 a US journalist starting in electronic media earned almost 20% more than his fellow staring in print. Quoted in BENNING (1999)

In addition to new positions being created many new occupations are emerging, with new skill repertoires and demands on employee time and energy. To a large degree the content workers will undergo the same changes as the ones detected for employment at large: 24 hour society, blurring of private and public life due to rising e-lancing, skills mismatch and the need for life long learning, demand for fast and flexible adjustment to fast changing industry needs, the need for net capability and literacy etc. And if not well looked after by policy (social dialogue) it will here too generate the same negative effects: more workload, disintermediation, less autonomy over what has been made, etc.

However, due to the specific nature of the content industries, some specific changes can be expected as well.

Technological changes are promoting the emergence of new occupations in the media industry. In the content area a particular feature is the inter-disciplinary team-work based nature of the work, which calls for a combination of technical and creative skills and sometimes business skills that cut across traditional professions and training systems. Evidence for these trends can be drawn from studies of labour market developments in interactive digital media all of which are affected by the graphics rich environment of the Internet, such as website design, e-commerce industry or entertainment and computer animation industry.

A surprisingly wide variety of new job roles is emerging (see under) , the quantitative significance of which is as yet unclear. If past patterns of professionalisation are repeated, it is likely that these roles will consolidate into a number of relatively well-delineated occupations. However, even so, many of the jobs created will require hybrid skills, which are not yet well provided by existing bodies and institutions.

The new skills for the new media will spill over into other areas of work not just in other media sectors, but with increasing use of ICTs into all sorts of other sectors. I.e. "media savvy" jobs will become more a generic skill. Meanwhile, there seems to be a greater emphasis on contingent employment for specific projects, rather than permanent contracts. This will of course affect social dialogue issues such as occupational definitions, professional accreditation, training provision.

However, even so, many of the jobs created will require new hybrid skills, which are not yet well provided by existing bodies and institutions.

Table 3 - Trends in the evolution of competences in the audiovisual sector

Legend Today's skills *** Future core skills ** Skills to acquire * Preferred skills	Administration	Images	Sound	Editing	Mixing	Graphics & Design	Titles	Effects	Scenes	Network management
Administration and production	***			**						**
Video operator		***	***			*		**		**
Sound operator			***		***				**	**
Editor			**	***	***	*	***	***	**	*
Video manager							**	**	***	*
Network technicians									***	***

Source: Perti Project (1999) "Impact of the Information Society on Work and Employment, Final Report to CEC Adapt program", Prisma Consultants, Estoril.

This is quite well demonstrated by a close analysis that has been carried out of changing skills structures in the audio-visual industry (Table 3). There are two points to note. First, that previously distinct skill profiles are converging. Workers are expected to master a much wider range of tasks both within their core competencies and subsidiary skill repertoires. Second, that all jobs now have at least some demand to understand and use network based tools (the final column in the chart): in the past this was the preserve of the network technician.

There are a number of issues (at stake here):

• Qualification demands and training responses - the vocational and educational training systems are only slowly responding to the new mix of skill requirements. Re-training provision for those whose skills and jobs are becoming obsolete (printing, traditional publishing).

• Implications for professional structures and career patterns. In the interactive digital media especially, but in television and journalism more

generally there seems to be a decline of stable unionized craft professions and shift towards increased use of sub-contracted staff and temporary project based teams. What are the implications for the future of the sector for employers and the workers?

• New media will bring new employment patterns. Software, film production, journalism, artist professions, each has a different structure. New hybrid occupations might emerge, plus new employment contract structures (outsourcing, freelancing) and new workplaces (telework, Small Office-Home Office).

Interactive digital media job roles

Technical

• Internet architect = webmaster with "muscle" able to do relational database design
• Product manager = day to day management of media content and showcases (e.g. web sites)
• Core programmers = use of "lower level" but extensive skills in C++, Windows NT, Unix for programming multimedia content
• Network security = protecting servers and sites, transactions and customers.

Creative (examples taken from animation/interactive digital media industry studies)

• Visual development – conceptualising scenes, artwork, production of 2D & 3D images, animation
• Storyboard artist – conversion of scripts into storyboard, plans shooting schedule, ensures continuity
• Layout artist – Stages scenes and camera positions, draws backgrounds and animations
• Painters and background animation - produces designs based on layouts
• Traditional animation and character effects - bringing characterizations to life
• Computer artist – producing 3D images from software, choreography of objects
• Technical artists - e.g physical lighting specialists or shader writers (programmers to make computer generated films have the realistic light and shadow properties)
• Other creative occupations include: graphic designers, interactive writes, instructional designer, game designers, video producers, sound designers, web designers and webmasters.

Content creation

• Copy writers for web advertising = journalists producing "infomercials", writing high impact copy for advertising, news, web resources.
• Public relations services = knowing client needs, analysing the relationships between media capabilities and know-how
• Web journalists = providing 24 hour updates of news coverage, using networked resources rather than legwork, operating from virtual press agencies.
• Portal compilers = providing content and packaging for portals
• Post production workers (e.g. in music industry) = editing and selecting sound bites, integrating with video clips.

Business

• E-commerce analysts - the new media are related to new business models that require new approaches to marketing and to conducting business.
• Specialist recruitment and staffing agents = in an area of fast change, a demand for hybrid skills and growing use of contract or contingent workers finding the right people grows in importance.
• Producers and technical and/or creative directors = core team workers able to assemble production teams and to manage the production process.
• Communications law specialists = dealing with protection of intellectual property assets, guarding against prosecution for non-compliance with the emerging privacy, data protection, making sure that taxation is properly handled.
• Media planners = packaging and sale of media space, planning media exposure for clients – this job gets more complex with media convergence.
• Customer service call centre operators = dealing with increasingly on-line relations to clients.

■ Outlook for Media and Jobs

To a certain degree digitization and subsequent convergence only accelerates the change of the content industry already set in motion by deregulation and subsequent moves like concentration, mergers, outsourcing and globalization. At this level the scale of the industry is expected to continue to change. But, the history of the media industries shows that new media seldom completely substitute for existing ones. In fact there is no example of a content-based medium that disappeared. The book, film or even theatre industries have many times been announced as to disappear, but are still alive (and kicking). What does change however is the market share and relative importance of these industries vis-à-vis each other, with consequences in terms of rationalisations, etc.

It is most likely therefore that the Internet will (profoundly) restructure existing industries as well, without however destroying them. Thus a scenario of complementary growth instead of "creative destruction" is the most sensible landscape to project policy forecast on. However, the advent of net based delivery platforms enabling convergence of up till now separate industries, and personalized (or narrow-cast) interactivity in up till mainly broad cast and passive media, opens possibilities which will go beyond the repackaging of old contents. New contents and new demands are therefore being generated and will most probably lead to unexpected outlets.

What will be the outcome is impossible to forecast. History shows that almost none of the mass media of the last 100 years were "invented" as such, but the resultants of various different attempts to create media. A generic conclusion is that the capabilities of the digital convergence lead to new ways of working with content and hence new ways of formalizing labour and labour relations.

The following profound changes in jobs and labour relations in the in the content industries are in one way or another coming (depending on which scenario will dominate the intensity of the trends will increase):

- from life long employment/loyalty and clear/guaranteed career development paths, to increasing free lance (e-lance), self employment structures and casual careers,
- from skills being kept all in-house in media companies, to the use of predominately outsourced expertise,

- from long-term sector based commitments to one or a few media to portfolio self-employment and/or short-term commitment on a project basis (regardless of the sector or the media),
- from a single-skill profile based on creativity to a multi-skill profile based on creativity and technical competencies,
- from a hierarchical, mono-sectoral (one medium) structure to a more horizontal, project based structure,
- from a highly regulated entry to the job market (based on excellence of knowledge) to a very open entry, based on "hot" ideas.

Finally, the process of "creative destruction" has a qualitative dimension that should not be ignored. The trend towards greater flexibility that is observable in many areas of industry is also apparent in the media industry. As we note below, new jobs brought in with industrial change (such as deregulation) and new technologies (e.g. digital media) often bring with them new patterns of work and contracts

Both trends to more new jobs (due to growth of the sector and in net based media) as well as changing jobs (due to the increasing net based character of existing media) require mix of old and new skills and hence old and new training.

Though empirical material is lacking, a scan by the authors of this paper of present training provisions in Europe reveals that the overwhelming majority of them tends to be demarcated along traditional lines. Multi disciplinary, multi media training programs seem to be missing and most content training tends to be very ‘old media’ and sector based.

New media will bring new employment patterns. Software, film production, journalism, artist professions, each has a different structure. New hybrid occupations might emerge, plus new employment contract structures (outsourcing, freelancing) and new workplaces (telework, Small Office-Home Office). There may be wide implications for social dialogue (notably the challenge of protecting the rights of these workers).

■ Issues

Clearly much of this paper is speculative in orientation. This is inevitable, we have been addressing industries and employment sectors that are important precisely because they seem to be undergoing dramatic changes

(often starting from zero). To begin with empirical evidence on these industries and jobs is rather poorly recorded, especially in Europe. The changes that are taking place moreover make the current general data collection efforts, based on traditional sectors and occupations even less likely to be useful in the future. Normally statistics assume that business is taking place as usual (i.e. that continuity will outweigh change). In the coming years this may actually be the least likely scenario. However, we would argue that developments in the area are of sufficient importance to merit further development of empirical programmes at both general quantitative and qualitative levels on the implications of new ICTs and digital media for jobs and skills (DUCATEL & BURGELMAN, 2000).

On the quantitative side we expect that the coming years will bring high levels demands ICT competences at both the ICT professional and the skilled ICT user levels. Such skill gaps are short-term issues and it will require quick responses from the sectors concerned in terms of responses of the relevant industry and the education sector to meet growing demand for personnel, courses, accreditation and so on.

However, there is a longer-term issue at stake, and perhaps it is more interesting as a final note for this paper. On a ten-year horizon, how will the landscape of skills have changed due to the Internet revolution? It is clear that Internet-skills will be more widespread, but how far will this new digital literacy have traveled?

Certainly, a large and growing army of highly technically qualified personnel is likely to be needed provide the backbone to the expected growth in ICTs. Here we are referring not just to the creation of informational systems on the Internet but the design of ubiquitous computing systems and services. The consequence of attempts to make computer technologies more user-friendly, we suspect will be that a lot of engineering (and increasingly life science and cognitive science) know-how will have to be hidden within "simple devices" or behind "intuitive interfaces".

But, component-based software if and when it finally "happens" and software tools should provide an extensive library of algorithms that will enable non-specialist professionals to assemble software from its parts. Thus, just as with Today's web designers or "power users" of Microsoft Office, will the main need be for people with good logical skills and sufficient experience to master the finer arts of using systems? But what will

the skill repertoires of such workers be like: this is important as they are likely to be numerous (a new white-collar class?). Will the new digital economy demand quite different (and higher?) combinations of literacy's (written, visual, aural and technical) to meet the demands of using multiple channels and multiple media? How will people fulfill these demands? There are no real answers.

Finally, and perhaps provocatively, we think that the issues raised here are important because they affect all sectors, not just the ICT services and the media. Already, the majority of ICT professionals are employed in non-ICT sectors. Likewise perhaps in the future the majority of new media "professionals" will be employed outside of the media in information using sectors such as health, education and commerce? In fact, we might venture to assert that new media could become a paradigm for employment and skills that fundamentally influence of these technologies on the way we think and work.

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