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The role of technology in value chain restructuring

*Nathalie Greenan, Yusuf Kocoglu,
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1 Introduction

It is generally agreed that major upheavals are taking place in the organisation of work as corporate structures are transformed in the context of economic globalisation and rapid technological change. But how can these changes be understood? In addition, what are the impacts on social institutions and on workers? The European Commission funded the 'Work organisation and restructuring in the knowledge society (WORKS)' project in 2005 under its sixth Framework Programme to investigate these questions. With partners in seventeen different institutions in fourteen EU Member States, this ambitious research project has combined theoretical work and a detailed analysis of a wide range of statistics with in-depth case studies to analyse the forces that bring about these changes, including global value chain restructuring (VCR) and the policy environment.

One of the underlying assumptions of the WORKS project is that the reorganisation of work can only be understood fully in the context of a global restructuring of value chains, entailing a simultaneous decomposition and recomposition of sectors, organisations, labour processes and skills. However, the considerable heterogeneity within Europe of skill supply, levels of employment, welfare systems, and economic sectors makes it especially difficult to disentangle the causes and effects of such processes and to isolate the primary drivers of change. Yet it is particularly important for Europe both to understand the factors that will enable firms to sustain their competitive edge, to ensure a future supply of jobs that is satisfactory both quantitatively and quality and to examine the impact of these changes on the quality of life. At the heart of this is a single issue: how are employment practices adapting to change and with what effect? If we can answer this more effectively on a Europe-wide basis, we will be able to propose practical solutions to real problems.

Starting in June 2005, the WORKS consortium, involving partners from seventeen different institutes across thirteen EU Member States, carried out an ambitious programme of theoretical and empirical work. These were carried out under five main pillars: 'theories and concepts', 'quantitative research', 'policy', 'qualitative research on organisations' and 'qualitative research on individuals'. The work of these pillars is summarised more fully below.

This is one of eleven thematic reports that bring together the results of all five pillars to deepen our insights into the topic of employers' use of technology and the impact on organisational structure.

The other reports will focus on the topics of: VCR in Europe in a global economy; changes in work organisation and representation at the workplace; strategies to reach flexibility in the organisation; skills and qualification policies and HRM; new career trajectories and biographies; changing gender and ethnic relations in the workplace; working time, gender and work-life balance; change processes and future perspectives; changes in work in transitional economies; and health, safety and the quality of working life.

The material on which this report draws is summarised below.

1.1 Theories and concepts

In the first stage of its work the WORKS partners collectively carried out a review of the very large body of literature with relevance to the project's research questions, in order to map the field, formulate hypotheses to be tested in the empirical work and develop a clear conceptual framework for the research. This was no easy task. One can view the restructuring of work in a global knowledge economy through many lenses. There are the lenses of different academic disciplines, for instance the sociology of work, economic geography, organisational theory, social psychology, ethnography, gender studies, industrial relations or political science. Then there are the lenses of different social perspectives, for instance, those of international development agencies, of national governments in developed and developing countries, of technology providers, of statisticians, of employers, of trade unions, of educators, of civil society, of skilled professional workers who are may be beneficiaries of change, and of those groups that are potential losers. There are also differences deriving from different national research traditions, different ideological approaches and many other variables. In each of these many fields, a body of literature has grown up, trying to make sense of the changes taking place and supplying fragments of evidence. Piecing all this evidence together was a major challenge. The very disparity of the origins of this literature means that it is difficult to find a common frame of reference. Even when the same terms are used, they may be used with different meanings and the lack of commonly agreed definitions can make the refracted pieces of evidence difficult to compare, often giving them a contradictory and anecdotal character.

Nevertheless, in its first six months, the project managed to bring together in a single report (Huws, 2006) a remarkably comprehensive overview of the available evidence, thanks to the large collective efforts of the interdisciplinary WORKS team. This evidence was carefully sifted with the aim of distilling insights that could help to produce a clear conceptual framework in order to develop hypotheses and research questions to guide the empirical research to be undertaken by the WORKS project. This programme of work was, however, highly ambitious, encompassing the aims of: improving our understanding of the major changes in work in the knowledge-based society, taking account both of global forces and of the regional diversity within Europe; investigating the evolving division of labour within and between companies and the related changes at the workplace; exploring the implications for the use of skills and knowledge, for flexibility and for the quality of working life; and examining the impact on occupational identities; time use and learning; as well as the impact on the social dialogue and the varieties of institutional shaping. Balancing the need to take account of these many dimensions whilst retaining a focus on clear research questions that could be addressed feasibly within a coherent research design in a relatively short space of time was a major challenge, and we begin by presenting the methodology that was adopted to achieve this.

The first task was to achieve a division of labour that on the one hand took full advantage of the specialist subject expertise of partners whilst also recognising the diversity of national research traditions across Europe and the need to take account of the literature in all major European languages. Once topics had been assigned to partners, in a second stage, these partners were asked to produce a list of 'key concepts' for inclusion in a glos-

sary.¹ The purpose of the glossary was to ensure that all partners could share a common understanding and make visible any differences of interpretation or definition of key terms so that they could be discussed and agreed, in a process whereby, in its contribution to the cohesion of the whole group, the dialogue involved in producing the entries was as valuable as the end result. The next stage involved the production of draft reports covering the main concepts and the associated literature. Despite the authors' broad knowledge of their chosen topics, and the fact that each report included inputs from institutes in more than one country, it was felt that the only way to ensure that each report covered the full range of relevant European scholarship was to add a further, vital stage in the work. This involved circulating each draft report as it was completed to all the other WORKS partners, including those who had not been involved in the actual process of report writing. In this stage, partners were asked to draw on their knowledge of the literature in their own language or national setting, as well as their specific subject knowledge, to comment on the reports, point to issues that might be regarded as contentious and add references to relevant sources. This process of peer review enriched and refined the report, which was then used by all partners as an input to the development of research questions, methodologies and research instruments for the empirical research.

1.2 Quantitative research

The 'quantitative research' pillar of the WORKS project studied the changes in work in Europe on the basis of comparative analyses of data from existing organisation and individual surveys. In a first step, major European organisation surveys and individual and household surveys relevant for changes in work were mapped and benchmarked in order to assess their relevance and their strengths and weaknesses for comparative analyses on changes in work. Next, and more important for the thematic reports, the research focused on the secondary analysis of the results of the organisation and individual/household surveys. For the organisation surveys, a thematic analysis of thirteen major national and international organisation surveys, focusing on the major results with respect to the key issues of the WORKS project, resulted in an overview report 'Comparative analysis of organisation surveys in Europe' (Ramioul & Huys, 2007). The key issues addressed in this report are:

- new forms of work organisation, organisational and technological innovation, changes in work. Here in particular some findings with respect to skill-biased organisational change and the role of employee involvement and participation are relevant;
- changes in skills and qualification and vocational training policies at establishment level;
- work-life balance and working time arrangements. Here conclusions from EU wide research on working time arrangements and flexibility policies are of particular interest;
- quality of the working life as measured in organisation surveys.

¹ Available on-line on http://www.worksproject.be/Glos_and_defint.htm.

For each of these issues, the most relevant conclusions from the organisation surveys were summarised, thus leading to a comprehensive overview of organisational changes in Europe based on this particular data source.

For individual surveys, three major sources of individual and household data made it possible to carry out longitudinal and EU comparative analysis on the issues relevant for the WORKS project: the Community Labour Force Survey (CLFS); the European Working Condition Survey (EWCS) and the European Community Household Panel (ECHP). Based on these three key data sources (Geurts, Coppin & Ramioul, 2007; Greenan, Kalugina & Walkowiak, 2007; Birindelli & Rustichelli, 2007; Brynin & Longhi, 2007) each focusing on the EU comparative analysis and on the identification of trends with respect to key WORKS issues. The reports focused on the following issues:

- tracing employment in business functions: a sectoral and occupational approach: in this report, an innovative method was used to measure changes in employment related to VCR (Geurts *et al.*, 2007);
- trends in work organisation and working conditions. For this report, three waves of the EWCS were analysed in a longitudinal and EU comparative perspective, shedding light on changes in task complexity, autonomy, working time independency, health and safety issues and working conditions (Greenan *et al.*, 2007);
- work flexibility in Europe: a sectoral and occupational description of trends in work-hours, part-time work, temporary work, and self-employment was carried out based on this important European data source (Birindelli & Rustichelli, 2007);
- occupational change in Europe: based on longitudinal data, aspects of work satisfaction, occupational mobility and overqualification were investigated (Brynin & Longhi, 2007).

1.3 Qualitative research on organisations

The organisational case studies within the WORKS project covered a number of generic business functions that represent a wide variety of activities and labour processes in the 'knowledge society' ranging from highly-skilled 'knowledge work' to semiskilled manual tasks. The research also aimed to focus on those business functions that feature prominently in the external restructuring of companies and thus in the restructuring of global value chains. The selected business functions were: research and development, production, logistics, customer service and information technology.

To study the restructuring of value chains these business functions need to be located in specific sectors. The selection of sectors reflected the emergence of global value chains in different historical stages: sectors where vertical disintegration and internationalisation is already a rather old fact, and sectors where these have developed only very recently. The sectors under study were:

The *clothing industry* is an example of an 'old' industry where restructuring of global commodity chains was already an issue in the 1970s. Recently, the integration of Central and Eastern Europe in Pan-European production networks and the phasing out of the Multi-Fibre Arrangement and the WTO Agreement on Textiles and Clothing considerably changed the trade regimes and resulted in a new wave of restructuring mainly affecting production in Southern Europe and the CEE countries. This sector also provides interest-

ing examples of ‘head and tail’ companies, which concentrate high-skilled work within Europe but carry out the rest elsewhere.

The *food industry* is the largest manufacturing sector in terms of employment in the EU. It was subject to major restructuring after the completion of the single market in the European Union in the early 1990s, which allowed companies to replace their country-by-country organisation with a Pan-European structure. In contrast with parts of the clothing industry, food production is by and large highly-automated. Both industries are interesting as examples of buyer-centred value chains in which the demands of the retail trade play a pivotal role.

The *IT industry* is a growing industry that saw a major wave of restructuring during and after the boom years in the late-1990s and around 2000, partly associated with off-shoring. Internationally, this has contributed to the emergence of a ‘new breed of TNCs’, global companies that supply services to other companies. To a large extent, the IT service provider companies have grown through large outsourcing contracts that include the transfer of personnel from their public or private sector client organisations, a tendency highly relevant for the research questions of WORKS.

Public sector organisations and *services of general interest* are currently subject to far-reaching restructuring because of liberalisation and privatisation policies and budgetary constraints. In these sectors, the lengthening of value chains through large-scale outsourcing is a very recent phenomenon. The consequences for the quality of work are highly-influenced by traditional differences in the regulation of work between the public and private sectors.

Each business function located in a particular sector was studied in a range of countries with diverse employment and welfare regimes (liberal, conservative, socio-democratic *etc.*). This made it possible to analyse the influence of institutional frameworks on the consequences of restructuring. Overall, 57 case studies were conducted in fourteen countries. The following overview shows the distribution of case studies.

Table 1.1 Sample of case studies

	R&D/design	Production	Logistics	Customer service	IT
Textiles/clothing	BE; FR; DE; PT; IT	BE; IT; PT; HU; GR	FR; DE; NL; PT; HU		
Food		GR; BG; IT; NO; DK; UK	BE; NO; BG; GR; UK		
IT	DE; AT; UK; BE; FR; NO	DE; AT; HU; BG; SW			
Public sector administration				AT; BE; BG; HU; IT; UK; SW	BE; NL; UK; FR; DE; NO; SW; PT
Services of general interest: post and rail				DE; AT; SW; NL; GR	

For each case study, eight to ten interviews with management, key employees, and shop stewards (in the selected business functions) were conducted. The interviews were complemented by company documents and other material that made it possible to produce a

comprehensive picture. Researchers in the respective countries synthesised the individual case studies from the interview data. Based on the individual case study reports, comprehensive comparative analyses were carried out to compose this report. The authors of the report are deeply indebted to the researchers who carried out the case studies in the various countries and to the respondents who devoted their time to our research and helped us to understand the developments in their companies and sectors. For the presentation in this report, all company names have been changed to assure anonymity.

1.4 Qualitative research on individuals

The organisational case studies were complemented by case studies designed to investigate the impacts of changes at work on individuals and their households. Thirty of these occupational case studies were achieved in fourteen countries, between June 2006 and May 2007; in total 246 in-depth individual interviews were carried out, according to common interview guidelines elaborated in May 2006.

These occupational case studies are closely related to the organisational case studies that were carried out in a selected number of business functions, during the same time span. In the WORKS project, the concept of the 'business function' lies at the core of the qualitative empirical research, since these business functions provide the most useful unit of analysis for studying VCR and changes in work. In order to study changes in work at the individual level, individual workers were selected within specific occupational groups linked to key business functions.

Six occupational groups were selected: designers in the clothing industry; researchers in information and communication technology; IT professionals in software services; production workers in food or clothing; logistics workers in food or clothing; front-office employees in customer relationships in public services. In each occupational group, three to seven case studies were conducted in different countries, covering a variety of socio-economic and institutional contexts. Each case study relied on seven to nine in-depth individual interviews, including a biographical dimension.

The analysis of the interviews was structured around five themes that grouped together the WORKS research questions. These were: career trajectory, occupational identity, quality of work, knowledge and learning, and work-life balance.

Particular attention was paid to gender issues. Gender was treated as a transversal theme in the analysis of changes in work at the individual level. The principle of gender mainstreaming (*i.e.* taking systematically into account the differentiated experiences of men and women in all items of data collection and analysis), formed one of the basic guidelines for the individual interviews.

1.5 The policy pillar

A central task in WORKS is to examine what effect policy initiatives and regulation at various levels - international, European, national, regional, sectoral and company - actually have on work life and work experience. Especially relevant in this regard is the role of institutions in the determination, implementation and enforcement of policy. We began with the question: can we expect divergences in the ability to regulate changes in work

due to restructuring according to different types of production or employment regimes, different types of industrial relations models, diverse institutional frameworks? Toward this end, all of the organisational case studies included a section on industrial relations and regulation of work. Within each company that was investigated, data was collected on the forms that worker representation took, which issues were negotiated, the role of workplace representation in restructuring (information, consultation, active intervention), the impact of European or national regulations, and the pressures on regulations and institutions due to restructuring. Additional interviews with trade union representatives and works counsellors were carried out where possible.

The research agenda motivating this line of inquiry was to examine what role the institutions and actors of industrial relations play in restructuring across value chain in diverse settings and across diverse institutional contexts. A further issue is what role workers' representatives have in tempering the effects at the workplace that result from this restructuring, including the terms and conditions of employment, fragmentation and segmentation, gender equality, training and skilling, and quality of work life. Existing studies have shown that there are major challenges for existing institutions and forms of social dialogue to deal with current trends in restructuring and changes at work. Therefore, the case studies also investigated the impact of restructuring on the strategies or effectiveness of workers' representation and workers' voice.

1.6 Employers' use of technology and the complexity paradox

Based on these materials, the report focuses on the impact of new technologies on the restructuring of value chain, work organisation, skills and training. For the last two decades, the economic landscape has been transformed by major reorganisations and by the spread of Information and Communication Technologies (ICT). This spread of ICT has been rapid, massive and transversal across organisations, whether private or public, even if there is some variety in the rhythm of adoption across countries and sectors. Organisational structures have also been deeply on the move as is witnessed by the restructuring of networks between business partners, by the adoption of new management practices or by changes in organisation charts. Our research through the available material has been guided by a paradoxical finding from the WORKS quantitative pillar, based on a secondary analysis of the EWCS (Greenan *et al.*, 2007). Even though knowledge is considered as a central driving force of growth and welfare in the European economy, employees in EU-15 indicate that the complexity of their work has remained stable or slightly decreased between 1995 and 2005: in 1995, 59 *per cent* of the work force declared that their tasks was complex, 76 *per cent* indicated that they were learning new things in the course of their work, 66 *per cent* could change the order of their tasks and 72 *per cent* their methods of work. In 2005, the same figures amount to 58 *per cent*, 70 *per cent*, 63 *per cent* and 67 *per cent*. This is a striking result, taking into account the development of the service sector, the increased experience of an aging work force and the rising level of education of EU-15 workers, three main forces that should be driving and increased work complexity.

Quantitative analysis is limited to carry out an in-depth analysis of what is going on. Could the use of ICT in the context of global VCR explain part of this evidence? Some results in the empirical literature qualify the idea of a positive and mechanical relationship between computer use and work complexity. Autor, Levy and Murnane (2003) for

the US, Spitz-Oener (2006) for Germany have shown that computerisation was associated with an increase in the skill requirement of occupations over the 1980s and the 1990s. However, computers substitute for routine manual and cognitive tasks such as picking and sorting or repetitive customer service but not for non-routine manual tasks such as janitorial services or legal writing. A consequence could be a polarisation of jobs, hollowing out intermediate occupations that require routine manual and cognitive skills (Goos & Manning, 2007) identify such a trend in the British economy over 1975-1999. Other empirical works identify some ambiguity in the uses of more recent waves of ICT. Askenazy (2004) stresses that the use of computers in flexible workplaces can contribute to narrow down the range of professional competencies in some occupations. Greenan and Walkowiak (2005) identify a complementarity between computer uses, work in teams and work intensity, but the positive correlation between computer use and autonomy or intensity of communication is explained by a selection effect: employees who access to computerised workstations have specific social characteristics and in particular, when they have a low level of skills.

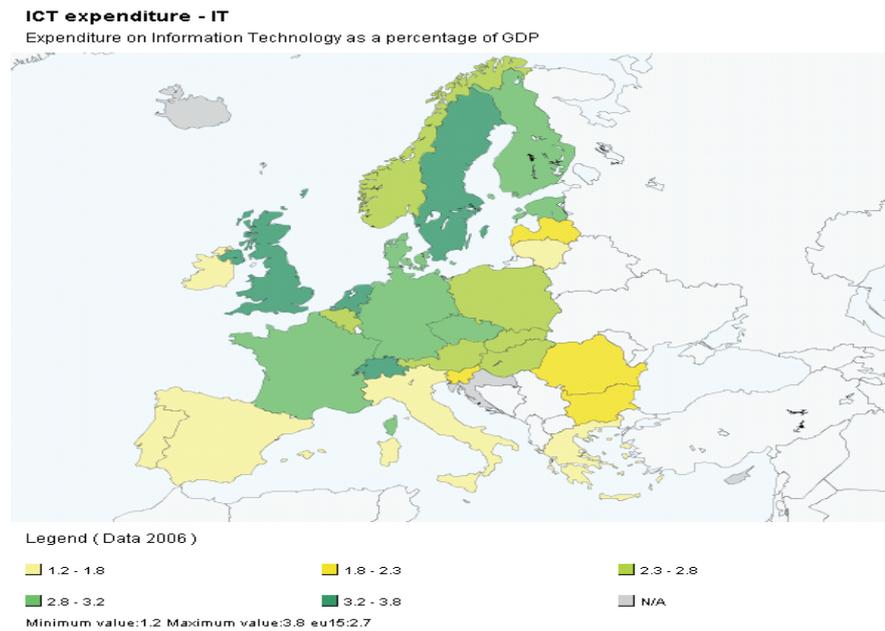
In this report, we will synthesise results obtained in the WORKS project from quantitative and qualitative approaches. The work complexity paradox will guide us in the analysis of the evidence. In the following, we are going to assess successively the relationship between technology and VCR (Chapter 2), work organisation (Chapter 3) and skills (Chapter 4). Technology refers to the practical application of knowledge that often takes the form of use of tools and crafts (Bell, 1989). Technology and the related knowledge play an important role in workplaces. In the developments of technology use, three phases can be distinguished: mechanisation, automation and computerisation. In the mechanisation phase, machines in simple operations support human muscle power. In the automation phase, machines phase the sequence and pace of discrete operations. Computerisation indicates the intensive use of ICT and refers to a situation where people are supported by a computer in performing their working tasks (Rafnsdottir & Gudmundsdottir, 2004). We will see in Section 2, from the analysis of the qualitative evidence, that the technologies involved in VCR are mainly ICT and more precisely, waves of ICT that has started their diffusion by the mid-1990s, with the Internet revolution. We will refer to them as VCR technologies. ICT are also going to be central in Sections 3 and 4 although the qualitative evidence in manufacturing industry identifies in addition technologies from the automation phase.

2 What is the interplay between ICT and value chain restructuring?

2.1 The diffusion of ICT in Europe

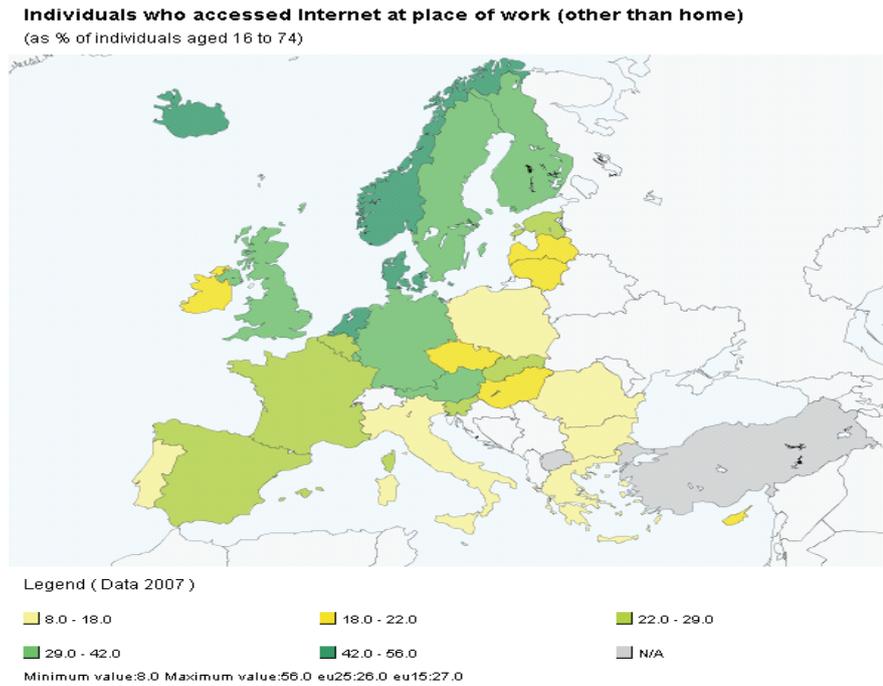
In this first section, we analyse the impact of the diffusion of ICT on value chain restructuring (VCR) in Europe. ICT are widespread across Europe, but their degree of use is uneven across countries. This is important because we may guess that the role of ICT in VCR is going to be contingent on its diffusion within countries involved in the value chain network. Using information from National account compiled by Eurostat, we are able to map the share of ICT expenditure in GDP across Europe (Figure 2.1). Sweden, the UK, the Netherlands have the strongest ICT intensity and Greece, Spain, Ireland, Italy and Lithuania have the lowest one. However, ICT intensity gives a partial summary of the use of technologies at the workplace.

Figure 2.1 ICT expenditures in Europe



The 2007 community survey on the usage of ICT in households gives the share of individuals who access internet at the workplace. For internet, we observe a pattern opposing the North West of Europe and the south East even more clearly than for ICT intensity (Figure 2.2). Norway appears to be frontrunner, followed by the Netherlands and Denmark (between 42 per cent and 56 per cent) then come Sweden, Germany, Austria and UK (between 29 per cent and 42 per cent). Lagging behind in this respect are Romania, Bulgaria, Poland, Greece, Italy and Portugal, with shares of internet users at the workplace that are below 18 per cent.

Figure 2.2 Internet use



Source: Community survey on the usage of ICT in households (Eurostat)

It is interesting to compare the distribution of internet use at the workplace across Europe with the distribution of older waves of technologies. There are no direct indicators of older waves of technologies in existing surveys, but a variable in the 2005 European Survey on Working Conditions gives some hints on the use of automated machines: employees are asked whether their pace of work is dependent on the automatic speed of a machine. This indicator shows an opposite geographical pattern: a high intensity of automated machine use is observed in Portugal, Slovenia, Hungary, Slovakia, Czech Republic and Estonia, while very low intensity characterises Sweden, the Netherlands, Denmark, Ireland and Poland (Figure 2.3). Greece and Bulgaria have a low intensity in computer, internet and machine use, thus showing a 'technology free' situation. It is important to

43 per cent of firms mention that ICT aim at 'a more efficient exploitation of internal/external knowledge' and at a 'faster communication with customers or subcontractors' and two fifths of the firms indicated that they aimed at a 'faster internal communication within the firm'. These three functions are connected with the organisation of the firms' information system. Other, more traditional functions like 'labour cost reduction' (26 per cent) or 'shorter production time' (13 per cent) are less prevalent. It is also possible to isolate in the population of firms the group that has introduced ICT innovations both over 1993-1995 and over 1998-2000. All functions of ICT are more frequently mentioned, but it is interesting to note that a third purpose seems to be emerging around 'greater flexibility of production' and 'continuous development of products and services'. This purpose can be labelled 'innovative' as that it intends to strengthen and further the innovative behaviour in the firm. Respectively 25 per cent and 22 per cent of the continuously innovative firms, mention these two driving forces. ICT have changed purpose over time and at one point in time, they may interact more or less deeply with work organisation. For example, If we go back to precise technologies, we can oppose internet that allows for a great flexibility without shaping the organisation, with integrative technologies like Enterprise Resource Planning (ERP) that carry a centralised organisational design (Benghozi, 2001).

There are surveys available at the European level to map trends in diffusion of organisational designs. Anand and Daft (2007) propose a characterisation of prevalent organisational designs in three main Eras: mid-1800s to the late-1970s, 1980s until the mid-1990s and the mid-1990s on. The prevalent organisations of the first era where self contained, with close boundaries with suppliers, customers and competitors. The functional, divisional and matrix structures became widespread during this era. Horizontal organisation designs with team and process based emphasis developed in the second era as a response to an increasingly complex environment. Internal boundaries of the organisation reshaped in order to improve co-ordination and communication. Since the mid-1990s, businesses have entered the third era where the external boundaries of organisations opened up, resulting in a restructuring of value chains, as a response to globalisation and backed up by the availability of ICT that transformed communication costs and drastically reduced the cost of distant co-ordination. The shape of networks relating business partners becomes the crucial element in organisational design. Three new organisational designs started to spread: the 'hollow' organisation that outsources internal organisation processes to outside partners, the 'modular' organisation that assembles pieces of the product provided by internal and external subcontractors, and the 'virtual' organisation developing a partnership with other organisations, including competitors to respond to an exceptional market opportunity.

A central aim of Chapter 2 is to describe the interplay between ICT and network designs in the restructuring of value chains. Section 2.1 shows the heterogeneity of technologies involved in VCR and takes into account sector based specificities. Section 2.2 handles the link between VCR technologies, co-ordination and control within networks. Finally, in Section 2.3, we classify employers' use of ICT in VCR in four general categories where distributed work is co-ordinated differently across organisations.

2.2 The heterogeneity of VCR technologies

The methodology followed in the WORKS organisational case studies puts a strong emphasis on VCR. This leads to focusing on a specific sub-set of technologies, *those that play a role when a company decides to outsource insource or manage a communication channel with a newly created unit*. We will group them under the label ‘VCR technologies’. Three service sectors have been investigated, the public sector, services of general interest, the IT sector, and two manufacturing sectors: the clothing and the food industry. The selection of sectors is also important in putting a limit on the set of technologies surveyed in the case studies. For example, as the trade sector has not been investigated, cases do not describe eCommerce technologies. Table 2.2 gives a nearly exhaustive list of the technologies mentioned in the WORKS case studies and involved in the restructuring of value chains.

Table 2.2 List of technologies that play a role in VCR in all case studies and diffusion in France according to the COI-TIC survey

Technologies	Number of cases (%)	Services	Manufacturing	COI-TIC (France)
ERP	12 (21%)	5 (16%)	7 (27%)	17%
Workflow management technologies	10 (18%)	7 (23%)	3 (12%)	7%
Software engineering system	9 (16%)	8 (26%)	1(4%)	-
Supply chain management technologies	8 (14%)	1 (3%)	7 (27%)	11%
Call centre technologies	8 (14%)	8 (26%)	0	-
ICT system for data base or documentation system	6 (11%)	4 (13%)	2 (8%)	-
Web portals	5 (9%)	5 (16%)	0	44%
Videoconference, groupware, email	4 (7%)	3 (10%)	1 (4%)	12%
Intranet	2 (4%)	2 (6%)	0	40%
Machines set in motion and control by computer	2 (4%)	0	2 (8%)	-
Computer aided design and pattern making	1 (2%)	0	1 (4%)	-
Traceability	1 (2%)	0	1 (4%)	23%
Performance tracking system	1 (2%)	0	1 (4%)	-
No technology involved	5 (9%)	1 (3%)	4 (15%)	-

Source: 57 WORKS organisational case studies (2006), COI-TIC survey (French public statistics, INSEE-CEE) firms with ten employees and more from the private sector

As the descriptions given in the case studies depend on the interviewed people, it is rare to find a great wealth of technical details. Thus, it is only possible to devise broad categories of technologies that play a similar role or have the same type of function. For example, we pooled together supply chain management technologies, order tracking systems and electronic storehouses that all play a role in logistics. We also pooled together videoconference, groupware and *emails* as they were generally identified in situations that needed the co-ordination of a teamworking at distance from one another. We give the precise definition of the identified technologies in Table 2.3.

Two preliminary findings can be noticed in Table 2.2. First, only six cases do not identify any technology playing a role in VCR. We will come back with more details on these cases in the next section. *An important result from the WORKS organisational case studies is thus that most VCR processes involve technologies and we can even be more precise by saying*

involve ICT. Second, VCR technologies cluster in two groups: generic and specific technologies. ERP, supply chain management technologies, workflow management technologies, call centres are in the first group, while the remaining technologies are in the second one. The first group of technologies is more frequently mentioned in the cases than the second one. Software engineering system are an exception: even though they are specific to the IT sector, they are frequently mentioned. This is because most of the IT sector cases mention this type of software.

There is no harmonised European data with such details available that we could use to compare it with the diffusion of technologies in the WORKS case studies. In the last column in Table 2.2, we refer to a French data source covering enterprises of ten employees and more in the private sector and conducted in 2006. Knowing that France has many features of an average European country, we can compare the share of firms using the different families of technology with the corresponding share from the case studies. The first group of technologies is equally or more frequent in the case studies than on average in French private firms, while the second group is less frequent.

Moreover, it is interesting to note here that the first group of ICT is recent. It started its diffusion, like Internet in the mid-1990s, jointly with the 'third era' organisational designs described at the end of Section 2.1. The second group of ICT is more mixed: traceability technologies are recent when intranet belongs to older vintages of ICT.

In the following, we will precisely define the 'generic' VCR technologies and a selection of more specific ICT in the service sector and in manufacturing. We will also highlight their interaction with the organisation and their role in the VCR. Indeed, depending on their characteristics and on the way firms implement them, ICT interact more or less intensively with organisational features and, by affecting in different ways over locations and time co-ordination costs within and between firm, ICT open new opportunities for organising economic activity.

Table 2.3 Definitions of technologies

Technologies	Definitions
Enterprise Resource Planning (ERP)	ERP is an integrated information system that serves all departments within an enterprise. ERP helps a manufacturer or other business to manage the important parts of its business, including product planning, parts purchasing, maintaining inventories, interacting with suppliers, providing customer service, and tracking orders. ERP can also include application modules for the finance and human resources aspects of a business. Typically, an ERP system uses or is integrated with a relational database system. The deployment of an ERP system can involve considerable business process analysis, employee retraining, and new work procedures (source: Huws, 2008).
Supply chain	The linked set of resources and processes that begins with the sourcing of raw material and extends through the delivery of end items to the final customer. It includes vendors, manufacturing facilities, logistics providers, internal distribution centres, distributors, wholesalers and all other entities that lead up to final customer acceptance (source: Bridgefield Group ERP/Supply chain Glossary).
Supply chain management technologies, electronic tracking system, electronic storehouse (SC)	The co-ordinated set of techniques to plan and execute all steps in the global network used to acquire raw materials from vendors, transform them into finished goods, and deliver both goods and services to customers. It includes chain-wide information sharing, planning, resource synchronisation and global performance measurements (source: Bridgefield Group ERP/Supply chain Glossary).
Workflow management technologies (WF)	The path and systems used in the linked flow of activities with a specific start and finish that describe a process. The flow defines where inputs are initiated, the location of decision points and the alternatives in output paths, and is used in systems that perform automatic routing (source: Bridgefield Group ERP/Supply chain Glossary).
Call centre technologies (call)	Call centre is a company, or department of a company, that offers operator-supported voice services. A large number of operators handle inbound calls via a hotline, with outbound calls being part of direct marketing efforts (source: <i>Dutch Telecom Glossary</i>).
Videoconference (VGE)	A conference during which participants at two or more locations are linked by fast telecommunication lines and are able to see and hear one another in real time.
Groupwares (VGE)	Software and systems that allow a distributed group of people to work on common activities, and include functions such as group calendars, real-time network meetings, common database access and others (source: Bridgefield Group ERP/Supply chain Glossary).
Web portals (Web)	A web portal is a term, often used interchangeably with gateway, for a World Wide Web site whose purpose is to be a major starting point for users when they connect to the Web. There are general portals and specialised or niche portals. Private niche portals are those that are used by employees of a company. Companies such as IBM and MasterCard use portals to help disseminate information to their employees in a timely and efficient manner.

Table 2.3 Definitions of technologies. Continued

Technologies	Definitions
Intranet (Intra)	An intranet is a private network that is contained within an enterprise. It may consist of many interlinked local area networks and use leased lines in the Wide Area Network. Typically, an intranet includes connections through one or more gateway computers to the outside internet. The main purpose of an intranet is to share company information and computing resources among employees. An intranet can also be used to facilitate working in groups and for teleconferences.
Software engineering system (soft. ing.)	Software engineering is the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software. It encompasses techniques and procedures, often regulated by a software development process, with the purpose of improving the reliability and maintainability of software systems (Wikipedia). Pattern making software suppliers for the clothing and fashion accessories industry. These software directory will assist designers with Pattern Design, Markers, Grading, Nesting software <i>etc.</i> (source: www.apparelsearch.com/pattern_making_software.htm).
ICT-based documentation system (Data)	ICT applications allowing capture, indexing and storage of documents and office or internet files.
Machines set in motion and control by computer	Automated machines, which automation is driven by a computer.
Traceability (Trace)	Traceability is the ability to trace the history, application or location of an entity by means of recorded identification. The word traceability can refer to:
Performance tracking system (PT)	<ul style="list-style-type: none"> - the origin of materials or components; - the history of the processes applied to the product; - the distribution and installation of a product after delivery (source: www.technifor.com/uk/glbsdef.htm). <p>Performance tracking system is an on-line information tracking system that assesses the performance of employees and the departments. Performance tracking system is designed by keeping in view of the following objectives: Systematically evaluate individuals, institutions, programs, and departments; Identify Indicators for both Performance & Process; Provide Drill down capability (by field, by function, by department, by finance) (www.cgg.gov.in/apstate_pts/User_Manual.htm).</p> <p>eGovernment involves simplifying and conducting processes relating to information, communications and transactions within and between governmental institutions, and also between these institutions, the public at large, and companies, by utilizing information and telecommunications technologies (source: Deutch Telecom Glossary).</p>

2.2.1 VCR technologies in services

WORKS organisational case studies have recorded major changes in the *public sector* in Europe driven by eGovernment schemes. The *EWA* case study in Belgium gives a precise description of these eGovernment schemes (Box 2.1). They aim at modernising and improving services to the citizens through a reorganisation of the direct interaction with them (front-office) and a process of administrative simplification (back-office). In fact, *EWA* is a newly created unit in the Walloon region, which is responsible for eGovernment and administrative simplification

Box 2.1 eGovernment

Nowadays, two streamlines are driving the modernisation and improvement of services to citizens:

- eGovernment: According to the European Commission, eGovernment is defined as 'the use of information and communication technologies in public administrations, together with organisational changes and new skills in order to enhance public services and democratic processes and to sustain public policies'.² Concretely, implementing eGovernment means reorganise the front-office (interface between public administration and the citizen) and the back-office (internal functioning of the public administration);
- administrative simplification: Simplification means redefinition of the back-office processes in order to enhance efficiency and propose a better service to the final customer (being a person, an enterprise or a public servant). This process is rooted in principles of eGovernment and the use of ICT tools. Examples of this process are the development of intelligent forms, the design of workflow instruments or the centralisation of customer data in a unique data warehouse.

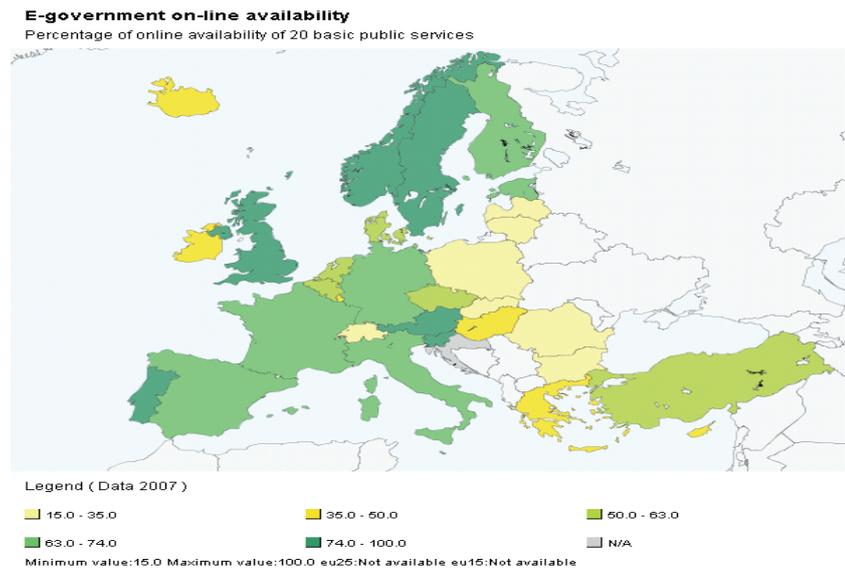
(Devos & Valenduc, 2007: 8)

The Community survey on ICT use provides information on eGovernment on-line availability for a list of twenty different types of basic services. In 2007, most of EU-15 countries had at least half of these services available on-line (Figure 2.4). Greece, Ireland and New Member States were not as advanced in terms of eGovernment.

Citizens and enterprises do not use internet for interacting with public authorities with the same intensity (Figure 2.5). In Finland, Denmark, Ireland, Italy and Slovenia, enterprises have an intense use of on-line government services, but not citizens. The internet pattern of opposition between the south east and the north west of Europe appears again for citizens' use of on-line government services.

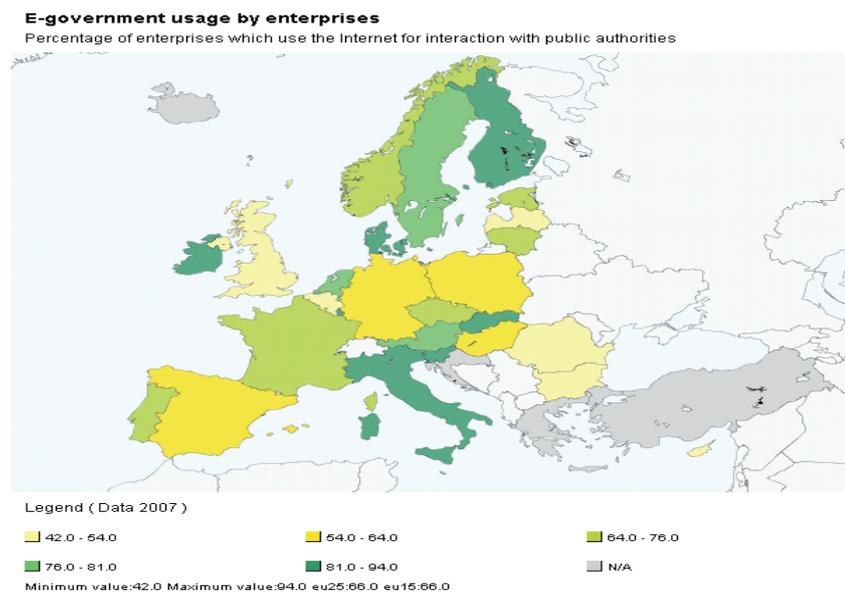
² Communication de la Commission au Conseil, au Parlement Européen, au Comité Economique et Social Européen et au Comité des Régions, *Le rôle de l'administration en ligne (eGovernment) pour l'avenir de l'Europe*, COM(2003) 567 final, (SEC(2003) 1,038).

Figure 2.4 eGovernment availability



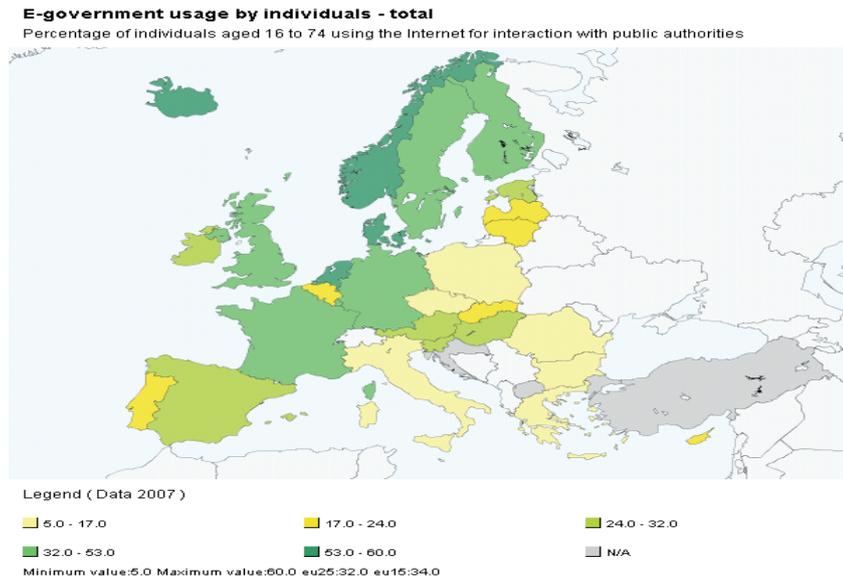
Source: Eurostat

Figure 2.5 eGovernment use by enterprises



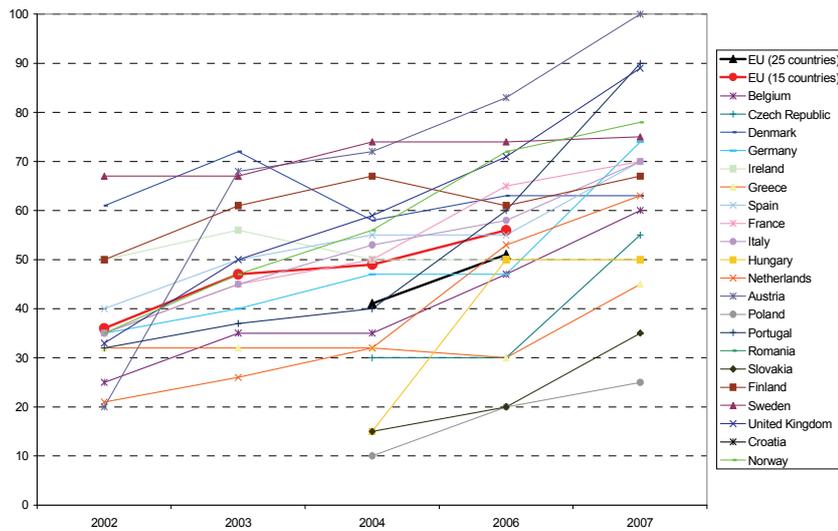
Source: Eurostat

Figure 2.6 eGovernment use by individuals



Source: Eurostat

Figure 2.7 eGovernment on-line availability: percentage of on-line availability of 20 basic public services, evolution between 2002 and 2007



Source: Eurostat

The strength of evolutions is amazing. There has been a rapid increase of eGovernment on-line availability in European countries: from 36 per cent to 51 per cent for EU-15 between 2002 and 2006 and from 40 per cent to 51 per cent for EU-25 within between 2004 and 2006 (see Figure 2.7). This increase concerns also countries with low level of ICT investment rate. Countries like Austria, UK and Portugal have done the biggest effort: from 20-30 per cent in 2002 to 90-100 per cent in 2007.

In the public sector the technologies involved in VCR have always a strong organisational dimension. *Call centre technologies* and *web portals* at the front-office, *workflow management technologies* between the front and the back-office are prominent technologies in eGovernment schemes and they are often articulated to one another. There is a call centre in six cases out of nine in the public sector. Most of the time these call centres are directed towards citizens and enterprises (seven cases), but one case is an internal IT help desk. Enquiries reported to the call centres are, depending on the cases, about local government services (*Customer*, UK, *EWA*, Belgium), council flats (*City Life*, Austria), driver and vehicle licences (*DVLA*, Italy) and crime reporting (*PCC*, Sweden).

Most of the time, citizen and/or enterprises have access to government services through different mediums. Call centres is one of them, but there are also walk-in centres and on-line or email requests. When different contact possibilities are opened, then a specialisation can take place. For example, web services are going to be devoted to routine requests when call and walk-in centres deal with cases that are more complex. The coexistence of different contact mediums generally implies some co-ordination mechanisms.

Box 2.2 below quotes the *City Life* case where contact centres deal with requests about council flats in a big Austrian city. A tenant can start posting a request through the call centre. It is partly processed and then passed on to an employee in the walk-in service centre that organises an appointment with the tenant. In this case, an electronic 'ticket' system follows up requests and records all the necessary information. This type of follow up requires an up to date database where information for processing requests are available (in this example detailed description and availability of the flats, lists of enterprises providing maintenance services *etc.*) and where requests are recorded and commented upon at each stage of processing. The creation of databases that can be accessed from different locations with a whole range of access rights is frequent in the public sector cases studies. It is central in the *GBA & Easttown* case study where the whole case is about the digitisation of a Dutch local government database with citizens' personal records.

Box 2.2 Call centre

Due to the high number of calls (3,500 per day), communication between call centres and walk-in service centres has always been a big challenge. The electronic 'ticket'-system has an important function - it follows a case from start to finish. Agents cluster a 'ticket' according to defined criteria, and then 'tickets' are sent to the respective employee at the service centre. All employees involved - in the call centre as well as in the walk-in service centres - can add their comments to such a 'ticket'. One of the problems that occurs is that not all messages from the call centre are clear enough to be processed. New call centre agents in particular do not know the relevant information for service-centre employees. For example, that a simple address is not enough to locate a technical problem. A great deal of additional information is recorded in the electronic system, *e.g.* time aspects, such as the duration of a case until completion. It shows in detail how

long a particular task took and who was responsible for it. Information and communication technologies play an important role in the overall workflow organisation.

Work at service centres became much more standardised and surveillance and pressure are on the rise. Due to the introduction of ICT-based communication tools and data processing systems, space for individual ways of organising work disappeared and possibilities for electronic surveillance in service centres increased.

(Schönauer, 2007: 4, 15)

It goes without saying that the emergence of the [call centre] branch depends largely on advanced IT hardware and software. Not only the process of communication itself needs special equipment, also the planning and monitoring of work is IT-enabled, as well as the analysis of results and the reporting to clients. Rapid technological development is typical for the branch and underlies both a further rationalisation of the process (for instance by 'auto-dialling') and quality-improvements (for instance by using software that facilitates instant access to the history of customers).

(Trommel, Bannink & Hoogenboom, 2007: 8)

Requests follow up are also conditional on a workflow analysis and a standardised procedure for dealing with them. When such a co-ordination device is in place, the transparency it establishes facilitates control and performance monitoring as the second quote from *City Life* case study indicates it. The *City Council* case in UK, where the IT function is outsourced, is another example of the association of call centre and workflow management technologies (Box 2.3). A workflow software aims at improving the internal business process efficiency as well as the external one when the process is outsourced. This means establishing a work procedure model with players, tasks and documents taken into account. The *City Council* case describes the restructuring of an IT help desk in a British local government involving an IT workflow management system where every work-related task has to be described and scheduled. Therefore, the work process has been substantially standardised.

Box 2.3 Workflow management

The key changes through restructuring relate to the relocation of the IT help desk to Scotland and increased standardisation of work processes. Before any one of *City Council's* employees could ring the IT help desk, located within IT, to report a problem. Now there is a central number for the IT help desk in Scotland, which takes a report and then passes on the issues back to IT. For any other work tasks, much more planning of the workflow is involved. Whilst before work tended to be carried out on an ad hoc basis, Prof's systems require logging every work-related task and scheduling of work to be carried out. So the workflow is more standardised and less flexible in responding to urgent, sudden problems. As the IT technician said 'as a result of increased paper work and being less flexible, I think we are providing a worse service than before'.

(Dahlmann, 2007a: 9)

Call centres and workflow management tools are ICT that respectively shape the front and the back-office in eGovernment schemes. Web portals are another front-office tech-

nology. They are mentioned in the *Intermed* (Hungary), the *Proconsulting* (France) and in the *EWA* (Belgium) cases studies. Web portals transfer part of the production of services to the customer, whether a citizen or an enterprise. They have two main consequences. First, they save time for other activities. In the *Intermed* case, for examples, employees can devote more time for individualised advice to job-seekers. Second, they contribute to the standardisation of services. An important issue in *Intermed*'s internal restructuring was to offer to job-seekers the same range of services throughout the network of labour centres.

Box 2.4 Web portal

The main guiding principles of the service model modernisation were as follows: Introduction of the principle of self-service both in the case of the job-seekers and for companies. This includes a more sophisticated segmentation of clients and the delegation of some (routinised and low value-added) tasks. Digitisation as a basis of high quality self-servicing (*e.g.* the procedure related to the work permission, description of the content of jobs and occupations and their medical requirements, all information concerning the trainings, services, subsidies, provisions and programmes offered by the *Intermed*, *etc.* are available via the portal of the *Intermed*). Contract-based co-operation with both the employers and job-seekers (these 'contracts' are a tool to establish, plan and follow more systematically the client relations). (Makó, Illessy & Csizmadia, 2007b: 19)

The Walloon portal (<http://www.wallonie.be/>) is the web interface of the institutions of the Walloon Region. It is a centralised tool, corner stone of eGovernment, designed and managed by *EWA*. Entering the home page, the customer selects one of the options citizen, enterprise or administration. The interface with citizens is structured along the 'life line' and a series of events all along the life line (from before birth to after death), or a list of themes linked to life events. Such an interface allows to structure information and services independently from any previous notion of what administrative department should be addressed. (Devos & Valenduc, 2007: 13)

The main driver of the VCR at the *Intermed* was the attempt of modernisation of the organisation that became necessary because of the changing labour market situation and the administrative workload resulting from the increasing bureaucratisation of the *Intermed*. The core motif of the modernisation process was the intention to combine the improvement of the quality with the standardisation of the services, *e.g.* to guarantee equal access for all job-seekers to get high quality services, independently from the significant regional inequalities characterising the country. The first step of the modernisation was the integration of the rather fragmented IT infrastructure in order to ensure countrywide access for both job-seekers and employers to the integrated database. The standardisation of certain elements of the service process (*e.g.* writing CVs, registration in the job-seekers' database, *etc.*) accompanied by the IT development ('information kiosks', PCs equipped with touch screen, *etc.*) have resulted in incremental changes in labour process through saving time for the employees of the local labour market offices to take more personal care for clients. The development of the IT infrastructure and the offered services, however, was not followed by a change in the regulatory environment of the *Intermed* that strongly influenced the content and structure of services as well as the

labour process. This case calls attention to the limits of ICT in restructuring of public services.

The French *Proconsulting* case is similar to the Hungarian *Intermed* one. A web portal for job-seekers is the key VCR technology. Its structure is customer oriented and it is driven by an eGovernment scheme. The portal of the Walloon region displays information along the life line rather than along an administrative structure. This new organisation of services reflects the customer orientation of the eGovernment scheme supported by EWA.

Services of general interest are in many instances close to the public service. The *Dutch Telecom* case, for example, focuses on a call centre. The last quote in Box 2.2, that summarises trends in call centre technologies, converges with the findings from the public sector cases.

Apart from these two cases, in the customer service function, three postal services (in Austria, Sweden and Greece) and a railway company (in Germany) have been investigated. Call centres are not as prevalent as in the public sector, but workflow management technologies are central. They are associated with Enterprise Resource Planning (ERP) systems or supply chain management technologies. We will see in Section 2.2 that these technologies are widespread in the manufacturing sector. Postal and railway services are in between the public service and manufacturing, as they do not only entail flows of information, but also physical flows in physical networks.

An ERP is a software package allowing business processes to be supervised and information to be shared between jobs via a single database. ERPs are split into modules that match business uses (SAP, Peoplesoft, Oracle are example of ERP software). Box 2.5 gives a quote from the *Swedish post* case study where the sales activity in the contact and the business centres are supported by the SAP system. This ERP software processes data from customers in the contact centre and data from the business market collected by geographically distributed sales teams. SAP makes the customer work more standardised in terms of processes and procedures. The *Swedish post* has also invested during its VCR into specific logistics support software called Pablo.

Box 2.5 ERP

The general work in the contact centres, now supported by the SAP system, is dominated by customer questions on the postal services, regulations, prices *etc.* both on telephone and email. On the business side there has been an attempt of using the incoming questions as sales opportunities [...] Normally each operator varies between telephone and ePost - both is processed in the same workflow.

The sales organisation has been changed over the last period. Sales on the business market has been moved from the Business Centres to sales teams geographically distributed. Key Account Managers form a specific team. Sales persons works both as indoor sales men in a contact centre environment now building up in the southern part and as outdoor sales persons with their own company car visiting customers. Sales persons have been specialised both on products (messages *versus* packages/logistics) and customers (SME *versus* large companies - KAM). At the same time the introduction of the SAP sales system support has changed the roles between sales administrators and sales persons. Through the intense use of the system many sales persons' (especially those unfamiliar with the system) time has been shifted from sales to administration. (Tengblad & Sternälv, 2007c: 12)

As a result of the development of an integrated and easily used data-processing programme and the establishment of so-called universal service counters, almost all services can now be carried out by the same member of staff (*ibid.*). Without computer-based integration, the services would be too labour intensive to be profitable for post office partners..

The post office-partner activities themselves are very customer-intensive, but at the same time the work process is highly-standardised and in most cases is structured by the post office's own computer programme. Using a touchscreen function, the worker clicks on the service concerned on the monitor. Then the programme shows the appropriate menu, from which the worker can choose the appropriate functions. In a certain way the programme guides the worker through the transaction. The introduction of a new programme in 2006 made the work even more simple (interview B2, C2). This programme also contains an electronic handbook in which all essential information is stored and can be referred to. (Hermann & Schönauer, 2007: 6, 9)

The second quote, from the Austrian *Postpartner* (Box 2.5) case study gives another description of a computer-based integration. Again, this case study puts forward the standardisation of the work process, together with the development of universal service counters. Post office employees are able to access from their computers to a large display of postal services and they are precisely guided into each transaction.

It is more difficult to characterise VCR technologies in the IT function of services of general interest. One reason is that ICT are omnipresent, making it delicate to identify which technology is precisely related to VCR and given descriptions are more technical (Box 2.6). IT providers supply software packages (for example, an ERP in the Swedish IT Business provider case) or develop specific applications tailored for each customer (for example, the *Euterpe* solution in the Belgian *ITPRO* case study). In the first example, the customer is the *Swedish post* and in the second, it is the Walloon region. The Norwegian *IT Health* case study is another interesting configuration where the IT provider develops and maintains an IT infrastructures for a group of sixteen health enterprises.

Box 2.6 The other side of the coin: IT solutions by:

IT providers *Euterpe*

The studied project concerns the implementation of a workflow software, named *Euterpe*, in order to manage the process of agreement of public grants to SMEs (grants for investment, employment and consulting). The title of the project is 'change and improvement of computerisation and organisation of grants to enterprises. *Euterpe* integrates usual office software (MS Office) into a workflow tool accessing central and shared databases.

According to IT people, *Euterpe* represents a technical solution for traceability, transparency, administrative simplification and workflow control. To reach these objectives, following actions have been taken:

- to develop a unique data base with integrated and authentic data about companies in the Walloon Region, available to everyone;
- to clarify the relation between several actors along the administrative chain, specify the input of these actors to the process, and to involve them in the implementation;

- to simplify the process for the administration and for the final customers, *e.g.* to encode less data and certainly not enter them more than once, possibility to check the state of the demand along the process, *etc.*);
- to reduce the processing time;
- to facilitate the evaluation of the process a file has to go through (*e.g.* find the reasons and moments why work volume is too important or why a file blocks).

(Vandenbussche, Devos & Valenduc, 2007: 9-10)

IT Health

IT Health owns, operates, maintains and develops all IT-related infrastructure at all of *IT Health* customers. *IT Health* is organised into four operational groups: IT service, planned management, project and market development and application. In addition there is a staff unit, with some core administrative supporting all operational groups [...]:

- IT services include a customer service centre which solves some problems (first line) and more complex problems are forwarded unto a central technical support group or individual support teams located at each health enterprise;
- Planned Management team: supports infrastructure development and maintenance of server and networks as well as client-based software and hardware;
- Project and Market Development supports the development of major technical projects at any/all hospitals locations;
- Application support team tailors the software databases to meet specific requirements and maintains these corporate applications over their life cycles. Major application projects that have been developed and are currently in use are EPJ (Electronic Patient Journal), administrative system software, patient administration software, specialised laboratory computer systems, requisition and reply system as well a digital X-ray systems.

(Dahl-Jørgensen & Torvatn, 2007: 4)

The *IT sector* is the last industry reviewed in the service sector, and more precisely, the R&D function in the IT sector. Once again, we note the heterogeneity of ICT according to what activity is carried out. The specificity of VCR technology in this sector is their lightness compared to the solution involving workflow management and integrated databases. email, conference calls, videoconferences and sometimes groupwares are the technologies involved in the networking activity between teams of researchers. These technologies do not have any structuring effect on the organisation of tasks and researchers recognise that they are limited as nothing replaces face to face communication in research activity.

Box 2.7 Videoconferences

The most important change in spatial division of labour took place in 1997 when sites lost part of their autonomy, with the introduction of a 'multisite' thematic units organisation. R&D activity is structured by projects. Each project involves R&D employees from different research centres and research units, that is to say from different geographical sites. This leads to a more intensive use of information and communication technologies as videoconferences or phone conferences for teamwork. However, several interviewees pointed out the low use and performance of these communication tools. 'Despite of all we can say about communication easiness, geographical proximity has its importance. It's yet easier to co-operate with people who are next to you.', said a researcher.

(Muchnik, 2007a: 12)

Communication between labs is generally by email, and there is a formal structure of reporting to the TTS leader now based in Japan; bi weekly reports, followed by a phone conference two to three days later with the TTS leader and project leaders from the three sites. There is also a structure of meeting and exchanges throughout the year: bi-annual visit to Japan by *UK Lab* project leaders and a reciprocal bi-annual visit from project leader/and or TTS leader to *UK Lab*. Despite the varied forms of communication employed by the virtual teams it was evident that face to face communication was irreplaceable, and this was a key limitation to the effectiveness of virtual teamworking.

(Gosper, 2007: 16, 23)

2.2.2 Value chain restructuring technologies in manufacturing

The prevailing VCR technologies in the clothing and food industry are ERP and supply chain management technologies. They are present in about a third of the cases. Besides, we may notice that cases without any VCR technologies are more frequent in manufacturing cases (15 *per cent*) compared with service cases (3 *per cent*). Other technologies mentioned are specific to each case: computer aided design and pattern making, ICT-based documentation system, traceability ICT tools, performance tracking systems or automated machines.

ERP systems are numerous in the clothing sector (Box 2.8) that can be characterised by the dominance of the 'Taylorist' work organisations with very low autonomy, in particular as far as methods of work are concerned, low learning and problem solving, low task complexity, repetitiveness and monotony, and precise quality norms to apply. They tend to equip both production and logistics as the final ambition of an ERP is to integrate the information system of all the functions of a company. Like in the public sector or in the services of general interest sectors, ERP imposes standards on procedures and processes, generates a unique data base, coding similarly materials on products in different production sites and in production as well as in the purchase or sales department, and favours monitoring and control. ERP solutions in the cases under review seem to integrate more modules in manufacturing than in the service sector.

Box 2.8 ERP

It is characteristic of the whole restructuring process that the new management tried to substitute the formerly usual manual practices (keeping track of everything by using only paper and pencil) introducing an integrated enterprise resource planning system (ERP) to optimise processes and ensure continuous controls. They were trying to follow the movements of raw materials and products through the logistics and production processes by assigning material and product codes to them, to be able to determine the key factors in the system that impact quality and capacity. At the same time, the introduction of the system met with the employees' serious resistance and that of middle management. They think that the system is full of errors and can't be operated easily. Upper management on the other hand believes that employees are not prepared to give up the old paper-based practices because the new system provides more transparency and control.

(Makó, Illéssy, Csizmadia & Mazsu, 2007: 10)

Computerisation took place in the 1990s with the introduction of a new information system. In 1991, a general ERP was implemented, completed with a specific ERP for distribution in 1995-1996. Three years ago, the system was extended to a standard software package, while it was still 'home made'. This system leads to a pooling of data all along the value chain, allowing sharing information via the system and as said more than one employee: 'to look for, in the data base, the information we need, without disturbing our colleagues'. [...] Moreover, the quite recent computerisation of the shops gives real-time sells by model, colouring and size. Every Monday, best sells of the past week are analysed by commercial and marketing units, and sells projections are made, having direct impact on restocking provisions.

The storehouse was completely modernised ten years ago with new equipment: pallet-covering machine, scotch tape machine and packing machine. The previous storage system has been eliminated and from the arriving in the storehouse until the exit, the products are now on track ways.

(Muchnik, 2007b: 10)

Supply chain management tools are procedures and applications responsible for anticipating and guiding physical business flows, customer demands, provisions for suppliers, planning tools help and decision aids. These tools may involve internal or external business (customers and/or suppliers). They can be in-house applications, software packages or ERP. For example, Box 2.9 gives a quote from the Portuguese *WW-DK Texteis* case study, where the company has developed an order tracking software to monitor relations with the customer (orders, delivery and billing).

Box 2.9 Supply chain management

The company has developed comprehensive software to monitor the process from order placement to order delivery. One objective of the implementation of WW OTS is to capture their customers and to tie them closer to the company. In general, the 'order tracking system' (WW OTS) aims at:

1. making communication with customers easier and more efficient; for instance, the software allows the company to answer very quick to customers' demands - and this is seen as a competitive advantage;
2. making order administration and work in progress tracking easier, quicker and more secure;
3. saving transactions costs.

With the development and implementation of the software of order tracking system, the company aims to achieve a full integration of IT solutions into the whole value chain. The idea is to integrate this software into the organisation of the customer (*e.g.* design department or purchasing department). With the implementation of the order tracking software, *WW-DK* aims also to tie the customer closer to the company: 'This is something which will capture the customers and tie them much closer to us. This is what we are aiming at' (general manager).

(Woll, Vasconcelos da Silva & Moniz, 2007b: 10).

We are just going to consider one case of specific technology that fits well with ERP and supply chain management technology: a performance tracking system. A British company

called *Maltco UK* uses this system. This system is a kind of workflow software focusing on performance analysis and continuous improvement. It extends to managers and executives standardised procedures to monitor a central component of their activity.

Box 2.10 Performance tracking system

Maltco UK introduced the MCR (Management Control Reporting System) which is a tracking device to measure key performance indicators (KPIs). 'MCRS tells every manager what meetings they should attend, when and what will be discussed at that meeting. For every meeting that sits within MCRS there is generally a management report which is looked at; the management report measures the key KPIs for a certain issue, e.g. packaging of cans per shift on a particular day. The report has a target and if the actual figure is good (and thus green), i.e. within target, no action needs to be taken, if the figures is outside the target and thus classified as a fail and marked red an action log is devised to tackle the problem immediately. In order to drive improvement at *Maltco UK*, items that are red receive the most attention, and in a team discussion, actions are agreed how to improve a certain problem. Proposed actions are logged in an action log (replacing meeting minutes in previous company). On the action log, a description of what that action is, is stated, who will implement the action, a timeline by when the action has to be achieved. The issue is followed up at subsequent meetings: this could be part of daily meetings and the person assigned to do that action for the following day, it will be established whether that person's completed their action or not. (Dahlmann, 2007b: 6)

To sum up, most VCR processes described in WORKS organisational case studies involve ICT, which are heterogeneous and vary in the deepness of their interaction with organisation across sectors. In the public sector, Call centre technologies and web portals at the front-office, workflow management technologies between the front and the back-office are prominent technologies. They prevail in eGovernment schemes, they are often articulated to one another and they have a strong organisational dimension. Services of general interest are in many instances close to the public service. workflow management technologies are central, they are associated with Enterprise Resource Planning systems or supply chain management technologies. In the IT sector, VCR technologies interplay only loosely with the organisation. email, conference calls, videoconferences and sometimes groupware are the ICT involved in the networking activity of teams of software developers. At last, like in the services of general interest, the prevailing VCR technologies in the textile and clothing and food industries are ERP and supply chain management technologies.

2.3 Value chain restructuring technologies between co-ordination and control

What kind of role can ICT play in VCR? It is clear that they participate in the co-ordination of distributed work across organisation units through the transfers of information that they allow. Standardisation is also an important issue. Putting it forward, we analyse in this section how information flows, co-ordination and control evolve in connection

with the use of technologies, and in particular ICT, during the restructuring of value chain.

2.3.1 Theoretical framework

Can we identify more precisely how ICT transform co-ordination mechanisms? Some economic models of organisation give insights on interactions between technologies shaping the information system of an organisation and parameters of the general organisational structure: centralisation or decentralisation of the information structure, change in the allocation of decision rights, number of hierarchical layers and span of control, specialisation in areas of information processing or in fields of expertise.

In his well-known 1986 model based on team theories, Aoki argues that a decentralised information structure becomes more efficient than a centralised one when uncertainty increases without being too high. However, this result is contingent on two characteristics of the information processing technology: its degree of precision and the time lag needed to process information. More concretely, if the headquarters of a company has to adapt its production plan to unanticipated events, based on what it is able to observe through its information system, it will make errors because observation is imperfect, and its analysis will take time. If ICT allow a greater precision while reducing the time lag, when the volatility of the environment increases, the moment when a horizontal co-ordination mechanism becomes more efficient than a vertical co-ordination mechanism is postponed. Thus, ICT could preserve the efficiency of centralised organisations in the context of globalisation, and in particular, ICT that favour the integration of information systems across distant units.

Sah and Stiglitz (1988) do not focus on production planning, like Aoki, but on project evaluation. They consider three organisation principles for selecting a project: hierarchies where unanimity is required, committees where k number of votes is needed for selecting a project and polyarchies where project selection is completely decentralised. If a better documentation or a more standardised presentation of projects reduce the marginal cost of individual evaluation, then the optimal size of a committee increases as well as the optimal level of consensus. A smaller evaluation cost increases the optimal size of a hierarchy as well as the optimal number of processing units in a polyarchy and the relative performance of committees increase relative to hierarchies and polyarchies. Thus, computerised data systems could make it more efficient to have more persons involved in project evaluation.

Williamson (1967) and Calvo and Wellicz (1978) investigate labour force control technologies. Efficient control technologies orient effort intensity towards its maximum level. Both models show that an improvement in control technologies tends to increase the optimal number of hierarchical layers.

Using a model of team theory, Kennedy (1994) argues that ICT lowers the gains connected with specialisation in information processing and increases communication costs. He develops the example of law firms. Software broaden the skills of analysts and reduce their comparative advantage. As a result, the specialisation in one stage of case processing becomes less interesting. If ICT lower the cost of data transfer, they have not yet increased the capacity to absorb and interpret information and if they encourage the transfer of information with lower value, then they tend to increase the cost of communication,

which is the cost of transferring the understanding of the data. These two properties of ICT tend to favour the integration of tasks that characterises the parallel structure.

Bolton and Dewatripont (1994) also deal with the trade-off between specialisation and co-ordination or communication cost using a model of information processing theory inspired by Radner and Van Zandt (1992). There are, however, some differences between the two models. In Kennedy's model, the whole team processes information in a sequential structure while one processor only deals with a case in a parallel structure. Bolton and Dewatripont assume that in the two structures, each processor receives the same number of items to analyse in the beginning. Structures differ in the length of transmitted reports: they aggregate more items and are thus longer in a sequential structure compared with a parallel structure. They also differ in their opportunity to specialise. In parallel structures, some processors are specialised in analysing information while other aggregate analysed information. Moreover, they assume that ICT lower fix and variable communication cost, which is the opposite of Kennedy's assumption. A first consequence in hierarchies is a reduction in the number of processors and an increase in the span of control, leading to less hierarchical layers. Secondly, a lower variable communication cost favours sequential structures over hierarchies.

Garicano (2000) has revisited organisational design in knowledge activities, proposing a model of knowledge hierarchy where production workers acquire knowledge about the most common or easiest problems and specialised problem solvers deal with more complex problems. In this setting, he shows that a decrease in the cost of acquiring and transmitting knowledge reduces the need for specialised problem solvers. Garicano (2000) then suggests that the different waves of ICT had different cost implications. First, expert systems and codification allowed by computers reduced the cost of acquiring knowledge, leading to flattened hierarchies and empowerment of production workers. Second, email and network technology has reduced the cost of transmitting knowledge and this could also result in flatter hierarchies but with a smaller range of expertise or less empowerment for production workers.

Antràs, Garicano and Rossi-Hansberg (2008) extend the model of knowledge hierarchy to international division of labour and offshoring decision. They show the importance of the presence of middle management skills in the host country for making it attractive. Indigenous middle managers play a role in improving the efficiency of the transmission of knowledge across countries because they understand and are able to solve local problems. However when ICT are used in host countries, they can substitute to middle management. In other words, the volume of offshoring increases more with middle management skills when the communication technology in the host country is bad than when it is good. This model is particularly interesting because it describes a channel through which ICT can play a role in VCR, in interaction with skills. Thus, both the availability of ICT and of intermediate skills in a country is going to be determinants of localisation choices in VCR.

In total, these models investigate how ICT may influence the range of organisational designs available for a business according to their main properties. Some models show that ICT can be used by organisations to compensate the effect of uncertainty by increasing the information processing capacities of hierarchies. But others also show that non hierarchical organisational designs could be favoured by ICT. The importance of knowledge in the activity, its codification and standardisation, and the cost of acquiring knowl-

edge and of transmitting or communicating it with ICT is of crucial importance. Structures also differ in their aptitude to gain from specialising information processing tasks. Section 2.2 has stressed the heterogeneity of ICT involved in VCR. We expect a range of network configurations in the VCR, with different types of interplay between ICT and organisational structures.

Gereffi, Humphrey and Sturgeon (2005) directly focus on global value chains and propose a theoretical framework drawing on different streams of literature to explain their governance patterns. They identify three key variables (a) the *complexity* of information and knowledge transfer required to sustain a particular transaction, (b) the extent to which this information and knowledge can be *codified* and, therefore, transmitted efficiently and (c) the *capabilities* of actual and potential suppliers in relation to the requirements of the transactions. Five types of global value chain governance are generated from this framework, ranging from high to low levels of explicit co-ordination and power asymmetry:

1. *markets*: due to low complexity of information exchange, transactions are not only easily codified but governed with little co-ordination. Costs of changing partners are low;
2. *modular value chains*: there are slight differences between this type of co-ordination and the previous one. This can be explained by the ability to codify the unifying components of products or services. As a result, little explicit co-ordination and low switching costs characterise this type of co-ordination of value chain;
3. *relational value chain*: this form of co-ordination arises when it is difficult to specify products or services due to the complexity of transactions. Due to the key role of the use of tacit knowledge between the partners involved in the value chain, co-ordination is based on the reciprocity relations (supported by ethnic ties, family relations, common working experiences, *etc.*). This type of co-ordination can be characterised by the high costs of switching partners;
4. *captive value chain*: this is the case when the suppliers dispose low level of competence and in producing complex products and services; they require significant intervention and monitoring (control) from the part of the lead firm. Switching costs for suppliers are rather higher;
5. *hierarchy*: this form of co-ordination is functioning efficiently when products or services are complex, requiring significant share of tacit knowledge. In addition, there is a shortage of highly competent partners or suppliers. Therefore the 'lead firms' are forced to design, produce services or products in-house.

The cases of VCR explored in the WORKS project describe the evolution of networks of workplaces when changes in the structuring of economic activity or in the value chain occur. Cases describe transformations in the relationships of units within an organisation or creation of a new relationship between two separate units or changes in an existing network linking two or more workplaces located or not in different geographical areas. Most cases can be described in terms of centralisation or decentralisation and they can be related to the global value chain governance typology by Gereffi, Humphrey and Sturgeon (2005). More precisely, we identify three main configurations with variants in the organisational design of the network of units involved in VCR. They are spread in all the sectors covered. They are given in Table 2.4 where the first column indicates the configuration variant, the second give the list of cases in each configuration with its acronym and country initials, the third gives the name of the VCR technology (see labels in Table 2.3)

and mentions whether the VCR is driven or enabled by ICT or whether ICT is a driving force in the VCR and the fourth gives the sector and the function covered by each case. They are the following: networks with a unit preserving or developing a central position (23 cases)³ to some extent similar to the 'hierarchy' or 'captive value chain', mutual dependence between units or partnerships (three cases) which is similar to the category of 'relational VC', decentralisation (thirteen cases) close to the category of 'modular value chain'. A last category groups twelve cases where the VCR did not lead to a change in the power distribution across the network. In one of them, there is no clear VCR process. Four of them do not mention any technology and the others involve the development of web sites (three cases) or of databases (two cases). The next sections are devoted respectively to the three configurations of network evolution where we are going to assess the role of ICT.

2.3.2 Standardisation and central power into the network

Networks where one organisational unit occupies a central position are by far the most frequent in the WORKS VCR cases. In Table 2.5, Column 2, we identify the components of the network and its central or stronger element that concentrates decisions rights over the activity in the network (CEN). In Column 4 we indicate what resource or mechanism plays a central role in upholding this position.

Of course, a first an important element is the financial links between components within the network. When components are subsidiaries of the CEN, then its managerial activity directly exerts influence on the activity in the network (eight cases). When components are business partners, then other mechanisms apply. Of course the type of contract between partners is going to be important. But it will constrain more or less the activity in the network according to the market position of the CEN: if it is strong, for example it is the main client of a given partner, then the CEN will be able to impose more conditions in the contract, and in particular standards. The fact that the CEN holds a resource that is important for the activity of the network is another possibility, mostly encountered in the textile and clothing industry. This resource can be a brand (*Green, Copy Fashion, Geisha*), a storage capacity (*Meanswearco*) or an unused capacity (*Comp. A*). Cases describe VCR, thus organisations are observed at a moment when the network is changing: it is being created (eight cases), reorganised (eleven cases), or restructured (nine cases). Sectors differ in terms of spread across these three situations, reflecting their historical stage in globalisation and VCR. The service sector is concentrated in network creation while the manufacturing sector is concentrated in reorganisation and restructuring of networks.

The privatisation and deregulation of telecommunication and postal services are at the origin of the network creations in services of general interest. We also find some network creation in the public sector, but in this sector cases are more spread across different types

³ In organisational cases, what is observed is a specific function in an organisation (customer service, IT, R&D and design, production and logistics) Section 2.2 focuses on the organisation of networks. Functions within a same organisation are not going to be substantially different in the way they participate in the network. When we count cases, we count functions in organisations, this is why there are some differences between the number of lines in the tables (where functions within an organisation are merged) and the number of cases we count.

of changes, and even across different network configurations. We also identify cases of network creation in the textile and food industry in Greece and Italy. Compared with the situation where one organisation carries out all the activity, the creation of a network may be interpreted as a decentralisation of the organisational structure. However, in the network creations we examine in this section, a central component, the CEN, keeps important decision rights over the network. This is why we consider these networks as centralised.

Comp. B, a textile company in Greece is the only case of network creation where technology plays no role. *Comp. B* has created a subsidiary in Rumania and develops partnerships in Bulgaria. In the *Greek post* case, we only observe a marginal role of ICT. This absent or weak role of ICT in the VCR is not surprising if we refer to Figure 2.1. In the *Comp. B* and *Greek post* cases, the CEN is localised in one of the European countries with the lowest share of ICT expenditures in GDP. Rumania and Bulgaria experience a more intense ICT diffusion than Greece, but they are still at a very low level.

In all other cases, ICT are important. They either drive the VCR (*Dutch Telecom*, *City Counsel*) or they enable outsourcing. ICT are driving forces when they directly shape the activity. In the *City Council* case, the IT function of a local government in UK is outsourced to a private multinational consulting service provider. *City Council* remains the strong component in the relationship through the Service Level Agreement that fixes targets. The ICT system that is implemented allows for performance monitoring around these contractually fixed targets.

Table 2.4 VCR technologies and the evolution of network organisation

Evolution of network organisation	Case and country	VCR technologies		Sector/function	
Centralisation: network creation	<i>Greek post</i> , GR	SC	driven	SGI/CS	
	<i>Dutch Telecom</i> , NL	Call + WF	driving	SGI/CS	
	<i>Swedish post</i> , SW	Call + Web +ERP	enabling	SGI/CS	
	<i>Postpartner</i> , AT	ERP	enabling	SGI/CS	
	<i>DVLA</i> , IT	Call	enabling	PS/CS	
	<i>City Council</i> , UK	Call + WF	driving	PS/CS	
	<i>Natural Delicacy</i> , IT	ERP + Trace	enabling	food/prod	
Centralisation: network reorganisation	<i>Comp. B</i> , GR	None	-	tex/prod	
	<i>City Life</i> , AT	Call + WF + ERP	enabling	PS/IT	
	<i>Green/SPA</i> , IT	ERP	enabling	tex/prod R&D	
	<i>WW-DK</i> , PT	SC	enabling	tex/R&D log	
	<i>Meanswearco</i> , DE	CAD	enabling	tex/R&D	
	<i>Copy Fashion</i> , HU	ERP	enabling	tex/prod log	
	<i>Fishing company</i> , NO	None	-	food/prod	
Centralisation: network restructuring	<i>Messenger</i> , AT	Soft. Ing.	-	IT/R&D	
	<i>Geisha</i> , NL	WF	enabling	tex/log	
	<i>Adele</i> , FR	ERP	enabling	tex/log R&D	
	<i>Beer AD</i> , BG	VGE/SC	driving	food/prod	
	<i>Meat Inc.</i> , DK	None	-	food/prod log	
	<i>Maltco</i> , Benelux	ERP	enabling	food/log	
	<i>Maltco</i> , UK	SC/PT	enabling	food/prod log	
Mutual dependence	<i>Trousers' Company</i>	SC	enabling.	tex/log	
	<i>Business Software</i> , DE	Soft. ing. + intra + VGE	enabling.	IT/prod	
	<i>Customer</i> , UK	Call + WF	enabling	PS/CS	
	<i>GBA and Easttown</i> , NL	Data	driving	PS/IT	
	<i>MM Spinoff</i> , DE	Web + Data	driving	SGI/IT	
	Decentralisation: creation of new autonomous units or preserved autonomy of units	<i>EWA</i> , BE	Call + Web + WF + Data	enabling	PS/CS
		<i>PPC</i> , SW	Data	enabling	PS/CS
<i>Eco Clothing</i> , DE		Call	driven	tex/log	
Decentralisation: outsourcing of non core functions	<i>INIT</i> , SE	Data + WF	enabling	IT/prod	
	<i>IT Health</i> , NO	Soft. Ing.			
	<i>Swedish post</i> , SW	ERP	enabling	SGI/IT	
Co-ordinated decentralisation	<i>Tevitom</i> , PT	None	lack of ICT	tex/prod	
	<i>Comtel</i> , FR	VGE	enabling	IT/R&D	
	<i>UK Lab</i> , UK	VGE/Intra	enabling	IT/R&D	
	<i>Comp. A/A NOR</i> , NO	Soft. Ing.	driven	IT/R&D	
	<i>Messenger</i> , AT	VGE/Soft. Ing.	lack of ICT	IT/prod	
	<i>Domainsoft</i> , HU	Soft. Ing.	enabling	IT/prod	
	<i>Softserv</i> , BG	VGE/Soft. Ing.	enabling	IT/prod	
No evolution	<i>Intermed</i> , HU	Web	enabling	PS/CS	
	<i>Proconsulting</i> , FR	Web	enabling	PS/CS	
	<i>German railway</i> , DE	Web + Data	driven	SGI/CS	
	<i>ITPRO</i> , BE	WF + Data	enabling	SGI/IT	
	<i>IT Healthcare</i> , PT	WF	no VCR	SGI/IT	
	<i>NEA</i> , BG	None	-	PS/CS	
	<i>Wonderwear</i> , BE	None	-	tex/prod R&D	
	<i>Comp. A</i> , GR	None	-	food/prod	
	<i>Comp. A</i> , GR	SC	driven	food/log	
	<i>CharleTIC</i> , BE	VGE/Soft. Ing.	driven	IT/R&D	
	<i>VR2</i> , DE	Soft. Ing.	driven	IT/R&D	

Source: WORKS organisational case studies

Table 2.5 Different ways of having a central position in a network

Case and country	Central element/network	Power evolution	Why?	Role of ICT
<i>Greek post</i> GR, SGI, SC	Co. P/Co. C (subsidiary)	Network creation	Direct influence	Marginal
<i>Dutch Telecom</i> NL, SGI, SC	DT/CNS (subsidiary)	Network creation	Contract & influence	Shapes activity
<i>Swedish post</i> SW, SGI, SC	Posten AB/subsidiaries/partners	Network creation	Contract & standards	Enables outsourcing
<i>Postpartner</i> AT, SGI, SC	Post AG/partners	Network creation	Contract & standards	Enables outsourcing
DVLA IT, PS, CS	DVLA/partners	Network creation	Contract & standards	Enables outsourcing + control
<i>City Council</i> UK, PS, IT	City Council/Prof (partner)	Network creation	Contract	Shapes activity
<i>Natural Delicacy</i> IT, food, prod	Natural Delicacy/HYDRO and other partners	Network creation	Contract, standards & strict quality control	Enables outsourcing + control
Comp. B GR, tex, prod	Comp. B/subsidiary in Rumania/partners in Bulgaria	Network creation	Direct influence/unused capacity	None
Trousers' Company DE, tex, log	Trousers' Company/subsidiary in Romania and partners in Asia, South-Europe	Network creation	Control by IT-supported logistics	Enables outsourcing + control
<i>City Life</i> AT, PS, CS	CEC/CCSC & Multicalit (partners)	Increased power of CEC	Contract & standards	Enables outsourcing + control
<i>Green/SPA</i> IT, tex, prod & R&D	Green/partners	Increased power of Green	Brand owning	Enables outsourcing & delocalisation
WW-DK PT, tex, prod & log	WW-DK/partners new horizontal orientation	Increased power of WW-DK	Organises the VC	Enables sourcing + control of VC
<i>Meanswearco</i> DE, tex, R&D	Meanswearco/partners partial verticalisation	Increased power of Meanswearco	Huge storage capacity/market growth	Enables outsourcing & delocalisation
<i>Copy Fashion</i> HU, tex, prod & log	Batimier group/Copy Fashion (subsidiary)	Increased power of Batimier group	Brand owning & influence	Enables outsourcing + control
<i>Fishing company</i> NO, food, prod	Fishing company/insourcing of AS Marine/Larry	Increased power over AS Marine	Direct influence through acquisition	None

Table 2.5 Different ways of having a central position in a network. Continued

Case and country	Central element/network	Power evolution	Why?	Role of ICT
<i>Geisha</i> NL, tex, log	Holding/ <i>Geisha</i> /subsidiaries in Africa, partners in Asia	Network restructuring to preserve power	Brand owning prod. of wax print	More flexibility in wax print prod.
<i>Adele</i> FR, tex, log	<i>Adele</i> /subsidiaries/partners	Network restructuring prod to distribution	Control of distribution channels	Improves co-ordination and control
<i>Messenger</i> AT, IT, R&D	<i>Messenger</i> (AT)/ <i>Digit</i> (HR) partners	Network reorganisation	Increasing flexibility	None
<i>Business Software</i> DE, IT, prod	<i>Business Software</i> + subsidiaries	Network restructuring for standardisation	Competitive pressure	Enables and drives VCR
<i>Meat Inc.</i> DK, food, prod	<i>Meat Inc.</i> /subsidiaries	Network restructuring centralisation of prod.	Direct influence	None in VCR automation of prod.
<i>Beer AD</i> BG, food, prod & log	<i>BeerY/Beer AD</i> (subsidiary)	Network restructuring Global Plan	Direct influence and standards	Improves co-ordination and control
<i>Maltco</i> BE & <i>Maltco</i> UK, food, prod & log	<i>Maltco</i> BE/BSSC, <i>Maltco</i> UK & subsidiaries	Network restructuring	Direct influence and standards	Enables outsourcing & delocalisation

Source: WORKS organisational case studies

Box 2.11 Network creation

After *DT* had created semi-autonomous contact centres in the nineties, it sold these centres to *CSN*, but remained control by acquiring 51 *per cent* of the shares of *CSN*. A few years later, however, the firm was taken from the stock market after which *DT* became the 100 *per cent* owner. For mainly strategic reasons, the *CSN* activities and most of the *DT*-related contact activities became separated again in two units. Thus, in the end *DT* outsourced all of its contact activities, but remained a high level of management control over these activities. Through these manoeuvres, *DT* was able to establish cheaper labour conditions in this business area.

It goes without saying that the emergence of the branch depends largely on advanced IT hardware and software. Not only the process of communication itself needs special equipment, also the planning and monitoring of work is IT-enabled, as well as the analysis of results and the reporting to clients. Rapid technological development is typical for the branch and underlies both a further rationalisation of the process (for instance by 'auto-dialling') and quality improvements (for instance by using software that facilitates instant access to the history of customers).

(Trommel *et al.*, 2007: 6 & 8)

As the management explained, the decision to outsource part of the production was dictated by *ND*'s insufficient capacity following an unexpected surge of demand for especially frozen vegetables.

As in similar outsourcing scenarios, the source trademark enterprise - which consequently holds a strong and acknowledged position in the market - has stronger contractual power *vis-à-vis* its subcontractors. Such asymmetry also characterises the relationship between *ND* and *ND*, and between *ND* and the other enterprises that supply its ice creams, fish products and snacks. In practical terms, *ND* lies in a position of substantial dependence insofar as *ND* is its main client - the client that provides work for most of the year and the largest chunk of its turnover. However, in the case of *ND/ND*, the asymmetry of power is not expressed in an imposition of and a pressure on the conditions in terms of prices and deadlines, but takes the form of an extremely strict control on the quality of the orders, on the compliance of processing standards and methods.

ND is investing heavily on information technology, fully realising just how vital IT is for its business. In this regard, *ND* has implemented a system for the integration of all the entities that take part in the production process, from the partners that supply raw materials - *i.e.* the fresh agricultural produce - to the carriers, *etc.* This system allows *ND* to locate raw materials, semi-processed products and finished products in real time and thus synchronise stocking at production and retail levels. It is clearly a key issue considering that most of the materials involved are easily perishable and do not have a very long shelf life. New technology is also a key factor in *ND*'s quality project which crucially hinges on the 'traceability' of the product. Each product comes with a code (which is a sort of identity card) that allows for the tracing back, along the value chain, of the product itself, from the packaging to the processing it has undergone, including transportation, all the way to the field where it was cultivated.

(Pedaci, 2007a: 3, 6 & 5)

The *Dutch Telecom* case, describes the outsourcing of contact centres to a subsidiary. It stresses the role of ICT in the emergence of the customer service branch on the market (Box 2.11). In the four remaining network creation cases (*Swedish post*, *Postpartner*, *DVLA*, *Natural Delicacy*) relationships in the network are based on contracts rather than financial link. *CEN* are able to maintain their dominant position because they impose standards on

the work process. As a result, the relationship is a quasi-integration. ICT enable this kind of VCR because they contribute to the determination of standards and to the control of their application. The *Natural Delicacy* case in Italy is a good illustration of this strategy (Box 2.11). *Natural Delicacy* was reluctant to outsource because their competitive advantage is based on quality rather than cost. Control over quality is especially difficult. They decided to do so because of insufficient capacity. An ERP system, allowing for the integration of all the entities that take part in the production process associated with a technology for traceability allowed to secure a good level of quality while outsourcing parts of the production. ICT contribute to the asymmetry of power in the network because they impose pressure on quality through the imposition of processing standards and methods as well as quality control.

Reorganisation of networks encompasses various transformations within the same existing network. In all cases, the reorganisation leads to an increase in the power of the CEN. Thus, the reorganisation may be described as a centralisation process. We identify just one case where ICT played no specific role in the centralisation of the network: the Norwegian *Fishing company* case, where AS Marine, a fish farm that was a previous partner in the network, is insourced to secure supply of white fish. Computers are present in the fish farm as they are used to register feeding and to operate the underwater cameras that supervise the net cages, but they played no role in the VCR. As a result, AS Marine's computer system is different to the systems used in other *Fishing company* farms. A co-ordination of computer systems could be planned in the near future. If implemented, these changes would clearly be driven by the VCR.

ICT play an active role in the other network reorganisation and they contribute to centralisation. Box 2.12 displays two examples: *City Life* in the public sector and *Green* in the textile industry. *City Life* Enterprise of the city manages 220,000 council flats for a big Austrian city. In fact, the city administration has created a three tier network where customer relations is outsourced to a subsidiary that subcontracts call centre activities to a private company. For the Austrian city administration, the creation of this three tiers network corresponds to a decentralisation of the customer service activity. However, as stated in the quote in Box 2.12, *City Life* enterprise of the city provides quality standards for all parts of the value chain and its central control has increased over time. The outsourcing of the telephone service pulled a standardisation of work processes in all components of the network and ICT-based tools and data processing systems made substantial contributions to this development. In the *City Life* case, it is also interesting to note that the middle component of the network, *City Life Customer Service Company* was able to remain quite independent because it owns the service number and the electronic knowledge base used by agents. This shows that business relations are always more or less two sided and even in a context of centralisation, some units can develop strategies to maintain some independence. We are here close to the configuration of mutual dependence that we will examine in Section 2.2.3.

Green is an Italian group in clothing industry. It has progressively trimmed down its central structure, with an increased reliance on outsourcing. Its central position in the network comes from owning a famous brand, not from imposing standards on the work process. As a result, *Green* has the power to set prices and delivery time. The threat to move job orders elsewhere is credible as *Green* is often the principal client of partners in the network. ICT also play a role of enabler in the VCR. As stated in the quote in Box 2.12,

the evolution of the network is facilitated by ICT. They are a vital support for networking, for integration of components that are not located in the same place, for the interactivity of machinery and equipment *etc.*

Box 2.12 Increased power of central unit

City Life Enterprise of the city provides the quality standards for all (subcontracting) parts of the value chain. It can therefore be seen as the most powerful element. But other units also have strategies to remain as independent as possible of their contract partners. *City Life Customer Service Company*, for example, has achieved a position where it is almost irreplaceable. The company owns the service number and the electronic knowledge base used by agents and it is totally independent of call centre providers. All terms and conditions in the contract with the city council are passed directly to the Consortium Multicall with its two call centres. Their contract contains an extensive service level agreement. Some examples of its contents are: 80 *per cent* of calls per week have to be answered within twenty seconds. Peaks that are announced 48 hours in advance must not cause any decline of the service level and the proportion of lost calls must not exceed 10 *per cent*. In addition, call centres have to provide extensive information, such as the call volume, the number of messages sent to the service centres, and they have to report frequently-asked questions.

Generally, the workflow of *City Life's* customer service can be described as very standardised, at call centres as well as at walk-in service centres. It was mainly the outsourcing of the telephone service that led to an increasing process of standardisation at service centres as well. ICT-based tools and data processing systems have also made substantial contributions to this development. Work at service centres is based on strict guidelines and is becoming increasingly standardised - in a way which is familiar from call centre work. All electronic 'tickets' have a 'traffic light' switching from green to red if a request is not processed within 24 hours. (Schönauer, 2007: 3,9)

It is all too clear that *Green*, not unlike other industrial establishments, is gradually adopting the organisational paradigm typical of the network enterprise, with the progressive trimming down of central structures and an increasing reliance on outsourcing as various value chain phases and functions are externalised, heralding the passage from a vertical to a horizontal integration. This process of change may even be further enhanced over the next years. The following comment is made by the HR Manager: 'It is necessary to trim down a structure that is increasingly becoming heavy, redundant even; we must therefore get used to the idea that we will be outsourcing an ever larger number of corporate functions.' This transformation is facilitated by the advent of new information and communication technology (ICT) on which *Green* is investing heavily. New technologies are a vital support for networking, for the integration of components that are not located in the same place, for the interactivity of machinery and equipment, *etc.*

The relations between *Green* and the companies that make up its network is characterised by a strong asymmetry of power, by an accentuated imbalance of the contractual power among the parties concerned. But this is a power relation scenario that is also a feature in other Italian industrial realities. Regardless of the actual size of the firms, the brand name owner - therefore, a company that has an recognised position of strength in the market - tends to exercise a control/domination over the suppliers. This situation, for example, is evident in the relationship between *Green* and *New Wear*. Not unlike many other subcontractors, *New Wear* is substantially in a position of dependence *vis-à-vis Green*, being the latter its principal client, providing a lot of months of work per year and most of its turnover. Thus, even if it works for other clients, *New Wear* has gained a specialisation in *Green* products. The asymmetry of power has lead *New Wear*, as well as other subcontractors, to accept the conditions (prices, delivery times, *etc.*) that *Green*

sets. It should be observed that *Green* often exercises its power by threatening to move the job order elsewhere.
(Pedaci, 2007c: 4 & 5)

Network restructuring is a stronger level of reorganisation in the network. Box 2.13 below gives two examples in the food industry: *Meat Inc.* and *Beer AD*. In the first case, technology plays no role in the VCR, while it is central in the second one. *Meat Inc.* is a group owned by the Danish pig farmers. Relationships in the network are based on financial links. The group has carried out a major restructuring in order to cut costs. Small slaughterhouses have been closed down and production has been centralised in a large new pig slaughterhouse in central Denmark where the process has been modernised through automation and changes in workflow organisation leading to Taylorisation of production work. Centralisation of production in middle Denmark instead of having many smaller slaughterhouses distributed all over the country has been made possible by the reduction of transportation costs. The new plant is able to take in pigs from all over the country without exceeding the eight hour maximum transportation time. Tasks have been specialised, separating slaughtering, cutting and deboning from meat processing and redistributing meat processing to local and foreign subsidiaries. This case involves automation, but this technology had no direct influence on the restructuring of value chain and ICT are not mentioned. However, *Meat Inc.* is a clear case of centralisation of production.

Beer AD is the Bulgarian subsidiary of a Benelux brewing group that has implemented a *Global Plan* to improve co-ordination among its network of subsidiaries over the world. Headquarters have been transferred from one centre in Leuven to different geographic zones and the IT function has been outsourced. At the local level, in Bulgaria, *Beer AD* is also increasingly relying on outsourcing. Overall, there is a feeling of loss of discretion power in *Beer AD*. Technologies are central in the *Global Plan*. The implementation of ICT tools are described (Box 2.13) as having strongly impacted the level of management with two innovations: an on-line programme where to register different levels of work and to ensure the access of managers to each brewery and the replacement of direct communication among the managers by virtual communication via *emails* and on-line conferences. It is also mentioned that the Bulgarian management had some freedom for deciding on specific and local peculiarities and that in many situations the workers experiment a lack of management or an ambiguity in the allocation of decision rights. In fact, this description can be interpreted in the frame of the model by Antràs *et al.* (2008) presented in Section 2.2.1. The Benelux brewing group could have decided to substitute ICT for middle management because of skill shortages in Bulgaria and of better availability and decreasing cost of advanced technology.

Box 2.13 Network restructuring

Although the *Meat Inc. Group* consists of many smaller companies distributed all over the world, it is still the parent company, owned by the Danish pig farmers that function as the strongest actor. The subsidiaries are run as independent companies, but the parent company has 100 *per cent* ownership share in five out of the eight companies. In two of the remaining subsidiaries, the parent company has well over 60 *per cent* ownership share, and one is a joint venture with a Fin-

nish company. The majority of the subsidiaries are thus obliged to deliver part of their return back to the parent company, so that part of the profit generated by the subsidiaries return to the pig farmers.

The restructuring in *Meat Inc.* has three characteristics: (1) a centralisation process, closing down smaller slaughterhouses and building a large facility in central Denmark; (2) automation and changes in the organisation of the production; (3) a specialisation of tasks, separating the slaughtering activities from meat processing and redistributing meat processing to subsidiaries working outside national borders.

(Gorm Hansen, 2007: 5 & 18)

After the privatisation, the organisation of the production activities has been relocated and concentrated into two breweries - in PLV and HAS. [...]. The restructuring waves were also accompanied with outsourcing processes. On the level of the group's value chain the IT function has been outsourced to Serbia and Czech Republic. Another reorganisation on the level of the group's value chain is the transfer of the HQ [Head Quarter] management from one centre to different geographical zones. On country level the PLV brewery has also outsourced the promotion (advertising) activities, as well as the maintenance of the grass plots at its territory. According to the Plant Manager there is a trend for further outsourcing of activities and 'most probably the only function that will remain in *Beer AD* will be the production'.

As consequent outcomes of these restructuring processes a certain amount of resistance and uncertainty appeared both on higher and the middle levels of management in *Beer AD*. For example, on the question if the decision making is coming directly from the HQ in Leuven or from the Zone in Moscow, the HR manager of *Beer AD* was not able to answer with confidence. However, she also admitted that although 'the freedom' for decision making has decreased for the last couple of years, there is still some free space for autonomy of the local management, but only concerning 'some specific and local (Bulgarian) peculiarities' as well as for some of 'the group's strategic projects that need to be first adapted and then implemented'

In relation to innovation, an important change that strongly impacted the level of management is the implementation of ICT tools. There are two important ICT innovations. The first one is the implementation of a special on-line programme where to register different levels of work and to ensure the access of managers to each brewery, part of the group's value chain. Besides, most of the new equipment in the production is set in motion and control by computers. Secondly, the direct communication among the managers (those in different *Beer AD* breweries, in the Head Office in Sofia, the Zone and the Central HQ) was partly replaced by virtual one via emails and on-line conferences. However, if the high management level evaluates this change as decreasing company's expenses prevails, on the middle and the blue-collars level it is accepted rather negatively: 'Now there is too much technologies in the communication and the direct relation with the people is missing ... sometimes it is better for the staff to be personally stimulates, congratulated, etc. and not via emails'.

(Stoeva, 2007: 4, 5 & 11)

Many VCR cases lead to increased centralisation. ICT do not always play a role in these changes of organisational structure, especially in southern countries (*Comp. B, Greek post*) and in the food industry (*Fishing company, Meat Inc.*). However, in many instances, ICT are very influential. They are a driving force when they are in the core of business activity (*City Council, Deutch Telecom*) or they enable centralisation through two major mechanisms: standardisation of the work process (*Natural Delicacy, City Life*) or tool for co-ordination (*Green, Beer AD*).

2.3.3 Mutual dependence

In the service sector, a small amount of cases cannot be interpreted in terms of centralisation or decentralisation. Decision rights and information seem to be evenly distributed across the units involved in the network. We group them under the heading 'mutual dependence'. Three cases are in this configuration: *Customer* (UK), *MM Spinoff* (Germany) and *GBA and Easttown* (the Netherlands). Interestingly, each case involve public and private organisation, they correspond to network creation and ICT are central in the service provided. In the previous section, we have noted that the *City Life* case some ingredients of a mutual dependence configuration in one of the relationships in the network.

Customer and *MM Spinoff* are public private partnerships: a new private structure is created from the joint investment of a public organisation and a private organisation. *Customer* is a joint venture involving a multinational IT service provider and consultancy that supplies customer service activities for two local governments in the UK, while *MM Spinoff* is the spin-off of a large multinational supplying IT eLearning solution to the interior ministry of the state of Baden-Wurttemberg. The balance in the relationships is rooted in the form of the relationship itself, and in the fact that both partners are powerful organisations investing in the long term. The private service providers involved enter a new market with future prospects as the solution they develop could be extended to other units of the public administration. Private and public partners also have their own field of expertise that protects them from an asymmetric relationship.

Their role of expertise and knowledge in the VCR is very well-documented in the *GBA and Easttown* case because it is problematic. *GBA* provides to *Easttown* municipal government an IT system in which citizens' personal records are administered and stored. The integrity of the data is a central concern for the two partners. The data is not owned by *GBA*, but by the administration and confidentiality must be secured. Moreover, outsourcing has generated a shift of knowledge on technical and legal-substantial issue from the local government to the private partner, implying some further co-ordination needs. This knowledge was a constitutive part of the field of expertise of the public partner. Both the confidentiality and the expertise issues generate a structure of quasi-monopoly for *GBA*, increasing its power in the relationship. Being aware of it, *Easttown* is participating into a network of municipalities (*Digital Impact*) that co-operate to devise solutions reducing the dependence on ICT providers.

Box 2.14 Mutual dependence

The focus of this case study is the public access/customer service function within a joint-venture company nicknamed *Customer*. *Customer* is a partnership between two local government councils (nicknamed *County Council* & *Mid District*) and 'Global' a British, multinational private sector IT service provider and consultancy.

The vision behind the setting up of *Customer* was to create a concept for customer service and customer access that provides a single effective point of contact for the public. Another aim was to build a universal model that would be applicable to a wide region involving smaller, regional district councils, like *Mid District* in a partnership with the *County Council* and a private partner with relevant expertise to modernise out of date services (HR, IT, Payroll) and support business change ideas. Of the seven district councils in this region, only one, *Mid District* has joined the partnership.

The councils can terminate the partnership at any time for convenience, but if they terminate for convenience they have to pay for all the original investment that Global has made, and any loss of profit. There are clauses for default whereby if Global is negligent or in default, then the councils can step in take over. However interviewees all emphasised that *Customer* is run on a partnership principle in which each partner has a high stake/investment. As the biggest share holder, Global has the highest risk, with the obligation to deliver the investment stipulated in the contract, as well as the responsibility to make the forecast saving.

(Dahlmann, 2007c)

The original project started as a so-called public-private partnership (PPP) in which 50 *per cent* of the budget came from the public sector, 50 *per cent* from the private company (holding). [...] Each partner brings finances, manpower, and know-how into the project, but the private company owns the software and the overall solution. The state gets the complete cost-free user rights for the system and its further development, not only for the original police project, but for all eleven ministries if they want. The private company gets to market, sell and develop the IT solution package to any other state or public administration.

(Meil, 2007b: 8)

Easttown municipal government has outsourced the development and support of the digitisation of the personal records front-office to IT provider *GBA*. *GBA* provides an IT systems in which citizens' personal records are administered and stored. This digitisation has consequences for both the administrative tasks and the co-ordination of the relation between the municipal government and the IT provider.

The result of the discussed changes is a shift in the overall division of knowledge. Knowledge on the technical as well as the legal-substantial issues shifts from local government to the IT provider. That supports an increased dependency of municipal governments upon IT providers and an increased tendency to outsource IT system development and support work to IT providers. As a result, inter-organisational resource dependency relations are to some extent reinforced. This leads to shifts that are important in relation to issues of democratic legitimation.

The ownership structure of externally provided municipal database systems is difficult, because the data that are to be processed are under public ownership and legitimation, while the database system is privately owned. An important prerequisite for the considered database system is the integrity of the public data and the fit between system and public records processes. As a result, the relation between the private provider and the public purchaser of the system contains mutual commitments: while the private provider is to service and maintain the system, the public purchaser is expected not to use the system in such a way that data integrity is compromised. As a result, the linkage between both parties is relatively close and the 'asset specificity' of the outsourced service is relatively high. The associated transaction costs are exemplified by the considerable investments both parties need to make in order to facilitate the outsourcing process.

(Bannick, Hoogenboom & Trommel, 2007: 7, 25)

2.3.4 Decentralisation

By itself, outsourcing is a decentralisation process. When an organisation decides to buy rather than make, it loses its decision rights about how the activity is being carried out. However, cases reviewed in Section 2.3.2 entail in general both outsourcing and centralisation. In fact ICT open new possibilities for gaining power through standardisation. We

are going to review now a small sub-group of the WORKS organisational cases that can be interpreted in terms of network decentralisation. Decentralisation takes three different form: the creation of new autonomous units or the preservation of the autonomy of units (six cases), the outsourcing of non core functions (two cases) and co-ordinated decentralisation (four cases). The last two forms of decentralisation have only been observed in the service sector while the first one is more mixed in terms of sector.

The *creation of new autonomous units* is a feature of VCR in the public sector. *EWA* is a new unit created in Walloon region administration to provide solutions for eGovernment and administrative simplification (Box 2.15). It results from the merger of three existing cells dedicated respectively to 'on-line services', 'simplification' and 'readability'. This new unit has been put outside organisational chart and its mission is transversal: it provides services to the whole administration. *EWA* has no formal power on the various DGs within the administration or on other public bodies, it can only influence their initiatives and decisions. It has the function of innovator in the 'value chain' of public administrative services. The Police Contact Centres in the Stockholm region have the same characteristics. They have their own budget, negotiated on a yearly budget and they provide their services to police department for the whole region, and sometimes they take overflowing traffic from other region. The organisational structure of the Police Contact Centres in Sweden is under discussion and two different solutions are being discussed: either centralising crime reporting in three to five big units covering the whole country, or opt for a decentralised structure based on technology like in the case of the Stockholm regions where three call centres have been created, two of them being located on islands of the archipelago. In Stockholm, this solution has been preferred because it was a way of creating new jobs in remote areas. In this case, ICT leaves the two possibilities of centralisation and decentralisation opened. The final choice between these two options is made on the basis of a political preference.

In the clothing industry, *Eco Clothing* is a company that succeeded to preserve its autonomy after being bought over by a shareholder-valued enterprise. Autonomy was preserved because the management refused to adopt a technology-based repository, proposed by the mother company. This repository was refused because it would have standardised too much the work profiles and other ICT tools were adopted to equip the logistic function. One of the reasons for which the mother company accepted this refusal is that its product management has high ecological and social standards. As a result, contractual relations are thought of in terms of trust, co-operation and knowledge transfers are respectful of the discretion power of management on the work process. The *Adele* case in France could also be mentioned. It has been classified with network restructuring involving centralisation because the distribution network of the company has become centralised. But production has been outsourced to Asia and Eastern countries. As contractors are highly-demanded when they deliver on time high quality products, they are powerful and are able to impose some of their conditions. Thus, in *Adele's* case, distribution has been centralised and production decentralised.

Box 2.15 Autonomous units

[...] the creation of *EWA* as a merger of former separate units [...] is the result of the convergence of two approaches of the modernisation of service provision to citizens.

The first approach focuses on the ICT potential for restructuring public administration: process re-engineering; administrative simplification; back-office restructuring [...].

The second approach focuses on citizens' needs and expectations towards their administration, and the ICT potential for improving the functioning of democratic institutions. [...]

Both approaches are obviously complementary, but they were carried out by different actors and did not follow the same agenda. The merger of the cells 'on-line services' and 'administrative simplification', in early 2005, is a way to achieve this complementarity.

Indeed, the EWA commissionership does not start from scratch. The on-line services cell already benefited from a good visibility and a strong reputation, after having successfully designed and implemented the new 'Walloon portal' in 2004 and carried out an impressive series of awareness events about on-line public services. However, it could not go ahead anymore without restructuring the back-office of the regional administration. At the opposite, the visibility of the simplification cell was rather negative; it was perceived as an opaque restructuring of administrative processes. A third cell of only two persons, named 'readability' (rewriting and redesigning all the administrative forms in order to make them more readable), was added in the merger.

The purpose was triple: to combine front-office and back-office restructuring; to foster administrative simplification through its association with the positive image of on-line services; to gather the skills and experiences of the three cells in a single team.

The new structure EWA was put outside any organisational chart, under the direct political responsibility of the Minister-President and with a transversal mission: to offer its competences and services to the whole regional administration.

(Devos & Valenduc, 2007: 9)

From the beginning the [Police] contact centres were organised as a part of a development project, with the project leader taking care also of operational management. The three centres, situated in three different islands in the Stockholm Archipelago, were built and staffed gradually over a period of two years. [...] After two years the contact centres were expanded. This was connected to an overall national strategy on building up contact centres in all regions in Sweden. This was partly done through similar organisational solutions as in Stockholm with specific centres but also through decentralised solutions using the established police precincts. Smaller regions could co-operate building joint contact centres.'

The contact centres forms a unit in the Roslagen police district (Norrtälje as HQ) and is a solid part of the organisation with a budget negotiated on a yearly basis. In this they have responsibility for the whole region, and also taking overflowing traffic from other regions.

Through the use of IT and the contact centre organisational solution the Police has straightened up the processes of crime reporting and in this also improved their service levels towards the public. If this has been an efficient solution in terms of resources saved in other parts of the organisation, freed time of trained policemen has not been calculated and is yet to be seen.

The restructuring is still an internal reorganisation of the value chain - focusing on the contacts with the citizens and in this in one way rationalising the organisation from the customer perspective in combination with the technological possibilities. [...] But at the same time parts of the Police organisation has used the technology in the framework of the existing organisation making it a decentralised contact centre. You could say that at present the police nationwide stands at the crossroads choosing between a highly-centralised structure - three to five centres all over the country - and a more decentralised based on technology rather than organisational solutions.

(Tengblad, 2007: 3, 4, 12)

The *Eco Clothing* as a family owned company became an affiliated company of a huge shareholder valued enterprise. [...] As a core activity the logistics department has been modernised

according to the logistics department of the mother company. With new information technologies, a new documentation system as well as a modified involvement of the employees and workers the department of logistics was reorganised in terms of effectiveness and a better outcome. The productivity rate per person was nearly doubled in the following five years.

The contractual relations as well as the power relation between the companies of the value chains remained stable after the restructuring process. Because of the high ecological and social standards of the product management of the company, the contractual relations in terms of long-term relationship, trust, systems of payment, co-operation and knowledge transfer are based on contracts between the partners. Furthermore the ongoing development of new textiles and new materials does not allow - according to the statements of the product manager - to beat down the prices constantly. In contrast the technological development of new materials, the complex design of the fashion *etc.* focused very much on stable, co-operative and creative relationships between the company and the customers.

Internally the workflow was revised with the support and expertise of the mother's company. Computer systems and the documentation system of the mother's company were widely adopted in the company. According to all interview partners this change was considered as an improvement for the workflow. This was not the case for a technology-based repository, which also was proposed by the mother company. This repository would have changed the working places into simple and standardised work profiles, which was clearly declined not only by the workers but also by the head of department and the management of the department. (Krings, Bechmann & Nierling, 2007b: 3, 4)

The *outsourcing of non core functions* is another situation that can be interpreted in terms of decentralisation. When the function is not core, the outsourcing company is not always willing to ensure control over it. This is observed in two cases from the services of general interest: *IT Health* in Norway and IT business provider in Sweden, where decentralisation is supported by ICT. In the *IT Health* case, the IT function of 16 health enterprises has been outsourced to the same IT provider (see Box 2.6). So in this case, the IT function has been centralised in one unique organisation when before it was decentralised in the IT departments of these health enterprises. However, IT is not felt as core in these enterprises and the IT service provider is in a position to maintain its autonomy. Thus, for each separate health enterprise, IT has been decentralised, but for the network of health enterprises, it has been centralised. In the IT business case, the *Swedish post* outsources its wage administration to an IT business provider. The basic motives for building up the relationship were from both parts strategic. The *Swedish post* wanted to outsource non-core activities to gain flexibility in the long run. The provider was motivated by the fact that it was their first contract in this area and he had both to take care of the operations and to implement a new IT system.

Co-ordinated decentralisation is another type of decentralisation, frequently encountered in the IT sector where R&D or programming work is organised in project teams. Box 2.16 gives quotes from three case studies, two in R&D and design (*Comtel* and *UK Lab*) and one in the IT production function (*Messenger/Digit*). In the three cases, the networks of companies are groups. As a result R&D or software development units within each network are related to a same holding company: *Comtel*, *Japtech* and *Commun*. The first group is French when the two others are international. Group structures can be seen as more centralised than business partnerships. But the organisation in project teams is decentralised: teams are created following a knowledge driven logic of projects and they tend to com-

pete with each others within the network. Teams are also virtual as work is geographically distributed across local French sites in *Comtel* and across countries in *UK Lab* (Japan, UK and China) and *Messenger/Digit* (Austria and Croatia). In the three cases, work organisation has evolved, changing the nature of the co-ordination mechanism in a decentralised frame. In the *Comtel* case, a matrix organisation involving the R&D, information systems and marketing division is added on each project team structure. This new management decision structure aims at reducing time to market: decisions in R&D, information systems and marketing have to be jointly rather than sequentially taken. In the *UK Lab* case, Japtech creates new R&D centres in UK and China and redistributes roles across them: at first basic research was transferred from Japan to UK and China, with Japan taking care of global R&D strategy, and this was reorganised in a second stage so that each site would do both an element of pure research and product development. In the *Messenger/Digit* case, *Digit* becomes part of the global software development team, under the supervision of *Messenger*, when it was before specialised in data entry.

Email, telephone or video conference, skype chats are important tools to carry out geographically distributed work. Quotes in Box 2.6 mention it for *Comtel*, *UK Lab* cases and *Messenger/Digit*. However, in the three cases, the limits of ICT for communication in virtual teams are underlined. At some stages in the project, nothing replaces physical proximity. The *Messenger/Digit* case gives a detailed description of the communication difficulties encountered: for example, it is not always possible in software development work to formalise the project work. Formalisation relies on the availability of a good documentation on the product. In case of further development, the documentation on the previous steps of product development is not always of high quality. Face to face meetings would make it easier to handle the problems connected with the a lack of formalisation and improvement in the technology itself would also help. It could lead to centralisation if it contributes to standardising in a systematic way the work process.

Box 2.16 Co-ordinated decentralisation

Since 2005, the company launched a new strategy and objectives for three years to accelerate the efficiency and commercialisation of integrated services (mobile, internet, fixed-line in a unique network). Some convergent products have already been commercialised. The 2006 reorganisation is a response to put in practice these objectives as an integrated operator. The new organisation represents a change in internal contractual relationships. In the previous mechanism, the *R&D Centre* had to sign a 'fictive' contract with a business unit in order to finance its activities on research projects. The researchers had to satisfy a demand, or find common interests with a business unit. It was a customer/supplier relationship between the R&D and Marketing divisions. The new organisation instead introduces a matrix relationship through a corporate marketing. The idea is to be more in a time-to-market model, that is to say: reduce the time necessary to go through the steps of the value chain between research, innovation and commercialisation. To do so, a new management solution is being introduced. The process decision won't be done anymore in a successive chain involving R&D, the information systems division (the one which tests the products before their commercialisation) and marketing services. The new organisation seeks the concomitance in the decision process. For each programme or project at all levels of decision, one responsible for each division (R&D, information systems and marketing) is in charge of the management and this head composed by three persons has to be in regular and physical contact to discuss and take decisions together at the same time, in the same

place: it means geographical proximity. Here, the demand for new technology products implies a new organisation.

(Muchnik, 2007a: 11)

Prior to 2001, Japtech's speech technology research and development was carried out entirely in Japan. It formed part of their corporate level research and development portfolio and was undertaken in the *Japan Lab* at the *Japtech Corporate R&D Centre* in Kawasaki. In 2001 a process of global decentralisation and expansion began with the establishment of speech technology research and development groups in the UK and later in 2003 in China. [...] As part of the expansion and decentralisation, each site was given specific roles: *UK Lab* was established to carry out longer term 'basic research', and to develop products (software) and market in speech technology for European and American languages; *China Lab* to develop products (software) and market for Chinese languages; and *Japan Lab* proposed to work on developing the outcomes of group-wide R&D into products and on the transfer of products to the business unit based in Japan. In 2006 there was further reorganisation and redistribution of work between the three sites, which seemed to be driven by the Japanese researchers being dissatisfied that they were no longer able to do basic research, which affected staff morale and motivation. The work was reorganised so that each site would do both an element of pure research and product development. Virtual and global teamworking has also been introduced as part of this process. Work is governed by formal structures of the company's Roadmap Committee and Global R&D Committee. (Gosper, 2007: 5)

Work is basically organised in projects. For each product development task decided on by product management a team is formed that is headed by a project manager. The project managers report to the head of product development. The main change of the work organisation consists in the geographically distributed work that came about through restructuring: Part of the projects' work is now relocated to Croatia. The basic organisation for this is the following: There is a project team and a project manager in Austria and a dedicated team with a team leader in Croatia. The project manager passes on programming or testing tasks to the team leader at *Digit*; the team leader distributes the work among his team members. Once the tasks are accomplished the team leader sends the results to the project manager for acceptance. [...]

While in one project the work orders are highly-formalised (the team leader at *Digit* receives a form with all necessary information), in another project the description of tasks for the *Digit* team take a multiplicity of forms ranging from brief verbal information to extensive written communication. Rather often, information is not sufficient or not clear enough so that misunderstandings occur and further clarification is needed. What is more, while this team leader in Croatia, in principle, gets the work orders from the project leader in Austria who in general is in charge of customer contact, sometimes the team leader at *Digit* has direct contact with internal or external 'clients'. This seems to depend on the availability of the project leader. Thus the team leader may lose the direct client contact again which means a loss of competence and a loss of first hand information. [...] 'Chatting' via Skype is the most important communication tool. The big advantage of (written) 'chat' is that it is even more informal than writing emails. Questions can be asked very spontaneously and the programme also offers the possibility to archive longer sequences of chat easily and to use them again later. This possibility, which seems to be very helpful to reconstruct the process of a project, however is not used in all projects extensively. [...] Telephone conferences with fewer people are held about once a week, but they have a very general management function. Specific things concerning the projects are not topic of these conferences, they have to be solved within the projects.

In the project with less formalisation and more co-operation problems programmers at *Digit* do not always know what they have to do. This is not only due to organisational or communication problems. Already the information the project manager at *Messenger's* development

department gets from product management doesn't seem to be sufficient: 'It is not clear how it should look in the end'. One of the reasons is that the product they are dealing with is rather old and badly documented. Under such conditions, organisational weaknesses make themselves felt more strongly with geographically distributed work.

In this case distributed working is not very well-supported by technology. On-line connections between *Digit* and *Messenger* (and the entire company) are somewhat fragile. One of the reasons is *Digit's* IT infrastructure. Firewalls are very sensitive. The connection between *Messenger* and *Digit* is not fast enough to use all possibilities their IT system offers. For example VPN (Virtual Private Network) makes it possible to access *Messenger's* databases and files directly from Croatia, but this doesn't fully work yet. One reason for this is that the whole IT was restructured at corporate level and that there is still much open as to how it is going to be organised. This is why shared servers, files, workspaces and the system for version management cannot be fully used for distributed work.

(Flecker & Schönauer, 2007: 10, 12)

2.4 Conclusion

A first an important finding in Chapter 2 is that VCR observed in the WORKS case study involve most of the time some ICT. Only four cases out of the 45 cases mentioning a clear evolution in relationships between organisations, do not stress any specific role for ICT in co-ordination: *Comp. B* in Greece, *Fishing company* in Norway, *Meat Inc.* in Denmark and *Tevitom* in Portugal. Table 2.2 gives the list of ICT and it is interesting to note that most of them belong to the latest vintage of ICT that started its diffusion by the mid-1990s.

A second important finding in Chapter 2 is that networks evolve in many different directions in the context of VCR as described in Table 2.4. However, increasingly asymmetric power relationships seem to be the more frequent outcome of the VCR: 29 cases out 57, described in Table 2.5 show ongoing centralisation. As many cases entail some outsourcing, this result is not obvious: when a firm contracts out a process or a module of its production, it implies a loss of control on the activity that could be interpreted as a decentralisation. In fact ICT often enable outsourcing by contributing to the quasi-integration of the new business partner and in particular when there is no existing financial link. Control over the activity of the business partner is obtained through standards applied to services, quality, routine tasks or work process. The unit that generates standards, embedded in ICT, often the central component of the network, reinforces its dominant position. This is why standardisation generally comes before and enables outsourcing.

3 How do technological changes relate to work organisation?

3.1 Introduction

Several theoretical models (see Greenan, 2003, for a synthesis) about recent technological changes in the economic and sociological literature underline its relation with trends towards multitasking, autonomy increased interdependencies between workers or development of horizontal communication (*i.e.* move from Taylorist system to post-Taylorist). Empirical papers based on quantitative data collected during the nineties showed that employees using new technologies are more versatile and/or multiskilled, that they are more dependent on colleagues in their work and that their work turns out to be more intense (Greenan & Walkowiak, 2005).

In the economics literature, the relation between technology and organisation is generally assessed at the firm level, since the firm would co-ordinate choices in technology and organisational practices in the context of its general strategy. However, this may not be always the case as some organisations are constrained in their choices by their suppliers, clients or by regulations.

Looking at the joint diffusion of ICT and new practices of organisation, the literature shows that new practices favour the development of more horizontal work logic (mutual adjustment), where decision taking is decentralised, where employees are more autonomous, work under high time pressure, and where collective dynamics are encouraged (Greenan & Walkowiak, 2005). Some of these changes in work are highlighted in Ramioul and Huys (2007: 12) survey of studies on organisational change: 'In short, there is no lack of incentives for organisations to change their work organisation, from what is described in general terms as a "traditional work organisation" to "new work of work organisation". This implies a shift from fragmented and standardised jobs to more autonomous group work and a shift from bureaucratic personnel management to an emphasis on involvement of employees through strengthening of the internal labour market.'

At the same time, the work complexity paradox mentioned in the general introduction calls these results into questions. Most of them have been obtained on a time period covering the 1980s and the 1990s. New waves of ICT and in particular those that have started their diffusion in the internet era as well as the growing importance of value chain restructuring (VCR) in the globalisation context could bring to the fore some new orientations in the shaping of work organisations. Moreover, results obtained on the 1980s and the 1990s (Autor *et al.*, 2003; Spitz-Oener, 2006; Goos & Manning, 2007) identify a rising polarisation of jobs in developed countries.

In this second section, we assess technological change at the job level with the work complexity paradox in mind. How does the introduction of new technologies in the recent

years affects the work system? Do the new technologies lead to enrichment of job or on the contrary to more repetitive work? What is going on in terms of supervision and control? How do workers react individually and collectively to the introduction of new technologies? To answer these questions, we rely on a secondary analysis of the 2005 edition of the EWCS, on the synthesis of organisational surveys of Ramioul and Huys (2007) within WORKS project, and on a review of organisational case studies. We also try to identify the scope of decision of management as far as technology and organisation are concerned, the existence or not of employee participation and its outcomes.

3.2 The link between technologies and work organisation: a quantitative evidence

Here, we adopt the synthetic indicators constructed by Greenan *et al.* (2007) with data from the 2005 wave of the EWCS in the quantitative pillar. We presents short summary of their results to introduce our quantitative section. EWCS measures the use of technology with several questions about the share of employees: using computer; using internet; being exposed to vibrations of machinery; and having a pace of work dependant on the automatic speed of a machine. As concerns work organisation, EWCS includes several dimensions like work complexity, independence in time allocation, industrial constraints and market constraints.⁴

3.2.1 Work organisation across Europe: main results from the WORKS quantitative pillar

The ESWC proposes a large set of variables to describe the work system. Greenan *et al.* (2007) have summarised them into a smaller number of synthetic variables taking into account the core relationships between primary indicators. A first and central dimension of the work system is the degree of work complexity. On one side, workstations involve complex tasks, discretion on how the work is carried out and learning opportunities. On the opposite side, employees declare routine job with simple tasks, no discretion and limited learning. The fact that complexity, discretion and learning goes hand in hand with each other supports the idea of the existence of a learning model of organisation. This interaction has already been identified in work based on employee survey at a national level and connected with economic performance issues at the employer level (Greenan & Guellec, 1998). However, in Greenan *et al.* (2007), complexity, discretion and learning make up a dimension of their own, weakly connected with other features of work organisation like quality standards, task monotony, job rotation, or support from colleagues. This result echoes findings of Lorenz and Valeyre (2005) based on the previous wave of the EWCS, where teams, job rotation and quality norms can be organised in different models offering different learning opportunities for employees.

Greenan *et al.* (2007) also identify a second important dimension in the work system opposing workers who are independent in their time allocation from those that are not because they work in teams or collectively. Discretion in time allocation means that work-

⁴ See Greenan *et al.* (2007) for more information about these indicators.

ers can choose or change their order of tasks and take their breaks, holidays or days off when they wish. This kind of discretion goes with some organisational features of work: there is no interdependency between tasks neither through quality norms nor through job rotation and workers are not able to get assistance from colleagues. At the opposite workers who are not free in their time allocation follow quality norms, rotate between jobs and get support from their colleagues. If we refer to the economic literature, we can note that in terms of the agency theory (Holmström & Milgrom, 1991), control over time allocation is central in the definition of autonomy. An autonomous agent will be able to attend to his or her personal business without being penalised. In this case, the employer should propose a contract where workers are financially responsible for their performance. Overall, as underlined by Chenu (2002), autonomy in working time depends on collective characteristics of sectors and occupations. As argued by Lindbeck and Snower (1996), interdependencies between workers generated by work co-ordination are a source of informational complementarity. Therefore, the workers who are constrained in their time allocation might share some information with their co-workers and have more leaning opportunities than those who remain peripheral in the communication networks generated by co-ordination needs.

Greenan *et al.* (2007: 19, Figure 2.1) map the degree of complexity of jobs and the degree of independence in time allocation within Europe. Results confirm the idea that the level of development goes with complex work (Lundvall, 2005). It is in Scandinavian countries (Denmark and Sweden) that workers frequently perform complex tasks, but other countries also offer high learning opportunities and complex tasks. Indeed, according to the average of the first synthetic indicator the Netherlands is ranked in the third position and Finland in fourth position. Surprisingly Malta is in the fifth position ahead of, for example, Austria and Luxembourg. In Lithuania and some other New Member States like Bulgaria and Romania routine jobs are more frequent. It is also the case in some Mediterranean countries (Spain, Cyprus, Portugal and Greece). Concerning the degree of independence in time allocation, neither the logic of geographical proximity nor economic performance helps explain the ranking of countries. For example, within Scandinavian countries Sweden has a high degree of independence in time allocation (third position), while Denmark has a very low. Italy, Romania, Belgium and France are the countries where the highest degree of independence in time allocation is observed. This independence is the smallest in Slovenia, followed by Denmark, Estonia, Germany and Bulgaria.⁵ This result shows the limit of this kind of quantitative data to understand the different dimension of work organisation.

Another important characteristic of work organisation lies in the way work is sequenced over time. Many authors mention increasing 'tension', 'strain', 'work effort' in recent decades in industrialised countries (Gollac & Volkoff, 1996; Green, 2004 & 2006; Green & McIntosh, 2001). This issue of work intensification is central to debates in industrial sociology and economics because of its importance as a determinant of work quality. Most studies suggest that a rising work effort has a detrimental effect on the work quality and the well-being of the work force. Boisard, Cartron, Gollac, Valeyre and Besançon (2003) show that excessive work intensity is a source of pain, annoyance and risk. Econometric analyses argue that, everything else being equal, work intensity is associated with

⁵ See Table 2.1 and Figure 2.2, in Greenan *et al.* (2007: 17-20).

physical and psychological pains and with occupational hazards (Askenazy, Caroli & Marcus, 2002; Boisard *et al.*, 2003). Finally, some people are able to afford high work intensity, but others cannot, so that high intensity is a cause of polarisation: some people experience a high level of well-being at work, while other people experience severe psychological pains (Baudelot *et al.*, 2003). In the long term, intensity may put the health of workers in danger, especially when they have little scope for taking initiative, limited cognitive and material means, and low social support (Karasek & Theorell, 1990). Work intensity not only deters health but also may lower capacity to interact and acquire the experience and skills required for coping with changes to come.

Despite its centrality in the determination of work quality, work intensity is not included as one of the social indicators that the European Union collects in its synthesis of work quality indicators (Green, 2006). A reason could be the problem of definition and measurement. Two types of intensity measures could be distinguished. Work effort could be measured through exposure to high working speeds or to tight deadlines (Green & McIntosh, 2001; Green, 2004). The weakness of this measure is the absence of information on the source of intensity. Another possibility is to use questions about factors on which pace of work depend (Amossé & Gollac, 2007; Boisard *et al.*, 2003). This kind of measure has the advantage of capturing the variety of constraints that influence the work rhythm: demands from colleagues, demands from customers, automatic speed of machines, numerical production targets, and direct control of a manager. The EWCS provides information on constraints that workers face when performing tasks, on their work rhythm, and also on the time they have to get the job done. Using information about the worker's exposure to high working speeds or to tight deadlines, we can measure the work intensity as reported by employees. The main advantage of self-report is that the workers themselves are likely to be best informed. However, the potential for biased reporting on contested features like work effort is clear. The replies to these questions clearly depend on what employees regard as 'high' speeds or 'rigid and short' deadlines. However, these are measurements of psychological comfort or suffering and, as such their subjective nature is not necessarily a defect (Boisard *et al.*, 2003).

Work intensity has two main components: the intensity of technical constraints and the intensity of market constraints. The intensity of technical constraints is driven by the automatic speed of machines or movement of products, by the existence of numerical production targets and by the dependence on the work done by colleagues. It also reflects the pyramidal organisation of work with the direct control of the supervisor putting pressure on the pace of work. The intensity of market constraints reflects the dependence on direct demands from people such as customers, passengers, pupils, patients, *etc.* in the pace of work as well as the absence of direct supervision and the lack of time to get the job done. High intensity of technical constraints and high intensity of market constraints are two different sources of work intensity as they are both positively correlated with working at a very high speed and to tight deadlines. Mapping these constraints across Europe, Greenan *et al.* (2007) show that the highest technical constraints are observed in Finland, Cyprus, Greece, Germany and Romania. On the opposite Ireland, Poland, Bulgaria, Latvia and Spain are the countries with the weakest technical constraints. This classification shows that industrial work organisation is still strong in developed countries and characterised by high speed and tight deadlines. The fact that the intensity of technical constraints is generally weak in transition countries could indicate a lack of industrial devel-

opment. Results are more as expected for the intensity of market constraints. The highest intensity of market constraints are observed in Scandinavian countries, in the Netherlands and in Germany. On the opposite, in Baltic countries (Latvia, Lithuania), as well as in Bulgaria, Hungary and Portugal these constraints are not prevalent.

It is by looking at trends over time in these indicators that Greenan *et al.* (2007) came across the complexity paradox: on average in the EU-15, there was a significant decrease in complexity of work between 1995 and 2005. In 2005, European workers are less able to choose or change the order of their tasks and their methods of work; their jobs involve less problem solving, complex tasks or learning opportunities. Jobs seem to entail less non-routine cognitive tasks in the last decade. Moreover, at the same time, work in the EU-15 has become more intense. Surprisingly, this intensification is mainly industrial *i.e.* linked to automatic speed of a machine or numerical production targets. In contrast, market constraints, *i.e.* those linked to direct demands of customers have decreased (especially during the last five years of analysed period, *i.e.* between 2000 and 2005). Besides, the independence in time allocation has increased significantly in the EU-15. What are the relations between these work organisation characteristics and trends and technology use?

3.2.2 Use of technology and work organisation: differences between manufacturing and services

Across European countries (EU-27), the degree of use of computers among employees is related to their industry. Using information from 2005 EWCS (see Table 3.1), we are able to show that the use of computer among employees is sharply higher in real estate and business activities and public administration than in manufacturing or transport and post (about 70 *per cent* against about 40 *per cent*). The noticeable result is: the share of employee using a computer is twice as high in real estate and business activities than in manufacturing (76 *per cent* and 37 *per cent*). As concerns the use of internet, the gap between industries is even higher: 69 *per cent* of employees in real estate and business activities are concerned by internet compared to solely 26 *per cent* in manufacturing. It is worth noting that the use of a computer does not imply systematically the use of internet: 45 *per cent* of employees use computer and only 36 *per cent* use the internet. This gap is the highest in public administration where 69 *per cent* of employees use computer but only 52 *per cent* use internet.

Table 3.1 Distribution of the use of technologies by sector (EU-27)

	Total	Manufac- turing	Transport, post	Real estate and business activities (ICT)	Public administra- tion
Using a computer	45.3	36.7	43.0	75.6	68.9
Using internet	35.9	26.4	35.8	68.7	52.2
Being exposed to vibrations of a machinery, hand tools, <i>etc.</i>	35.2	58.8	35.5	15.5	21.2
The pace of work is dependent on automatic speed of a machine	41.4	68.0	45.7	23.5	27.8

Source: EWCS (2005)

Table 3.1 also shows the share of employees working with automatic machines, which is measured by the exposition to vibrations of machinery⁶ and the pace of work dependent on automatic speed of a machine. The results are clearly related to the industry: the highest share of employees working with machines is in the manufacturing and the lowest share is in the real estate and business activities. About 40 *per cent* of employees across EU are concerned by the automatic speed of a machine. This share increases to 68 *per cent* in the manufacturing industry and falls to 24 *per cent* and 28 *per cent* in the real estate and business activities and public administration.

Since the nature of technologies is different across industries, as shown in Table 3.1, the consequence in work organisation should be different. Table 3.2 shows the partial correlations between technologies used by employees and the synthetic indicators of work organisation described in Section 3.1.1. These correlations are controlled by dummies on countries, industry, detailed occupations, gender and age.

We are in particular interested by the partial correlations between the degree of work complexity and ICT use. Table 3.2 (Column 1) shows that whatever the industry considered, the uses of a computer and of internet are positively correlated with work complexity. The results about the relation between the use of machines (being exposed to vibrations of a machinery, being dependant on automatic speed of a machine) and complexity are less clear and related to industry. The partial correlations are not significant in the real estate and business activities and in the transport and post activities but they are positive in public administration and both positive and negative in the manufacturing activities. Thus, the trend of decreased work complexity is not directly explained by the diffusion of computer and internet use. ICT diffusion is another trend that should favour an increased degree of job complexity. This preliminary analysis does not help us in clarifying the complexity paradox.

As concerns the relation between technologies and independence in time allocation, Table 3.2 shows clearly that whatever the industry considered, the use of automatic machines is negatively correlated with the independence in time allocation of work. The correlation between the use of ICT and independence in time allocation is not clear. It seems to be negative with the use of computer (not in the manufacturing) and positive with the use of internet (only significant in the manufacturing).

Finally, whatever the industry considered the use of ICT is positively correlated with the intensity of market constraints. The positive correlation between the use of ICT and the intensity in industrial constraint is robust in the real estate and business activities and in public sectors but weaker in manufacturing and non significant in the transport and post activities. The correlations between our proxies of machine use and intensity of constraints is positive and strong for industrial constraints and negative for market constraints. Thus the use of ICT is more related to the intensity of market constraints whereas the use of automatic machines is more related to the intensity of industrial constraints.

⁶ The variable 'Being exposed to vibrations of a machinery, hand tools, *etc.*' is not always a good indicators of working with an automatic machines but since we do not have other 'good' indicator we use it as a proxy.

Table 3.2 Partial correlations between technologies and work organisation (EU-27)

	Complexity	Independence in time alloca- tion	Industrial constraints	Market constraints
All sectors				
Using a computer	0.24***	-0.04***	0.08***	0.08***
Using internet	0.24***	0.03***	0.06***	0.08***
Being exposed to vibrations of a machin- ery, hand tools, <i>etc.</i>	0.05***	-0.14***	0.21***	-0.00
The pace of work depends on automatic speed of a machine	-0.03***	-0.19***	0.53***	-0.28***
Manufacturing				
Using a computer	0.22***	0.00	0.02	0.07***
Using internet	0.23***	0.04***	0.03**	0.09***
Being exposed to vibrations of a machin- ery, hand tools, <i>etc.</i>	0.03**	-0.22***	0.24***	-0.06***
The pace of work depends on automatic speed of a machine	-0.09***	-0.26***	0.65***	-0.34***
Transport, post				
Using a computer	0.27***	-0.07***	0.01	0.13***
Using internet	0.25***	-0.02	0.00	0.14***
Being exposed to vibrations of a machin- ery, hand tools, <i>etc.</i>	0.04	-0.19***	0.13***	-0.11***
The pace of work depends on automatic speed of a machine	-0.03	-0.27***	0.55***	-0.33***
Real estate and business activities (ICT)				
Using a computer	0.23***	-0.08***	0.08***	0.06**
Using internet	0.27***	-0.03	0.07***	0.10***
Being exposed to vibrations of a machin- ery, hand tools, <i>etc.</i>	-0.01	-0.15***	0.13***	-0.07***
The pace of work depends on automatic speed of a machine	-0.01	-0.22***	0.49***	-0.26***
Public administration				
Using a computer	0.26***	-0.06**	0.10***	0.06***
Using internet	0.24***	0.00	0.12***	0.03
Being exposed to vibrations of a machin- ery, hand tools, <i>etc.</i>	0.08***	-0.04*	0.18***	0.02
The pace of work depends on automatic speed of a machine	0.07***	-0.11***	0.45***	-0.23***

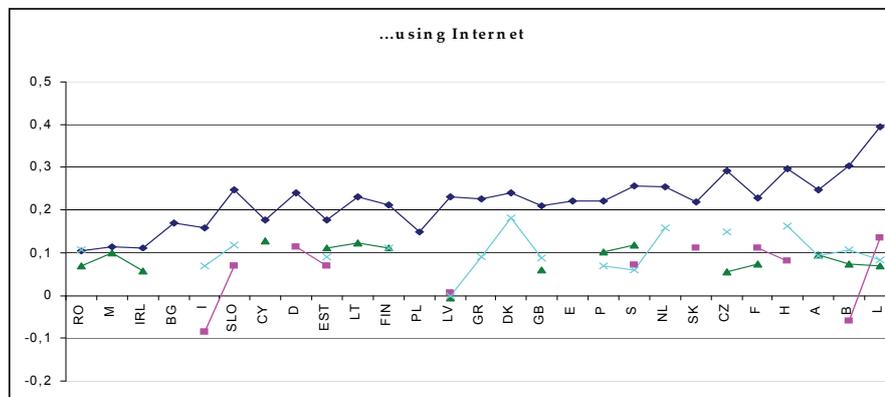
Note: correlations are controlled by dummies on countries, industry, detailed occupations, gender and age.
Source: Author calculations, EWCS (2005)

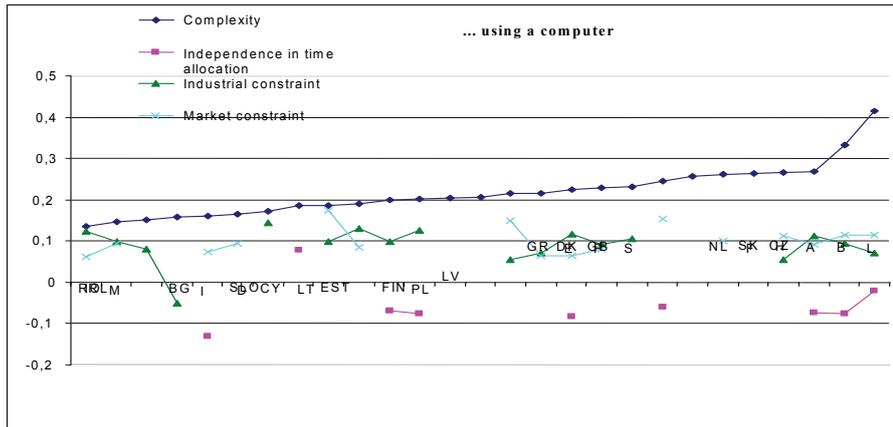
Figure 3.1 displays partial correlations (when there are significant at 10 per cent level) between technology use the four work organisation synthetic indicators across countries (EU-27). It confirms the results discuss above for industries. On the horizontal axis, we rank countries according to correlation coefficient between computer use and work complexity. Partial correlations between use of ICT (computer and internet) are always significant and positive, whatever the country considered. Romania and Malta are the countries where the correlation between ICT and work complexity is the weakest. On the opposite, these correlations are the highest in Luxembourg and Belgium.

In most countries (eighteen countries from the EU-27), using a computer is not correlated with independence in time allocation and the correlation is negative in eight countries. The strongest negative correlation is observed in Italy and Spain. The negative link between using a computer and independence in time allocation is similar in Poland, Belgium, Austria, Finland, and the Netherlands; it is weaker (in absolute term) in Luxembourg. However, one should notice that the correlation with internet is not significant for these countries (except for Belgium and Luxembourg). The only country where the correlation between independence in time allocation and using a computer is positive is Germany. As described in Table 3.2, independence in time allocation is more correlated with the use of a machine than with the use of ICT. Indeed, in all countries (except Cyprus) being exposed to vibration of a machine or hand tools and having the pace of work that depends on automatic speed of a machine is associated with less independence in time allocation. Collectives that generate interdependencies in work, or interdependencies in timework, are probably more frequent when workstations are equipped with automated machines. As concerns the relationships between technologies and constraints, Figure 3.1 shows clearly, for all countries, that the market constraints are positively associated to the use of ICT and negatively associated to the automatic speed of machine. The positive correlation between industrial constraints and technologies is higher for the use of machines than the use of ICT. This correlation is the strongest when the pace of work depends on automatic speed of a machine and it is higher in Hungary and the lowest in Sweden.

This quantitative section underlines that differences across sectors are more important than difference across countries when one analyse the relation between technology and work organisation. The next section examines qualitative evidence of this relation for services activities and manufacturing. We have not been able to uncover the complexity paradox using quantitative data on technology use. One possible reason is in the heterogeneity of technology. If there are some polarisation effects connected with technology use, we need to take into account the diversity of technology and of uses and their possible indirect effect on the work system. Qualitative evidence could help us going one step further.

Figure 3.1 Partial correlations between technologies and work organisation within each European country





3.3 Value chain restructuring technologies and work organisation: qualitative evidence

Case studies provide two main results on the relation between VCR technologies and the work organisation: standardisation of work process and in less extent increase of work control through electronic system. The next section reviews results from the service sector and the following one focuses on manufacturing.

3.3.1 Services

The literature about the role of ICT diffusion on services work organisation is very limited compared with the abundance of studies on manufacturing work organisation. Yeuk-Mui (2001) analyses the effects of the use of ICT on call centres, a particular frontline service work. He shows that the effective technology and the immediate supervisors are, among other, important factors that contribute to employee job satisfaction, stress and work capability. However, the effects of ICT on work organisation is not automatic, it depends on the management policy. Holman, Batt and Holtgrewe (2007) make an international comparison of work organisation in call centres. They underline two conclusions: (1) high rate of turnover (about 20 *per cent* per year) particularly in subcontractors (about 25 *per cent* per year); (2) high rate of low quality job, 12 *per cent* of agent work in high quality job compare to 67 *per cent* who work in low or very low quality of job. Job quality is also lower in subcontractors compare to in-house call centre.

Technologies described in occupational case studies in the services sectors and in the public sectors are mainly ICT-based. In these sectors, one of the important changes underlined in case studies is the customer-oriented organisation of services. Job contents in these activities shift from 'public services' to more 'commercial' oriented activities. This shift to customer orientation was in many case studies combined with a strong standardisation of task. Case studies underline how ICT play an important role in this move with standardisation of tasks and/or enabling direct contact between company and customers. ICT technologies affect the work organisation for front-office workers as well as for back-office workers.

3.3.1.1 *Customer orientation with standardisation of work process and increase of digital control*

Standardisation of tasks through ICT is an important objective for manager to reduce cost of production of services. This standardisation of work process has consequences for work organisation because it leads to strong codification of work process. Work organisation at call centre can be described as very standardised. The case study of *City Life* in Austria is good illustration of standardisation driven by the introduction of ICT. The new electronic ticket system to handle requests increases the degree of standardisation of work process (Box 3.1). The standardisation of work process was combined with strict time control of work. For example, in *City Life* (Austria) standardisation leads to the requirement to answer 80 *per cent* of incoming calls within twenty seconds, 80 *per cent* of emails and faxes within 24 hours and to make recalls within 24 hours. Then employees were under a great pressure to keep the time.

Box 3.1 Standardisation of work

Generally, the workflow of *City Life's* customer service can be described as very standardised, at call centres as well as at walk-in service centres. It was mainly the outsourcing of the telephone service that led to an increasing process of standardisation at service centres. ICT-based communication tools and data-processing systems have substantial contributions to this development. Work at service centres is conducted on strict instructions about procedures; it is becoming more and more standardised - in a way that is familiar to call centre work. Although employees at service centres have strict instructions on how to handle each case, they say that it is important to act more flexibly. Hardly any case is completely similar to another and instructions and laws change continuously; it takes employees about two years until they have experienced most of customers' problems.
(Schönauer, 2007: 12)

The same results are observed in the case study of *DVLA* (Italy) where it is also about the outsourcing of one part of public activity to call centre. In this case study, the increase of digital control of employees is described like 'digital Taylorism' which leads to demotivated work force and with high degree of stress (Box 3.2).

Box 3.2 High level of control

In the long run, this system of controls has proven to be a weakness in the management of work because it tends to standardise and therefore demotivate work force, triggering confrontational or nonco-operative attitudes with respect to the company.
If on the one hand rigidity of control is experienced as an additional form of pressure in work that is already considered as being stressful, paradoxically for some operators strictness of control is viewed as a key element for the success of the service.
(Piersanti, 2007: 11)

However, some case study report higher standardisation combined with higher degree of control but no increase of stress at work. The case study of *Customer* (UK) is a good example. Even if the work on the telephone and email is highly-standardised within time constraint to answer customer, employees do not feel an increase in stress. The main difference between these three case studies is that in the first two (*City Life* and *DVLA*) the service was outsourced in a completely separate call centre structure whereas in the *Customer* case, the new structure is still in the public sector even if it is decentralised. These results leads to conclusion proposed by Holman *et al.* (2007) that the work condition in call centre are generally worst in subcontractors compared to in-house.

3.3.1.2 *Customer orientation with standardisation and change of job content*

The standardisation of work process with ICT tools is a key element to outsource one activity from company to partners with no special qualification on the outsourced service. The outsourcing of postal service in Sweden and Austria from postal Company to private partners is a good illustration. The role of ICT tools is to highly simplify and standardise

the postal task (Box 3.3). But, standardisation in these case studies do not leads to the feeling of more control because the control is not about the result of work process and the link with supervisor is only electronic. The main consequence of the standardisation is an increase of workload for post partners and for postal employee through multitasking. In the case of post partners, the postal activity is one part of their job and they need to do their main core work at the same time. As concerns, postal employees they have to sell non-postal products like cd, dvd or mobile phone in the case of Austrian Post employee. In the Swedish case study of postal service, the restructuring concerns also the creation of contact centre for customer with high standardisation of work process like in call centre. This standardisation of work was strongly supported by the introduction of new ERP system, which also increased the intensity of work. Therefore, we can underline that in the Swedish case study of postal activities, standardisation and increase of workload came with the shift from face to face services to ICT-supported multichannel services (call centre, internet, ...) (Box 3.4).

Box 3.3 Simplification of task

The same time the work process is highly-standardised and in most cases is structured by the post office's own computer programme. Using a touchscreen function, the worker clicks on the service concerned on the monitor. Then the programme shows the appropriate menu, from which the worker can choose the appropriate functions. In a certain way the programme guides the worker through the transaction. The introduction of a new programme in 2006 made the work even more simple.

(Hermann & Schönauer, 2007: 9)

Box 3.4 Increase of workload and ERP

The introduction of the SAP system has lead to a higher workload and greater demands on the sales persons. The administrative work has increased at the same time as the demand for more personal visits at the customer sites.

(Tengblad & Sternälv, 2007c: 13)

Standardisation of the work process can also have more complex effect on jobs content. The *Dutch Telecom* (the Netherlands) case study shows a good illustration. Since *Dutch Telecom* outsourced its information on telephone number service, the work of contact agents, especially at the lowest level has been standardised. It is supported by several ICT facilities such as software for organising the structure of a conversation. The main objective is to automate the communicative aspect of transaction to reduce to a minimum the informal part of conversation. However, at higher occupational levels, employees have to sell more complex products. If they are also supported by intelligent software, their role is to facilitate the promotion of new products rather than standardise or formalise the way the employee operates.

3.3.1.3 Customer orientation with eAdministration

ICT tools are also key element of eGovernment schemes. The main objective of eAdministration is to simplify the relation between citizens and administration. Standardisation of services is then essential to transfer one part of the service to citizens as in the case study of *EWA* in Belgium. This case describes an internal externalisation with the creation of on-line public services and administrative simplification through the intensive use of ICT. Since eGovernment leads multichannel relationships between the administration and citizens, employees have to face an increasing frequentation resulting in heavier workload. Moreover, employees have to deal with the data entry of the files they prepare with the citizens. They have to combine in the same time front-office and back-office tasks, which could be a source of stress when there is big affluence of citizens. However, employees do not consider that the restructuring or the ICT-supported systems are the problem but the lack of political measures to adjust with the increasing demands and file. Introduction of eAdministration through ICT tools could increase workload but at the same time could improve the quality of job. The case study of *Intermed* (Hungary) is a good example. The eAdministration favours the transfer of one part of the service to the job-seekers themselves (self-service), saving time to take care more complex cases. This is considered by employees as an improvement of job quality. However, employees have to face an increased workload because of administrative tasks and the coexistence of the paper based and digital administration (Box 3.5).

Box 3.5 Increase of workload not connected to ICT use

The amount of time necessary to satisfy the needs of the various clients has decreased significantly. As a result of the time saving the employees of the local labour market offices have more time to take care of clients not able to use the self-service system. This also means that the relative weight of such high value-added tasks as counselling is growing within the activities of the *Intermed*. Although the time used for service utilisation decreased on the clients' side, the workload of the *Intermed* employees did not decrease due to the continuously growing administrative workload related to the legal environment of the operation. In addition, the coexistence of the paper-based and the digitalised administration further increased the workload of the staff members of the local labour market offices.

(Makó *et al.*, 2007b: 20)

The French case study about the restructuring of the public institutions for the payment of unemployment allowances (*Proconsulting-Unedic*) follows the same organisational change as *Intermed* in Hungary: the implementation and development of call centre and internet services for administration of unemployed registrations. The developments of telephone platforms and of the internet reduce the physical reception of unemployed persons. This saved time is dedicated to giving advice about the re-employment process, which is one of the new important roles given to the institution. Employees positively view this change as an increase of public service provision. The development of eAdministration transformed functions performed by the Assedic agents because parts of their activity completely disappeared (calculation of unemployment indemnities) and less time is devoted to administrative tasks or spent on the phone. So, following the new 'cultural' impulse,

the saved time is now dedicated to a better reception of the 'customers' thanks to work computerisation (Box 3.6). According to the discourse of managers, the development of internet reinforces the polyvalence of Assedic workers introducing an additional activity. Development of eAdministration gives more reactivity, more flexibility and develops just-in-time organisation. A new function was created with the development of internet: *Relais internet*, which is in charge of helping Assedic workers on internet use and on new implemented ICT tools. However, employees moderate this positive discourse about eAdministration because they insist on the fact that they need to have a face to face contact with 'customer' to be more efficient.

Box 3.6 eAdministration and change of job content

The development of eAdministration transformed functions performed by the Assedic agents because some parts of their activity completely disappeared (see 4.1): less work is dedicated to administrative tasks; less time is spent on the phone. So, following the new 'cultural' impulse, the saved time thanks to work computerisation is now dedicated to a better reception of the 'customers'. The functions of the agents are supposed to be less productive (administrative processes, calculating indemnities) and more oriented to servicing customers (giving advices, orientations *etc.*).
(Muchnik, 2007c: 11)

The restructuring of public services through ICT tools can also lead to the creation of new relations with citizen as described in Police Contact Centre (Sweden) case study. The creation of this new phone contact centre generates a new division of work between call operator (administrative employees) that documents a crime reporting IT system and the police officer who decides if further investigation is needed. Every team member has to be competent on every task and every operator has to be flexible in the range of the complete quantity of tasks. This new division of labour creates good level of work satisfaction.

3.3.1.4 *Substitution of the customer function by the technology*

As described above one of the important changes with the development of eAdministration is the substitution of the customer service by the technology and the development of 'self-service' for customer. The case studies of postal service in Sweden and Austria, or the restructuring of unemployment institution in Hungary and in France are good illustration of that shift. The 'customer' service is now done by the technology with the participation of customer. Internet is the main vector of the substitution between services provided by employees and services directly generated by the final customer. This shift is also remarkable in the *German railway station and service case study (DB Station & Service AG and DB Sales Ltd, Germany)*. The restructuring of customer service is based upon the massive introduction of electronic sales methods (automatic machines and internet). These electronic sales methods are an example of substitution between labour intensive sales and ICT tools since one part of sales is delegated to the final customer. The negative consequence for employees is that they are compared to the sales machines and they have to do better than machines because of their higher cost (Box 3.7). Then there is more pressure

and higher intensity of work. The common results of all case studies is the delegation of one part of the service from internal function to the final 'customer' or private partners to save labour cost and rationalise contact with customers or citizens.

Box 3.7 Substitution of the customer function by the technology

The travel advisors are expected to sell more in order to justify higher expenses of personnel sales in comparison to the ticket machines: they are encouraged to urge the customers to purchase extra or more expensive products (first class instead of second class, seat reservations, return ticket, purchase of a Railcard). So they have to sell harder than they used to in the past. This has been further developed since 1/1/2007 in that individual commission is paid out for the sale of Railcards and first class tickets.
(Dunkel, 2007: 9)

3.3.1.5 *Restructuring of services without big impact of technology*

Two case studies report no important introduction of ICT in customer function, and both are from Eastern European countries. The first is the case study of Greek *Postal service* where an electronic tracking system was introduced at the same time of restructuring, National postal service creates subsidiary to handle courier service (*Postal service, Greece*). The only consequence for work organisation is that the standardisation of job facilitates the interchangeability of workers. This case study is an interesting counter-example of the Swedish and Austrian case studies where ICT tools were the key element of big restructuring process. The choice of the Greek National Post was opposite with limited use of new technologies. The second case study concerns the job-seekers institution in Bulgaria (*NEA Bulgaria*). In this case study there is no description of technology implementation, the restructuring is about standardisation of services offered to job-seekers through the organisation of a one-stop shop with separation of back and front-offices but no introduction of special ICT tools. Compared to the Hungarian or French case studies on the institutions that provide services to unemployed persons, the contact with citizen remains more 'traditional' and face to face. One can link the poor role of ICT in the restructuring of value chain in Greece and Bulgaria with the low diffusion of ICT in these two countries (see Figure 2.1 in Section 2).

3.3.1.6 *Formalisation of workflow and loss of autonomy in the IT function*

The impacts of ICT diffusion on the work organisation in IT function are less important than in customer service. The main impacts are also about standardisation of work process and higher formalisation of workflow. The consequence for employees is in some case higher monotony, lower flexibility and lower autonomy in their day-to-day job. For example, *IT Health* (Norway) case study reports that even if the content of work did not really change, where the local IT consultants were generalists before centralisation, they are moving towards more specialised roles and tasks. This specialisation led to less variation in work and thereby more monotony. The case study of IT services in Public sector (*EWA, Belgium*) reports that due to the standardisation of task some interviewees point

out that they have lost a part of their autonomy and flexibility. However, the main result of this Belgian case study is that generally speaking, the outsourcing of IT services has not made such a big difference in the day-to-day work. The increase of monotony is also the result highlighted in the *City Council* (UK) case study. The modernisation of IT system in the IT department, with the use of a system to handle requests arriving at the help desk, leads to standardisation of work, less flexibility in responding to urgent requests, more paperwork and less autonomy in fixing hitches.

Box 3.8 Substitution of the customer function by the technology

For any other work tasks, much more planning of the workflow is involved. Whilst before work tended to be carried out on an ad hoc basis, *Prof's* systems require logging every work-related task and scheduling of work to be carried out. So the workflow is more standardised and less flexible in responding to urgent, sudden problems. As the IT technician said 'as a result of increased paper work and being less flexible, I think we are providing a worse service than before'.
(Dahlmann, 2007a: 9)

We can also observe this negative impact on monotony of work for one specific part of employees with IT services in Ministry of Interior (*MM Spinoff*, Germany). The introduction of an eLearning system for police officers lead to a standardisation and formalisation of the teaching work in the police academy who had to develop some of their coursework as eLearning modules. However, for individual police officers the eLearning system did not change their day-to-day work, but the move to eLearning modules was a change towards more training.

The change described in *GBA and Easttown* municipal government (the Netherlands) case study shows the greatest impact of technology on work organisation in IT function. The restructuring is the outsourcing of IT systems in which citizens' personal records are administered and stored to *GBA*, an IT service provider. This restructuring is an example of ICT-driven outsourcing with strong mutual dependence shift in knowledge that implies changes in work organisation. This outsourcing leads to a share of knowledge and a strong redistribution of roles at all hierarchical level: more co-ordination for management between the back-office service provider and the own organisation, more tasks for administrative employees and decrease of tasks for IT officials (Box 3.9).

Box 3.9 Substitution of the customer function by the technology

A continuous process of restructuring unfolded since the super-pilot period. Ever more, previously paper records are being digitised. This leads to continuous shifts in the work of employees at both *GBA* and *Easttown* at all hierarchical levels. At the municipal government, the work of IT officials to some extent disappears. The work of municipal personal records administrators on the other hand is broadened but appears to lose some of the depth, while new administrative functions capture this loss of depth. At managerial level, we observed that employees get more and more involved in the co-ordination of tasks between the back-office service provider and the own organisation, while co-ordination becomes *Profoundly* more complicated, because of the

need to accommodate front-office issues. At GBA, we see a greater integration of tasks at all levels. While account and strategic managers more and more need to anticipate municipal governments' concerns, product developers and product support staff need to more and more understand these concerns. It appears hardly possible to isolate relatively simple aspects of the tasks of these workers and offshore them.

(Bannink *et al.*, 2007: 5-6)

3.3.1.7 No evolution in the R&D function

Since the R&D function is an atypical one with specific work organisation, the introduction of technology does not affect strongly the work organisation of R&D employees. For example, the *Comtel* (France) case study shows how the introduction of a new market segment (small and medium enterprises) leads to increase workload and that the project managers have difficulties do cope with demand under time pressure. However, these results are not directly linked to the technology but to the restructuring of R&D activities among projects. Since R&D is structured by project with different geographical sites, the use of ICT (especially telecommunication technology) gives more flexibility to organise teamwork even it is not completely satisfactory (Box 3.11). The case study of *UK Lab* (United Kingdom) reports also the role of ICT in co-ordination between geographically distant teams. For example, in *UK Lab*, workers need to liaise with Japan (mother company location). Therefore, project leaders and managers come in early for phone conferences, meetings are scheduled early in the morning in order to get the results to Japan before the working day ends there. ICT tools facilitate these meetings and increase efficiency even if there are many complications due to cultural, language and temporal differences. The last case study that gives some interesting indications is *Messenger/Digit* (Austria/Croatia). It gives an example where technology does not support very well the distributed worked between Croatia and Austria. The on-line connections between the two companies are fragile because of lack off technical appropriate tools, and then there is lack of efficiency of distributed work (Box 3.11). *Messenger/Digit* (Austria/Croatia) case study put in light the technical complexity of the international co-ordination between two firms and the negative consequences of non-adequate technological solutions.

Box 3.10 The role of technology for teamwork

R&D activity is structured by projects. Each project involves R&D employees from different research centres and research units, that is to say from different geographical sites. This leads to a more intensive use of information and communication technologies as videoconferences or phone conferences for teamwork. However, several interviewees pointed out the low use and performance of these communication tools. 'Despite of all we can say about communication easiness, geographical proximity has its importance. It's yet easier to co-operate with people who are next to you', said a researcher.

(Muchnik, 2007a: 12)

Box 3.11 Lack of adequate technology

In this case distributed working is not very well-supported by technology. On-line connections between *Digit* and *Messenger* (and the entire company) are somewhat fragile. One of the reasons is *Digit's* IT infrastructure. Firewalls are very sensitive. The connection between *Messenger* and *Digit* is not fast enough to use all possibilities their IT system offers. For example, VPN (Virtual Private Network) makes it possible to access *Messenger's* databases and files directly from Croatia, but this doesn't fully work yet. One reason for this is that the whole IT was restructured at corporate level and that there is still much open as to how it is going to be organised. This is why shared servers, files, workspaces and the system for version management cannot be fully used for distributed work.

(Flecker & Schönauer, 2007: 12)

The other case studies on the R&D sector do not report big impacts of technology on work organisation, the main changes are related to restructuring of value chain with no direct implication of technology.

3.3.2 Manufacturing

In the manufacturing sectors, the introduction of technology concerns ICT tools (like in the service sectors) as well as automatic machines. Therefore, effects of technology on work organisation and job content are more complex. Technology introduction can lead to positive changes like job enrichment or enlargement, or clear improvement in working conditions but also in negative changes like more repetitive work. Case studies in the manufacturing sectors put in light that the changes of job content concern mainly basic operator when automatic machine are introduced and mainly managers or supervisors when the technology is more ICT-related. The manager role becomes more focused on coordination while ICT take up surveillance and control. WORKS case studies reveal also a capital saving behaviour for some firms. If the technology is an important investment, the company has to change the work organisation and define new job contents to optimise its use.

3.3.2.1 Job enrichment or enlargement

The *Copy Fashion* (Hungary) case study shows how the introduction of a new ERP system that rationalised the logistics resulted in job enrichment and increased skill requirements. The restructuring transforms the monotonous standardised work of logistics employees to more flexible and more various with quality control or working with new ERP system (Box 3.12).

Box 3.12 ICT and job enrichment

Before the implementation of the changes in the value chain, employees working in logistics had to perform a limited number of operations, now, in contrast, they have to be flexible, they have to be able to perform any single operation in their area. *E.g.* a raw materials warehouseman has to be able to deal with accessories and quality control, as well as understand and operate the

integrated enterprise resource planning system (ERP). This flexibility is definitely needed so that the company can overcome capacity shortages due to layoffs and sick leaves. (Makó, Illéssy, Csizmadia & Mazsu, 2007: 15)

The *Green* (Italy) case study underlines that ERP and other ICT tools support the delocalisation of production from Italy to Eastern Europe country. The consequence for employees is a reallocation from industrial work process to that of services such as sampling. The tasks have been widened, enriched, and destandardised. Employees have been made poly-functional but the link with the technology and ICT is not direct, it is more the consequence of the delocalisation strategy, and ICT has only a facilitating role. Menswearco in Germany is another case study with delocalisation from Western Europe to Central and Eastern countries. The company outsourced the whole production to Central and Eastern Europe countries and kept only design, logistics, marketing and sales in-house. The restructuring was accompanied by an intensive technological development especially in design and pattern making. The job of designers and patterns makers became richer because their new task needs knowledge of design as well as technical knowledge and craftsmanship. These two cases illustrate the process of delocalisation of low quality job to low wages countries accompanied by enrichment of job for workers in the western firms. The role of technology in the enrichment of job content is not crucial in the first case but it is important in the German one. The *Wonderwear* (Belgium) case study also describes a delocalisation from a Western country to low wages countries. However, this case study reports no significant influence of technology on the restructuring process or on work organisation.

In the food industries, technology can have also positive effect on job enrichment, like in *Maltco's* (UK) case study. A Management Control Reporting System, which is a tracking device to measure KPIs is introduced in *Maltco*. One important consequence is multi-skilling, as employees learn to work with several machines on one line or to work across lines (Box 3.13). *Beer AD* (Bulgaria) case study shows similar results that with multiskilling following the introduction of new technology. The company made a large technological modernisation of production and most of the new equipment in the production is set in motion and control by computers, requiring more technological skills, and improvement of the language proficiency. As described by the Plant Manager: 'It will be soon expected from the employees not only to use the machines, but to be able to repair them as well' (*Beer AD*, Bulgaria: 6). The changes of job content also imply an enlargement of responsibilities because operators are now responsible for maintenance of machines and for hygiene at workplace. The introduction of the new technology also affects the job content of managers at the production level, since they have to better supervise their subordinates, but also to communicate on-line with their superiors.

Box 3.13 ICT and multiskilling

Project Nemo has led to a number of changes for packaging operators: in terms of tasks carried out on the packaging line, one person was only skilled in doing one particular aspect (e.g. wrapping plastic around cans), now the work force is being encouraged to seek further 'training' opportunities, which essentially means they are learning to use several machines on one assem-

bly line, they also have to work across the canning and kegging lines, located in two different halls. *Maltco UK* want to create a more flexible work force in terms of skills and available working time.
(Dahlmann, 2007b: 8)

The main conclusion of these case studies is that the massive introduction of ICT in VCR lead to an improvement in the job contents of part of employees because of new opportunities and new knowledge needs. This result is observed both in clothing industries and in the food industries and is sometimes linked to delocalisation.

3.3.2.2 *Improved working conditions*

The introduction of new technologies leads to improved working conditions in *Fishing company* (Norway) through job enrichment and the replacement of workers by machines for the hardest work. The *Eco Clothing* (Germany) case study also shows strong positive effects of technology on working condition. The Company introduced ICT to face crisis and rationalise production. Consequently, the work intensity increased but with the new ICT and documentation system, the job content became more interesting. Employees recognise that the working conditions improved after the change and they felt more motivated. This case study is interesting because the decision about the degree of technology was taken with the participation of workers (Box 3.14). The choice was between the best technological organisation with more Tayloristic-oriented pattern or less technological organisation with higher participation of workers. This case study illustrates the importance of the management approach when studying the relation between technology and working condition.

Box 3.14 Technology improve working condition

Another important aspect related to quality of work is the increasing intensity of the workload. With the economic growth in the last two years the intensity of work has increased. But according to the interview partners, through the new technological system, the new documentation and return system, working has become more effectively and less exhausting for the workers in the logistic department. [...] Respecting to the quality of work the turnover didn't indicate the loss of qualitative aspects. [...] Nevertheless the productivity per person has increased and the workers are working more effective...
(Krings *et al.*, 2007b: 8)

3.3.2.3 *Standardisation, repetitive work, job rotation and teamwork*

The relation between the introduction of new technology, standardisation and repetitive work as described in services sectors is also present in the manufacturing industry, especially in the food industry. The *Meat Inc.* (Denmark) case study, which concerns slaughtering and deboning activities, shows how the use of semi-automated lines for slaughtering and the use of conveyer belts changed the content of job. First, the automation had a

positive effect because the heavy and dangerous tasks decreased, as well as injuries. However, employees experienced a higher standardisation of work with very repetitive tasks; the job being transformed from craftwork to industrial automatic labour. In the previous system, each worker used to cut out an entire piece of meat from the beginning to the end. With the new system, each worker is doing one small part of the job. The work and wage system shifted from individual to collective. To ensure a minimum level of variation in job content, and to avoid injury due to monotony, groups rotate position several times a day. Finally, the introduction of technology has a double impact on work organisation: higher safety and higher monotony. The *Natural Delicacy* (Italy) case study also exhibits a double impact from the introduction of the traceability of products with a system for the integration of all the entities that take part in the production process. Technological innovation leads to an improvement of the work contents for only a small part of *Natural Delicacy* workers: tasks are less manual and more supervision-oriented and a job rotation experiment was introduced. This is the positive effect of technology. The negative effect is that for the majority of workers, job content has become very poor and tasks are repetitive and boring. The introduction of a new ERP in the case of *Maltco* in Benelux illustrates the consequences for workers when the content of their job is reduced by technology. The main objective of the introduction of ERP in this case is to integrate all existing and heterogeneous systems into one vertically integrated one. The new job content is less challenging (tasks are more repetitive, less complex, require less know-how). Due to the decrease of job contents, workers feel overqualified and they are anxious for the future of their job. This job insecurity due to computerisation is expressed by one interviewed 'they're now busy with ERP, to see if it's not easier whether customers can directly enter their orders in ERP (...) so I suspect that in one or two years [my job will be redundant]' (De Bruyn & Ramioul, 2007b: 10).

3.3.2.4 Optimisation of machine use

Some case studies reveal that the work organisation could strongly change when the main objective of the company is the optimisation of the newest machines use. The food industry seems to be more concerned than textile industry. *Fishing company AS* (FC) (Norway) invested in a new technology (computer system and underwater camera) to face increasing demand and the production was reorganised to optimise its the use. In order to exploit the machines more hours every day, production day was extended from eight to twelve hours, and the workers began working in shift system (6 hours). The new work organisation changed the content of job for the line workers as well as for fish farming workers (Box 3.15). The line workers have more tasks to do with the increasing number of machines, fish farming workers were replaced by machines for the most physically demanding tasks and the use of computers have become familiar to them. The optimisation of use of newest technology is also the driving force to changes in work organisation in *Maltco* (UK) and *Maltco* (Benelux). In the first case it is the optimisation of Management Control Reporting System, which leads to change of job contents, and in the Benelux case it is the use of the new Enterprise Resource Planning (ERP) which implies the negative change for workers.

Box 3.15 Optimisation of machine use and of work organisation

For the line workers, the development implies that they have more machines to learn to operate, but also that work has become somewhat less repetitive in the sense that they now have more tasks to rotate between. Rotating between tasks also means alternating between rooms, which gives the workers a break from the cold and noisy processing hall.

The aquaculture industry has gone through massive changes over the years, with a lot of new machinery and production techniques, as well as increased bodies of regulations to comply with. Whereas before, fish farming was considered physically demanding work, today machines have replaced a lot of what used to be manual tasks.

(Sætermo, Torvatn & Dahl-Jørgensen, 2007: 17, 19)

3.3.2.5 *Change in control*

Another result is the effect of technology on the control of operations. It concerns management control when the technology supports the communication among managers or the centralisation of decision making. It could also be more direct through the electronic performance tracking system.

The restructuring of *Beer AD* (Bulgaria) characterised by high level of technological investment was accompanied with ICT tools to facilitate communication between geographically separate units. There are three main geographical zones: Belgium, Moscow (power of decision) and Bulgaria (production) and another powerful actor within the process of restructuring in Austria. If ICT tools decreased the cost of communication between units, it also diminished the opportunity of direct contacts, resulting in a lack of face to face communication among managers and between managers and blue-collars. Consequently, some workers have problem to fully adapt to the new system of communication and reporting. The consequence of this geographical dispersion and lack of communication is that 'quite often the workers don't know who is the manager responsible for their operations and the middle level managers don't know to who they are obliged to report to...' as underlined by one of the interviewed person (Stoeva, 2007: 5). Consequently, one can conclude that ICT transforms the role of management at the production level.

The introduction of new technologies changes the control organisation when it supports centralisation process of decision making within vertical integration for example. *Green* (Italy) case study shows how ERP plays an important role in the centralisation of decision making process. Finally, the standardised business processes supported by ICT allow more space to the management in controlling the production and logistic process.

The introduction of technology can also directly affect the control of employee's work with performance tracking system or automatic rhythm. For example, *Natural Delicacy* (Italy) illustrates the case where work is rigidly controlled by the machinery (Box 3.16). The production line is the well-known method to control the productivity of workers and the case study of *Meat Inc.* (Denmark) also illustrate this with the introduction of the conveyor belt.

Box 3.16 Optimisation of machine use and of work organisation

This latter aspect, is at the base of the low satisfaction level recorded by *ND* and *ND* employees. Their work is rigidly controlled. Their work is controlled by the machinery. A number of devices measure the work carried out by the machinery and, consequently, of the worker himself. Acceleration premiums depend on these measurements. Besides these controls, there are those carried out by the department heads and foremen. 'For each production line - a worker explained - there is always a person who is in charge of and invigilates that production, including workers productivity, quality and defects.' Sanctions take the form of letters, *i.e.* of written reprimands. At the third letter, the firm may fire the worker.
(Pedaci, 2007a: 12)

Table 3.3 VCR technologies and the evolution of work organisation

Evolution of network organisation	Case and country	VCR technologies*	Sector/function	
Standardisation of work process with outsourcing	<i>City Life</i> , AT	Call +WF + ERP	PS/CS	
	<i>D VLA</i> , IT	Call	PS/CS	
	<i>Swedish post</i> , SE	Call+Web+ERP	SGI/CS	
	<i>GBA & Eisföretag</i> , Benelux	Data	PS/IT	
	<i>ITPRO</i> , Benelux	WF+Data	SGI/IT	
	<i>IT Health</i> , NO	ERP	SGI/IT	
	<i>Swedish post/WMdata</i> , SE	ERP	SGI/IT	
	<i>Messenger/Digit</i> , AT	Soft Ing	IT/R&D	
	<i>Green SPA</i> , IT	ERP	Tex/Prod&R&D	
	Standardisation of work process with work enlargement	<i>Domainsoft</i> , HU	Soft Ing	IT/prod
		<i>Proconsulting</i> , FR	Web	PS/CS
		<i>Customer</i> , UK	Call+WF	PS/CS
		<i>EWA</i> , Benelux	Call+Web+WF+Data	PS/CS
		<i>Postpartner</i> , AT	ERP	SGI/CS
<i>Dutch Telecom</i> , Benelux		Call+WF	SGI/CS	
<i>Wonderwear</i> , Benelux		none	Tex/R&D	
<i>Copy fashion</i> , HU		ERP	Tex/Prod&Log	
<i>Fishing company AS</i> , No		none	Food/Prod	
<i>Beer AD</i> , BG		VGE/SC	Food/Prod	
<i>Maltco</i> , UK		SC/PT	Food/Prod& Log	
Standardisation of work process with less autonomy, more monotony and control		<i>Business Software</i> , DE	Soft Ing+intra+VGE	IT/Prod
		<i>Customer</i> , UK	Call+ WF	PS/CS
		<i>City Council</i> , UK	Call+WF	PS/IT
	<i>Dutch Telecom</i> , Benelux	Call+WF	SGI/CS	
	<i>MM Spinoff</i> , DE	Web+Data	SGI/IT	
	<i>ITPRO</i> , Benelux	WF+Data	SGI/IT	
	<i>IT Health</i> , NO	ERP	SGI/IT	
	<i>Meat Inc.</i> , DK	None	Food/Prod	
	<i>Natural Delicacy</i> , IT	ERP+Trace	Food/prod	
	<i>Maltco</i> , Benelux	ERP	Food/Log	
	Standardisation of work process with increase in workload, stress	<i>City Life</i> , AT	Call +WF + ERP	PS/IT
		<i>D VLA</i> , IT	Call	PS/CS
		<i>EWA</i> , Benelux	Call+Web+WF+Data	PS/CS
		<i>Intermal</i> , HU	Web	PS/CS
<i>Swedish post</i> , SE		ERP	SGI/CS	
			Enabling	Enabling

Table 3.3 VCR technologies and the evolution of work organisation. Continued

Evolution of network organisation	Case and country	VCR technologies*	Sector/function
Standardisation of work process with more flexibility in working time model	<i>Green SPA</i> , IT	ERP	Tex/Prod& R&D
	<i>G-Log</i> , PT	SC	Tex/Log
	<i>WV-DK</i> , PT	SC	Tex/R&D
Standardisation of work process with no change on work organisation	<i>Maltco</i> , UK	SC/PT	Food/Prod& Log
	<i>INIT</i> , SE	Soft ing.	IT/prod
	<i>Softserv</i> , BG	VGE/Soft ing.	IT/prod
Standardisation of quality control with work enlargement	<i>Adèle</i> , FR	ERP	Tex/Log R&D
	<i>Copy fashion/HU</i>	ERP	Tex/Prod
	<i>Beer AD/BG</i>	VGE/SC	Food/Prod
Standardisation of quality control with less autonomy, more monotony and control	<i>Beer AD, BG</i>	SC	Food/Prod
	<i>Natural Delicacy</i> , IT	ERP + Trace	Food/Prod
	<i>German railway</i> , DE	Web + Data	SGI/CS
No standardisation or no information	<i>IT Healthcare</i> , PT	WF	SGI/IT
	<i>PCC</i> , SE	Call	PS/CS
	<i>NEA</i> , BG	None	PS/CS
	<i>Comtel</i> , FR	VGE+Intra	IT/R&D
	<i>UK Lab</i> , UK	VGE+Intra	IT/R&D
	<i>Comp A/A</i> , NO	Soft Ing.	IT/R&D
	<i>Charlie TIC</i> , Benelux	VGE/Soft Ing.	IT/R&D
	<i>VR2</i> , DE	Soft Ing	IT/R&D
	<i>Eco clothing</i> , DE	Data + WF	Tex/Log
	<i>Wondravent</i> , Benelux	None	Tex/Prod
	<i>Mansuvarco</i> , DE	CAD	Tex/R&D
	<i>Geisla</i> , Benelux	WF	Tex/Log
	<i>Company A</i> , GR	SC	Food/Log
	<i>Company A</i> , GR	None	Food/Prod
	<i>Maltco</i> , Benelux	ERP	Food/Log
	<i>Trousers' Company/DE</i>	SC	Tex/Log
	<i>Greek post/CO</i> , GR	SC	SGI/CS
	<i>IT Research Labs</i> , AT	-	IT/R&D
	<i>Company B</i> , GR	None	Tex/Prod
	<i>Tetition</i> , PT	None	Tex/prod

* See Table 2.3 for labels and definition of technologies.

Total number of cases studied: 57.

Source: WORKS organisational case studies

3.3.3 VCR and standardisation of work organisation: synthesis

Standardisation appears to be the most frequent evolution of work organisation related to VCR explored in the WORKS project. We identify two main configurations with variants in the standardisation process involved in VCR and they are spread in all the sectors covered: standardisation of work process and standardisation of quality control. They are given in Table 3.3 and 3.4 where the first column indicates, like in Table 2.4, the configuration variant, the second give the list of cases in each configuration with its acronym and country initials, the third gives the name of the VCR technology (see labels in Table 2.3) and mentions whether the VCR is driven or enabled by ICT or whether ICT is a driving force in the VCR and the fourth gives the sector and the function covered by each case.

Table 3.3 and 3.4 show that 36 cases studies upon 57 (63 *per cent*) describe a process of standardisation and especially standardisation of work process (33 cases). We have identified five big variants within these standardisation processes: with outsourcing; with work enlargement or multitasking; with less autonomy, more monotony, more control; with increased workload or stress; with more flexibility in working time. Some interesting sectoral differences can be identified. In Services, standardisation is more often associated to outsourcing, less autonomy, more control and an increase in workload and stress. In manufacturing, standardisation is more often associated with more flexibility in the working time model. The standardisation of quality control is only present in the manufacturing sector, especially in the food sector. Finally, standardisation with work enlargement and multitasking is present in the manufacturing sectors as well as in the service sector.

Beyond these sectoral differences, the relationship between ICT and work organisation is not mechanical neither in manufacturing nor in the service sector. The next section shows how the role of management is important and can influence the interplay between VCR technologies and the work system.

Table 3.4 VCR technologies and the evolution of work organisation: a sectoral synthesis

	Total	Manufacturing (Tex, Food)	Services (SGL, PS, IT)
Standardisation of work process			
With outsourcing	10	2	8
With work enlargement, multitasking	13	7	6
With less autonomy, more monotony, more control	10	3	7
With increase of workload, stress	5	0	5
With more flexibility in working time model	6	6	0
Standardisation of work process with no change on work organisation	4	2	2
Standardisation of quality control			
Standardisation of quality control with work enlargement	2	2	0
Standardisation of quality control with less autonomy, more monotony and control	2	2	0
No standardisation or no information	21	10	11

Note: Since one case study can show several results, the sum of table exceeds the total number of cases studies. Total number of cases studies: 57.

Source: WORKS organisational case studies

3.3.4 Management role, workers' consultation and work intensity

The restructuring of value chain and the introduction of technology affect widely the work organisation and the job content. Therefore, the behaviour and the role of the management, as regards work organisation and working conditions, vary across the case studies. Some case studies reports real participation of workers in decision, with or without unions. These could be named 'participative'. On the opposite, some case studies reports 'non participative' restructuring processes. The participation of workers is not connected to sectors because we can identify 'participative' and 'non participative' case studies in manufacturing as well as in services sectors.

In the manufacturing sector the 'virtuous' case is represented by *Eco Clothing* (Germany). Due to normative orientation of the company towards ecological and social standards, management gives importance to the participation of workers to technological choice. The first technological option presented by the Mother Company would have signified a more Tayloristic oriented working organisation. With the participation of workers, the choice was made to adopt another technology to keep the work structure more complex and more motivating. The decision to take into account the workers opinion on the technological choice is a strategic orientation adopted by the company (Box 3.14). The guideline of this strategic choice is to consider that qualitative aspect of the working processes is important for production. *Eco Clothing* demonstrates that high level of quality of working condition is compatible with increase of productivity. The opposite 'non-participative' case could be represented by *Maltco* (Benelux) in the food industry. The introduction of new ERP system leads a job insecurity atmosphere. This negative social climate could be linked to the absence of worker participation in the restructuring process. The decision was taken by the top of management with no information to workers. Even some managers were not informed. For example, the decision to offshore the export department was announced in February 2006 with no discussion, but it is only in August 2006 that management announced the number of people who had to go or to be relocated. Furthermore, the decision about the persons concerned by relocation or an early retirement was only made by management with no consultation of union or workers.

Box 3.17 Participation of workers in the choice of technology

Both, the team responsible as well as the head of the department logistics, agreed in the broad participative processes during the introduction of the new technological and organisational system. The strategic idea was to change the different systems of logistics with the involvement of the employees. Therefore the process was organised as an open process, where the labour was reconsidered as a qualitative aspect of the working processes.

... Yes, well, the technology insofar, that we aren't on the highest level of technology. Simply we said no, we also like to consider, where it makes sense to introduce new technologies, but for us it is very important, that the employees are regarded as employees, with other words that they keep their own responsibility. That means not only bring one product from A to B, but also to feel the own responsible part in their working processes. That they consider what they can improve from their perspective, but not only from a technological perspective ... (Head of department of logistics).

(Krings *et al.*, 2007b: 8)

In the service sector, we can confront 'participative' *Customer* (UK) case to the 'non-participative' *City Life* (Austria) case. The *Customer* (UK) case concerns the transfer of customer services activities of the two local governments to a joint venture company, with the transfer of employees. Trade unions participated actively to the negotiation of the transfer of employees. Even if nothing particular is reported about the role of workers in technology adoption, the new practices have been introduced in a way that is well-accepted by the staff. The *City Life* (Austria) case is about the outsourcing of customer service to a call centre subcontractor. Since, the proportion of quasi-freelancer is very high at call centre, there is no work council or union. There is no regular discussion on job quality, just some employees can be involved in quality circle. Furthermore, there is clear distinction between management and employees as regards the access to the information. We can conclude that the main roles of union (or workers representation) are about: the question of transfer of employees within outsourcing project; the wage consideration and general working condition. Except the case study of *Eco Clothing* (Germany), there is no important example of workers participation to the decision about the introduction of technology in the value chain or about its consequence on working condition. For example in *Natural Delicacy* (Italy), where the unions are strong, the discussion after restructuring concerned the technology because it leads to the use of acids in the equipment cleaning process. 'Many workers - as a *ND* trade union representative said - have complained about sore throats and burning eyes after having cleaned the machinery' (Pedaci, 2007a: 11). However, there is no element about the participation of unions on the choice of technology and the restructuring process. In the public sector and in Scandinavian countries, negotiations between unions and management apply generally to the contractual conditions of work and to the transfers of employees during the restructuring of value chain. The negotiations table does not include choices of organisation or technologies. The *EWA* (Belgium) case study shows that the question of implementation of eGovernment or other new technology as regards to the relation between public services and citizen as very important for the trade unionist (Box 3.18), but there is no element about the relation between eGovernment and work organisation.

Box 3.18 Participation of workers in the choice of technology

A group interview with union officers in charge of the public sector confirmed that they do not consider the implementation of eGovernment and the multichannelling of services to citizens as a challenge from the trade union point of view, because they assess that the effects on employment and working conditions are limited and, if any, rather positive as they give a positive image of the modernisation of administration.
(Devos & Valenduc, 2007: 22)

3.4 Conclusion

This section about the relation between technological change and the work organisation puts out many interesting results. First, the quantitative section shows that the relation varies more across sectors (manufacturing/services and public sectors) than across coun-

tries. Moreover the quantitative analysis concludes on the following results: a positive correlation between use of ICT technology (computer, internet) and the complexity of work; a negative correlation between the use of machine and the independence of time allocation of work; the use of ICT seems to be more related with the market constraints whereas the use of machine seems to be related to the industrial constraint. We do not uncover the complexity paradox by assessing with quantitative data the organisational characteristics of the work of computer and internet users. In EU-15, ICT diffusion should favour and increasing degree of work complexity, just as the development of the service sector, the increased level of education or the aging of the work force. However, using the available data at a European level we cannot distinguish between different uses of internet or of computers. In particular, we are not able to identify users of VCR technologies or work characteristics of employees affiliated to an organisation that is restructuring its network of business partnerships. The WORKS organisational and occupational case studies, focusing on VCR, allow us to overcome this limitation of the quantitative assessment.

The main results from the case studies about the relation between the ICT and the work organisation are double: higher standardisation of work and to a less extent increase of work control through electronic system. In the service sectors and public administration, technology supports outsourcing of non-core activities to private partner (postal service in Austria and Sweden), to call centre (*DVLA*, Italy) or the delegation of part of the production of service to the final customer (electronic ticket in Railway service, internet for other public services). The main role of ICT is to highly simplify and standardise the task to ensure a good transfer to the customer. These changes are linked to the development of eAdministration in public services and mainly to cost reduction strategies in other services sectors. In the manufacturing sectors cases, ICT are also the main observed technologies but in some cases new machinery is observed, with results, which are more complex to synthesise. The introduction of ICT changes the job contents of operators: standardisation and enlargement in some case studies but also higher standardisation and monotony in other ones. As far as the job content of managers is concerned, the introduction of ICT involves more co-ordination and less direct and more ICT-supported control. Thus, VCR entail in a non negligible number of cases a standardisation process that can lead to a simplification of tasks whether manual or cognitive.

But the relationship between ICT and work organisation is not mechanical neither in manufacturing nor in the service sectors. The role of management is important and can influence the interplay between VCR technologies and the work system. In some case studies, noted as 'participative' (*Customer*, UK for example), the introduction of VCR technologies lead to an enrichment of worker whereas in the 'non-participative' cases (*City Life*, Austria for example), the introduction of VCR technology entails standardisation and reduced task complexity at the periphery of the business partners network.

4 How do technological changes relate to skill?

4.1 Introduction

In the theoretical pillar of the WORKS project, Ramioul (2006) synthesises the literature on the impact of technological innovation on the demand of skills by distinguishing three levels of analysis: the macro level of regional or national economies, the level of organisations and the level of the individual workplace and the employee. The macro economic perspective highlights educational and labour market policies, while the meso level one focuses on organisational strategies and personnel policies of firms. Finally, the micro perspective shows job requirements, individual career trajectories and employability associated with ICT diffusion. Qualitative and quantitative approaches carried on during the WORKS project allows to contribute to meso and micro approaches of the debate on the relations between ICT, work organisation, skills and training.

According to the theoretical and empirical papers on skilled-biased technical change and productive complementarities, the decline in price of electronic components and ICT has generated a co-ordination in technological and organisational choices, which in turn requires a more skilled work force. The underlying ideas are that either new technologies increase employees' productivity as soon as they use it; either they receive higher wages, because they hold skills or attitudes, not statistically measurable, but known by their employers, that render them more capable of using them efficiently. Many papers showed the existence of such biases in favour of skilled workers in 1990s. Work that is more recent based on the analysis of trends in the wage distribution show a trend towards polarisation. In many countries, more jobs are created at both ends of the wage scale than in intermediate jobs position. In a this section, we tackle the question of skilled-biased technological/organisational change or polarisation by analysing what is happening now in Europe with new generations of VCR technologies. Are these technologies still skills demanding and what skills are required?

In economics, the theory of technological bias describes technological changes as exogenous shocks on the production function. If the shock is non-neutral, it implies a modification in the productive combination of factors. The consequence is the evolution of the relative productivity of each factor, and a change in the demand of each factor. Historically, from the thirties to the fifties, economists of growth successively focused on the relation between capital and labour, by assuming successively that technological change was biased in favour of capital and then that it was neutral on the combination of capital and labour. The debate on the bias of technological change has been updated by labour economists observing the development of inequalities between skilled and unskilled workers during the nineties. The labour factor was no longer considered as a homogenous factor. In the SBTC approach, workers differ according to their skill. Technological change implies an increase in the relative demand of skilled workers. Different empirical papers,

based on macro data, sectoral data and individual data, confirm the existence of a skilled-biased technological change in different developed countries. In most of these studies, skills are measured either with occupation breakdowns (like manual/non manual workers) or with educational breakdowns. One can find a synthesis of these results in Acemoglu (2002), Pianta (2003), Chennells and Van Reenen (2002) or in Bouabdallah, Greenan and Villeval (1999).

The link between the diffusion of new technologies and the evolution of skills has also been widely debated in work sociology during the seventies by the deskilling/upskilling theory. In 1974, Braverman upheld the argument, whereby the automation of machines tended to confine skilled workers to semi- or unskilled work while developing a need for managers and professionals to choose the projects and supervise the work. Greenan and Walkowiak (2005) show that this was not the most widespread form of use of technologies in 1997 for stable employees in industrial firms. Indeed, like ICT, the use of automated machines has a positive correlation with variables measuring work enrichment. Deskilling of the work force seems linked to exclusion from the use of ICT and automated machines, rather than to their use. Autor *et al.* (2003) confirm the existence of such an upskilling process in the banking sector where jobs are more complex for unskilled manuals when they use ICT. These results suggest that the upskilling process associated to the use of ICT would mainly concern less skilled labour. But some empirical papers also show the deskilling of managers working in operational functions who would lose their autonomy with the implementation of new technologies like ERP. Such process would lead to stigmatise and deskill middle management occupations (Buscatto, 2002). More recently, Autor *et al.* (2003), followed by Spitz-Oener (2006) and Goos and Manning (2007) have developed a conceptual framework to analyse and measure empirically job polarisation during the 1980s and 1990s. ICT are complementary with non routine cognitive tasks of skilled professional and managers on the upper part of the job distribution ('lovely jobs'). Their diffusion indirectly favour non routine manual tasks and lead to a rise in employment of unskilled low paid jobs ('lousy jobs'). And as a result, the demand for jobs in the middle of the job ladder would be falling because they mainly require routine manual and cognitive tasks. In this process, workers are displaced from 'middling jobs' to 'lousy jobs', because routine tasks are performed by computers.

The skilled-biased technological change theory and deskilling/upskilling theories have been strongly criticised for their determinism. Indeed, as developed in the literature review of Ramioul (2006), technological determinism assumes that a specific technological infrastructure highly determines the task pool and thus the specific division of labour that is necessary to make the technology work. Moreover, as argued by Ramioul (2006), these studies mainly focused on the use of computers. The impact of ICT on organisations can of course no longer be limited to the introduction of personal computers, on the contrary. The capacity of ICT for integrating all information flows within and beyond the organisational boundaries, the steering and monitoring capacities of production flows and workflows, the growth of ICT-enabled services *etc.* can have a considerable impact on the way the production is organised at the level of the value chain and at the establishment's level and is of a qualitative different nature than automation. These characteristics make ICT an 'organisational technology', because of its integrative nature and because of its impact on knowledge and communication structures in organisations.

The organisational choice theories (Roberts, 2004) and a mutual shaping between technologies use and organisation (Batenburg & Steijn, 2005) provide a more realistic approach. The notion of complementarity used in the economics literature conceptualises this idea of mutual shaping. According to Milgrom and Roberts (1990), any two productive activities or practices in a firm are complementary if the development of one increases the productivity of the other. In this case, the choices made by the firm in these two domains must be co-ordinated. In a standard production function, the firm essentially chooses the quantities of its production factors. In addition to these operational choices, there is a set of strategic choices of products, equipment, and organisational practices. If the complementary variables of the production function increase simultaneously, the value of that function increases by more than the sum of the value of the changes induced by the increase in each of the variables when taken separately. In the model of 'industrial excellence' mentioned by Milgrom and Roberts (1990 & 1992), computer-aided drafting, computer-aided-design, computer-aided design and manufacturing, and computer aided production management software, as well as programmable automated machines and robots are complementary to the rapid renewal of products, to small-batch production, to multitasking and multiskilling, as well as to just-in-time production and delivery practices, outsourcing and subcontracting. Several empirical studies have sought to test the complementarity between ICT equipment and new forms of organisation on firm level data (Gollac, Greenan & Hamon-Cholet, 2000; Caroli & Van Reenen, 2001; Bresnahan, Brynjolfsson & Hitt, 2002; Greenan, 2003). On other side, the complementarity of innovative organisational work with high-skilled labour is often interpreted as a skilled-biased organisational change. However, as shown in the sociological field, a wide variability of skills configurations, depending on managerial options and social relations may exist (Vendramin *et al.*, 2000). Ramioul and Huys (2007) provide an overview of organisation surveys on this issue. In this part, we provide a quantitative evidence of the correlations between technologies, organisation, skills and training at the workstation level and show the disparities in these correlations within European countries.

In the previous sections, we showed that one of the specificity of VCR is to transform power of decision between insourced/outsourced firms. Therefore, these technologies could be power-biased. Guy and Skott (2005) develop the idea of a power-biased technological change to explain the rise in earning inequalities using an efficiency wage model. For them, ICT are power-biased because they allow firms to monitor low-skill workers more closely and thus reduce their power of decision. Results from case studies allow discussing such a hypothesis. They will contribute to clarify the relationship between VCR technologies and the organisational contexts to explain their effects on occupational groups and training in a better way.

If the use of technologies is associated with an evolution of required skill, it is interesting to understand how this adjustment takes place. Behaghel, Caroli and Walkowiak (2008) analyse alternative channels for the French establishments at the end of nineties: training or hiring the new skills, or a combination of the two. Consistently with the results showing a skill-biased technological or organisational change, they find that new technologies and organisational changes are associated with an upward shift in the occupational structure within firms. They show that about one third of the upgrading of the occupational structure is due to hiring and firing workers on the external labour market, whereas two-thirds are due to promotions. If the internal labour market strategy seems

relatively important, authors cannot qualitatively assess it. Case studies help to identify the nature of the training associated with technological change.

Section 4.2 provides quantitative results evidence of the links between use of technologies, work organisation, skill and training within the EU. In Section 4.3, with organisational and occupational case studies, we identify more precisely how VCR technologies and skills development are interrelated. Throughout our assessment, we try to identify whether it is the employer or the employee who covers the cost of training related to the technology based reskilling process.

4.2 Technologies, organisation, skills and training: a quantitative evidence

Athey and Stern (1998) describe two different methods generally used to measure productive complementarities using micro data. The first approach analyses correlations between ICT and organisation variables conditional on observables. The second approach consists in estimating, in a production function framework, parameters associated with the interaction of ICT and organisation variables. Athey and Stern show, while working on different error configurations in the measurement of variables that neither of these two approaches is entirely satisfactory and that they only measure ‘presumptions’ of complementarity. In this part, we compute partial correlation between technologies, organisation, skill and training, using the 2005 EWCS.

The Table 4.1 provides the distribution of technologies, work organisation and training variables within nine occupations, based on the one-digit International Standard Classification of Occupations (ISCO-88 (COM)) codes:⁷

- legislators, senior officials and managers (coded 1 or ‘legislators’);
- professionals (coded 2 or ‘professionals’);
- technicians and associate professionals (coded 3 or ‘technicians’);
- clerks (coded 4 or ‘clerks’);
- service workers and shop and market sales workers (coded 5 or ‘service workers’);
- skilled agricultural and fishery workers (coded 6 or ‘skilled agr’);
- craft and related trades workers (coded 7 or ‘craft’);
- plant and machine operators and assemblers (coded 8 or ‘plant workers’);
- elementary occupations (coded 9 or ‘elementary’).

We group these occupations together to distinguish high and low-skilled white-collars and blue-collars (Box 4.1).

⁷ Another way to classify employees from the EWCS is to use the revised International Standard Classification on Education of 1997 (ISCED-97). As the WORKS project, ISCO classification is more relevant than the ISCED one, we then present figures according this classification.

Box 4.1 Categories of employees

Using ISCO codes, the European Foundation for the Improvement of Living and Working Conditions distinguishes four categories of employees:

- high-skilled white-collar (ISCO codes 1, 2 and 3) includes legislators, senior officials and managers, professionals and technicians and associate professionals;
- low-skilled white-collar (ISCO codes 4 and 5) includes clerks and service workers and shop and market sales workers;
- high-skilled blue-collar (ISCO codes 6 and 7) includes skilled agricultural and fishery workers and craft and related trades workers;
- low-skilled blue-collar (ISCO codes 8 and 9) includes plant and machine operators, assemblers, and elementary occupations.

White-collars clearly contrast with blue-collars in their use of technologies, whatever their level of skills. Unsurprisingly, the former mainly use ICT (computer and internet) while the second principally use automated machine. Once again, one should notice that being exposed to vibrations of machinery and having its pace of work that depends on automatic speed of a machine constitute two imperfect proxies of the use of automated machine. Among white-collars, the level of skill does not categorise workers' use of ICT. Indeed, the proportion of users of a computer in high-skilled white-collar occupations varies between *65 per cent* and *76 per cent*, which represents the same level as the one observed for clerks (*76 per cent*), who are low-skilled white-collars. This general picture also holds for internet. In the same way, among blue-collars, the level of skill does not categorise workers' use of automated machines. Indeed, the proportion of skilled agricultural and fishery workers that use automated machines is lower than the proportion of unskilled plant operators or elementary occupations users, which, in turn is lower than the share of users among (high-skilled) craft workers. Therefore, in these first figures, the nature of the job is more relevant to explain the use of a specific technology than workers' level of skill. This result could be due to sectoral differences in the equipment use.

4.2.1 Technologies, skills and work organisations

Using French data, Greenan and Walkowiak (2005) highlighted three phenomena characterising the equipment (in ICT and automated machines) of workstations in manufacturing. Firstly, deskilling of the work force is linked to exclusion from the use of technologies rather than to their use; secondly, the use of technologies leads the workstations of unskilled workers to 'catch up' the workstations of skilled workers; thirdly, ICT is the privileged tool for transforming the work organisation. Do these three phenomena fit with the European situation? Table 4.2 allows discussing these results at the European level. It provides the partial correlations between use of technologies and work organisation according to the levels of skill of white and blue-collars. The first phenomenon, observed in France at the end of the nineties, is only partly observed at the European level in 2005, while the two other phenomena are also characterise the diffusion of technologies in the EU.

Table 4.1 Distribution of technologies by occupation (EU-27)

	High-skilled white-collars (37%)			Low-skilled white-collars (25%)		High-skilled blue-collars (18%)		Low-skilled blue-collars (21%)		Total sample
	Legislators	Professionals	Technicians	Clerks	Service workers	Skilled agr.	Craft	Plant workers	Elementary	
Using a computer	65.6	76.0	69.7	75.6	34.5	5.4	16.1	16.4	15.3	45.3
Using internet	60.5	65.9	56.0	59.3	22.9	3.3	10.6	7.6	9.8	35.8
Being exposed to vibrations of a machinery hand tools <i>etc.</i>	26.2	18.1	23.3	12.5	19.2	54.5	80.3	62.4	36.1	35.2
The pace of work is dependent on automatic speed of a machine	14.6	7.8	12.2	12.8	9.3	18.1	33.2	45.3	19.4	18.5

Source: EWCS, 2005

Table 4.2 Partial correlations between technologies and work organisation by level of skill (EU-27)

	Complexity	Independence in time allocation	Industrial constraints	Market constraints
All skills				
Using a computer	0.24***	-0.04***	0.08***	0.08***
Using internet	0.24***	0.03***	0.06***	0.08***
Being exposed to vibrations of a machinery, hand tools, etc.	0.05***	-0.14***	0.21***	-0.00
The pace of work depends on automatic speed of a machine	-0.03***	-0.19***	0.53***	-0.28***
High-skilled white-collars				
Using a computer	0.21***	-0.03*	0.08***	0.07***
Using internet	0.21***	0.03*	0.07***	0.05***
Being exposed to vibrations of a machinery, hand tools, etc.	0.01	-0.14***	0.21***	-0.01
The pace of work depends on automatic speed of a machine	-0.01	-0.20***	0.49***	-0.24***
Low-skilled white-collars				
Using a computer	0.27***	-0.06***	0.11***	0.07***
Using internet	0.25***	0.01	0.10***	0.05***
Being exposed to vibrations of a machinery, hand tools, etc.	0.07***	-0.10***	0.18***	0.04***
The pace of work depends on automatic speed of a machine	-0.01	-0.10***	0.44***	-0.22***
High-skilled blue-collars				
Using a computer	0.14***	0.04***	0.00	0.04**
Using internet	0.18***	0.10***	-0.04**	0.11***
Being exposed to vibrations of a machinery, hand tools, etc.	0.07***	-0.14***	0.19***	-0.04**
The pace of work depends on automatic speed of a machine	-0.03**	-0.17***	0.63***	-0.32***
Low-skilled blue-collars				
Using a computer	0.20***	-0.04***	0.03*	0.05***
Using internet	0.23***	0.00	0.01	0.06***
Being exposed to vibrations of a machinery, hand tools, etc.	0.06***	-0.15***	0.23***	-0.02*
The pace of work depends on automatic speed of a machine	-0.02	-0.26***	0.60***	-0.35***

* Correlations are controlled by dummies on countries, industry, detailed occupations, gender and age.

Source: EWCS, 2005

Firstly, for all organisational variables, partial correlations with technologies have the same sign when they are computed on the different subsamples of skills or on the total sample. Use of ICT (computer, internet) is associated with more complexity, more industrial and market constraints and less independence in time allocation, whatever the level of skill. There is one exception for high-skilled blue-collars for whom the correlation between ICT use and independence in time allocation is positive. In other words, we observe that use of ICT has a positive correlation with variables measuring work enrichment. In that sense, deskilling of the work force seems linked to exclusion from the use of ICT rather than to their use at the European level. Results are more contrasted for automated machines. Being exposed to vibrations of a machinery or having the pace of work that depends on automatic speed of a machine are generally associated with less independence in time allocation and market constraints and more industrial constraints. The links between the use of an automated machine and work complexity and intensity of

market constraints depends of the variable considered (being exposed to vibrations of a machinery or having the pace of work that depends on automatic speed of a machine) as well as the occupation considered. The use of automated machines could generate a complex process of upskilling and deskilling. But this result could also be due to the fact that the variables are not good proxies of the use of automated machines.

Secondly, if the sign of the correlations between work organisation and technology does not depend on the level of skill, the strength of the correlation slightly varies according to the level of skill. Generally, these correlations are all the more strong that the skill is low. For example, the correlations between work complexity and ICT use is stronger for low-skilled white-collars than for high-skilled white-collars, and for low-skilled blue-collars than for high-skilled blue-collars. In a certain way, use of technologies leads the workstations of unskilled workers to 'catch up' the workstations of skilled workers.

Thirdly, organisational workstation characteristics react more frequently to the use of ICT than to that of an automated machine. Moreover, ICT is distributed throughout all the categories in work force, while automated machines have not penetrated the world of white-collars. ICT is thus the privileged tool for transforming the work organisation.

To sum up, we observe that: (1) deskilling of the work force seems linked to exclusion from the use of ICT rather than to their use while the use of automated machines would be associated to a more complex process of upskilling and deskilling; (2) use of technologies lead the workstations of unskilled workers to 'catch up' the workstations of skilled workers; (3) ICT is the privileged tool for transforming the work organisation.

4.2.2 Technologies, skills and training

These results raise the question of training of the work force: (1) Does the upskilling described with ICT entail more training? Does the upskilling/deskilling process associated with use of automated machines entail more or less training? (2) Do low-skilled workers receive more training than high-skilled ones to catch them up? (3) Are ICT users more trained than other workers? In this section, we answer these questions by highlighting the kind of training received by workers and the heterogeneity of these adjustments in European countries.

The EWCS also allows assessing the links between the use of technologies and training. It distinguishes four forms of training undergone by workers, over the past twelve months of their interview, to improve their skills: training paid for or provided by the employer, training paid for by the employee, on-the-job training (co-workers, supervisors), and other forms of training (like self-learning, on-line tutorials, *etc.*). Table 4.3 provides the partial correlations between use of technologies and training according to the level of skills of white- and blue-collars workers and Graph 4.1 represents these correlations within European countries. In this graph, countries are ranked according to the correlation between computer use and the training financed by employer.

First, ICT use (computer and internet) is always positively correlated with training, whatever the kind of training and whatever the skill of worker (Table 4.3). The strongest correlations between the use of ICT and training concern training financed by employers, but also other forms of training like self-learning, on-line tutorials, *etc.* Once again, these positive significant correlations could be a sign of upskilling associated with the use of

ICT. The upskilling process associated with the use of a computer is quite transversal to European countries since these correlations are non-significant only for Slovenia and Estonia (Graph 4.1). For all other countries, correlations are positive. The ranking of the correlations from France to Belgium could capture the ranking of this upskilling process within European countries.

Table 4.3 Partial correlations between technologies and training by level of skill (EU-27)

	Training paid by employer	Training paid by employee	On-the-job training	Other forms of training
All skills				
Using a computer	0.14***	0.04***	0.11***	0.13***
Using internet	0.11***	0.06***	0.08***	0.11***
Being exposed to vibrations of a machinery, hand tools, etc.	0.01	0.01	0.03***	0.01
The pace of work depends on automatic speed of a machine	0.00	0.02***	0.02***	-0.01
High-skilled white-collars				
Using a computer	0.13***	0.01	0.07***	0.12***
Using internet	0.10***	0.06***	0.07***	0.10***
Being exposed to vibrations of a machinery, hand tools, etc.	0.00	0.02**	0.06***	0.02**
The pace of work depends on automatic speed of a machine	0.02*	0.03***	0.03***	-0.03***
Low-skilled white-collars				
Using a computer	0.10***	0.06***	0.11***	0.13***
Using internet	0.06***	0.05***	0.05***	0.10***
Being exposed to vibrations of a machinery, hand tools, etc.	0.00	-0.02	0.02	0.01
The pace of work depends on automatic speed of a machine	0.00	0.01	-0.01	-0.01
High-skilled blue-collars				
Using a computer	0.19***	0.10***	0.12***	0.14***
Using internet	0.15***	0.14***	0.06***	0.11***
Being exposed to vibrations of a machinery, hand tools, etc.	0.00	0.03**	-0.02	0.02
The pace of work depends on automatic speed of a machine	-0.06***	0.02	0.01	0.01
Low-skilled blue-collars				
Using a computer	0.13***	0.02*	0.14***	0.14***
Using internet	0.14***	0.03*	0.11***	0.11***
Being exposed to vibrations of a machinery, hand tools, etc.	0.03**	0.00	0.03**	-0.01
The pace of work depends on automatic speed of a machine	0.02	0.02	0.08***	0.02*

* Correlations are controlled by dummies on countries, industry, detailed occupations, gender and age.

Source: Authors calculations, EWCS, 2005

For automated machines, results are more mixed.⁸ Correlations are often non-significant. In some cases, they are significantly positive but very weak and in two cases they are sig-

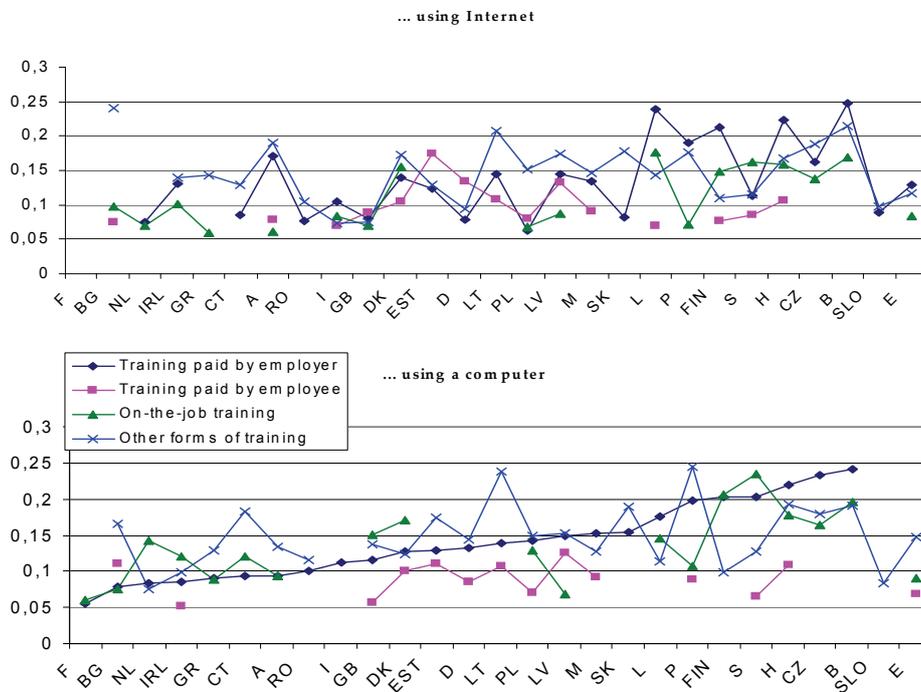
⁸ But once again, our variables imperfectly proxy the use of automated machines.

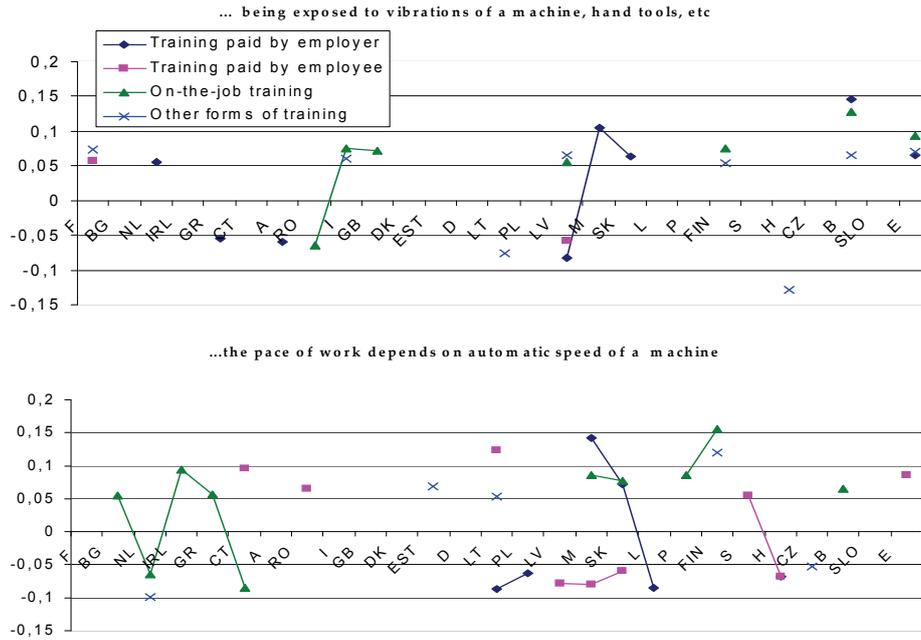
nificantly negative. Comparing European countries also give an account of this heterogeneity. For example, being exposed to vibrations of machinery is positively correlated with training paid by employer in the Netherlands, Malta, Slovakia, Belgium and Estonia, which suggest an upskilling process. At the opposite, correlations are negative for Greece, Austria and Latvia, which suggest a deskilling process. For other countries, these correlations are non-significant. Once again, this result show the complex upskilling-deskilling effect associated with use of automated machines.

Secondly, the catch up phenomenon noticed in the previous part depends on the form of training. It seems mainly realised through on-the-job training, since correlations between ICT and on-the-job training are stronger for low-skilled than for high-skilled white and blue-collar. For the training paid by employer, this result is inverted. For other forms of training the strength of the correlation with ICT does not depend of the level of skill.

Thirdly, once again, the correlations between technologies and training show that ICT is the tool of transformation of work. Indeed, correlations more significant for ICT than for automated machines. The comparisons of graphs for ICT and automated machines by country also confirm this idea.

Graph 4.1 Partial correlations, in countries of EU-27, between training and use of technologies





* Correlations are controlled by dummies on industry, detailed occupations, gender and age. Correlations significant at a 10 per cent level are represented on the graph.

Source: Authors calculations, EWCS, 2005

4.3 Technologies, organisation and skills: a qualitative evidence

Few quantitative studies have analysed the nature of skills generated by ICT use. In France, Walkowiak (2003) showed that relational skills are as much important as ICT skills. That is why ICT users generally follow teamwork training more often than ICT training. Case studies help to qualify the processes of upskilling, deskilling associated with technological change. They show precisely the new skills requirements (Section 4.3.1) and the new jobs that firms create to adapt to technological change (Section 4.3.2). They also highlight some cases of polarisation of skills (Section 4.3.3) or some cases where there is no skill effect (Section 4.3.4). Table 4.4 summarizes the distribution of cases studies among these categories. It is worth here, however, to make a clear distinction between ICT professionals and ICT users as the skill sets of these two groups of employees are different. According to Dixon (2005) the most important difference is that the professionals' work is only dedicated to information and communication technology. Their whole working time is devoted to designing, developing, implementing, testing, operating, maintaining, supporting and managing ICT systems for use by others. For ICT users, on the contrary, ICT provides only a tool that helps them to carry out their work. Therefore, ICT users' skills mainly refer to the skills needed for effective use of ICT. In the following, the professional/user distinction will be marked.

Table 4.4 ICT use and skills

Skills	Case and country	Technologies	Sector/function
<i>New skills</i>			
Only ICT skills	<i>Meanswearco</i> , DE	CAD	Tex/R&D
	<i>Natural Delicacy</i> , IT	ERP + Trace	Food/prod
	<i>Fishing company</i> , NO	Machinery to process fish, computer system and underwater camera	Food/prod
ICT- and customer-oriented skills	<i>Copy Fashion</i> , HU	ERP	Tex/prod+log
	<i>MM Spinoff</i> , DE	Web + Data	SGI/IT
	<i>Maltco</i> , UK	SC/PT	Food/prod+ log
	<i>Eco Clothing</i> , DE	Data + WF	Tex/log
	<i>Customer</i> , UK	Call + WF	PS/CS
	<i>Swedish post</i> , SW	Call + Web + ERP	SGI/CS
	<i>Postpartner</i> , AT	ERP	SGI/CS
	<i>Proconsulting</i> , FR	Web	PS/CS
	<i>Beer AD</i> , BG	VGE/SC	Food/log
	<i>CharleTIC</i> , BE	VGE/Soft. Ing.	IT/R&D
	<i>German railway</i> , DE	Internet+ticket machine	SGI/CS
	<i>Adele</i> , FR	ERP	Tex/log + R&D
	<i>NEA</i> , BG	None	PS/CS
ICT and communication skill	<i>Geisha</i> , NL	WF	Tex/log
	<i>DVLA</i> , IT	Call	PS/CS
	<i>Beer AD</i> , BG	VGE/SC	Food/prod
	<i>INIT</i> , SE	Soft. Ing.	IT/prod
	<i>City Council</i> , UK	Call + WF + ERP	PS/CS
	<i>Maltco</i> , Benelux	ERP	Food/log
	<i>Domainsoft</i> , HU	Soft. Ing.	IT/prod
	<i>Business Software</i> , DE	Soft. Ing. + intra + VGE	IT/prod
	<i>Softserv</i> , BG	VGE/Soft. Ing.	IT/prod
	ICT professional skills	<i>Comtel</i> , FR	VGE
<i>UK Lab</i> , UK		VGE/Intra	IT/R&D
<i>Comp A/A NOR</i> , NO		Soft ing.	IT/R&D
<i>Messenger/Digit</i> , AT/CRO		VGE/Soft Ing.	IT/R&D
<i>VR2</i> , DE		Soft. Ing.	IT/R&D
<i>IT Research Labs</i> , AT			IT/R&D
<i>New Jobs</i>			
	<i>EWA</i> , BE	Call+web+WF+Data	PS/CS
	<i>PCC</i> , SE	Call	PS/CS
	<i>Postpartner</i> , AT	ERP	SGI/CS
	<i>Beer AD</i> , BG	VGE/SC	Food/prod
<i>Polarisation</i>			
	<i>City Life</i> , AT	Call+WF+ERP	PS/IT
	<i>Dutch Telecom</i> , NL	Call+WF	SGI/CS
	<i>GBA & Easttown</i> , NL	Data	PS/IT
	<i>Maltco</i> , Benelux	ERP	Food/log
	<i>Meat Inc.</i> , DK	Automated production line	Food/prod
	<i>Trousers' Company</i> , DE	SC	Tex/prod
	<i>Intermed</i> , HU	Web	PS/CS

Table 4.4 ICT use and skills. Continued

Skills	Case and country	Technologies	Sector/function
<i>No skill effect</i>			
No use of ICT	<i>Wonderwear</i> , BE	Nothing	Tex/R&D+log
	<i>Company B</i> , GR	Nothing	Tex/prod
	<i>Company A</i> , GR	Nothing	Food/prod
	<i>Tevitom</i> , PT	Nothing	Tex/prod
Use of technology but no skill effect mentioned	<i>Greek post</i> , GR		SGI/CS
	<i>ITPRO</i> , BE	WF + Data	SGI/IT
	<i>IT Healthcare</i> , PT	WF	SGI/IT
	<i>IT Health</i> , NO	ERP	SGI/IT
	<i>Swedish post</i> , SW	ERP	SGI/IT
	<i>Green SPA</i> , It	ERP	Tex/prod+R&D
	<i>WW-DK</i> , PT	SC	Tex/R&D
	<i>G-log</i> , PT	Track	Tex/log

Source: WORKS organisational case studies

4.3.1 New skills

In a large part of case studies, the adoption of new technologies is associated with new skills requirements for ICT users. As expected, most cases describe new need in ICT skills associated with ICT use. In some cases, however, ICT skills were combined with such generic or social skills like among others communication, customer handling, teamworking and problem solving. Here the term ‘generic’ refers to the fact that these skills are transferable, *e.g.* irrespective of any specific occupational context, and the term ‘social’ means here that they are non-technical skills or competencies and involve abilities to facilitate performance in social situations (Hurrell, 2007). Customer-oriented and communication skills requirements are accompanied by the use of new technologies. According to the way these skill requirements combine, we can distinguish three categories. The first one represents cases where technology generates only new ICT skills. The second category represents cases where the new ICT skills are combined with customer oriented skills. The development of the later requires interacting with customer outside of the firm. They represent a kind of commercial skills. In the third category relational or communication skills appears as important as ICT skills when new technologies are implemented. As for customer oriented skills, communication skills represent soft skills. While customer oriented skills are focused on the customer and goes beyond the frontier of the firm, communication skills that we discuss here refers to interpersonal skills used at the workplace when communicating with colleagues to solve unforeseen problems. Moreover, when looking at new skills generated by implementation of ICT, analysing the skill content of workers from the ICT sector is particularly interesting. For the ICT professionals we can precisely identify what is the content of ICT competencies. That is why we introduce a fourth category of new skills for them.

4.3.1.1 Only ICT skills

Cases where only new ICT skills are required from the users are the simplest to explain. New ICT skills are directly generated by the use of new technologies. These new ICT skills are required for people using these new technologies. For example, the introduction of technological development in design and pattern making at *Meanswearco* (Germany, clothing industry) involves new CAD-related skills for designers and patterns makers. Such cases are also observed in the food industry (like *Natural Delicacy* in Italy or FC in Norway). In the case of *Fishing company*, in Norway, the firm introduced several technologies: machinery to process fish, computer systems and underwater cameras. It entails to have a certain amount of technological skills to use computers for fish farmers and it does not really transform core competencies of slaughter and fillet production workers.

Even for more sophisticated technologies, the upskilling process associated with the implementation of the technology could be due to only ICT skill. For instance, the implementation of the new ERP system to integrate the logistic processes and production capacity at *Copy Fashion* (Hungary, clothing industry) only generated computer-related skill need in the area of logistics.

Of course, one should argue that besides new ICT skills workers generally need several other competencies. It is true. However, in the cases reviewed here, those skills have not evolved with the implementation of new technologies. The example in Box 4.1 extracted from the *Fishing company* case shows that core competencies of fish farmers remain the same, even if new ICT skills are required to use technology. In the same way, *MM Spinoff* in Germany point out that the core competencies of Policemen did not change with the introduction ICT eLearning tools but they need to learn how to use the IT system. Since these computer-related skills are very basic, one could not consider it as an increase of core competencies.

Box 4.2 Only ICT skill requirement

Fish farm employees are working with living animals that grow, get sick, escape, *etc.*, and their work is also subject to other changing factors such as weather conditions. In sum, this means that the work cannot be too rigidly planned and organised, and improvisation plays an important role. The workday consists of various tasks that must be performed, such as feeding, but the employee is very free to organise his day the way he wants. He must therefore be able to make independent evaluations and decisions on what to do and with what priority, and also foresee certain tasks, such as preparing the cages before bad weather. Ability to work independently is valued as one of the most important skills needed to work at a fish farm, besides, of course, the ability to work at sea. Before, physical strength was also essential because the job implied a lot of heavy lifting. However, today machines have replaced most of the hard work. As one employee illustrates it, 'before, we used to receive the feed in bags of 25 kilos. Today, there are feed boats with hundreds of tons of feed coming, and we use remote controls to fill it in'. Computers have also become part of the everyday workday. That means, the workers must have a certain amount of technological skills and be able to, for example, register feeding in the computer system or operate the underwater cameras that supervise the net cages. (Saetermo *et al.*, 2007: 20)

4.3.1.2 ICT- and customer-orientated skills

Situations where only ICT skills are required are rare. They generally combine with other new skills. The second category regroup cases where ICT and customer oriented skills are required when new technologies are implemented. Unsurprisingly these new skill requirements are mainly identified in cases that study the customer service function in the public sector or in the services of general interest: *Customer* (UK, public sector), *Postpartner* (Austria, service of general interest), *Postpartner* (Sweden, service of general interest). However, new customer-oriented skills are not limited to customer function since these requirements are also mentioned in the ICT function of a service of general interest (*Proconsulting*, France), in the logistic function of the food industry (*Beer AD*, Bulgaria). It means that customer orientation skills tend to be a quite transversal requirement associated with technological change.

First, let us analyse the changes in customer service function. In that function, ICT and customer skills appear strongly related to each other (cf. Box 4.3). Indeed, the technology is a tool used in the relation with customer. However, this evolution is felt differently in the public sector compared with the postal services. In the case of *Customer* (UK, public sector) these new skill mix requirement is linked to new culture of customer service and understanding newly learned technologies. Employees feel it as an upskilling. In postal services, the introduction of the ERP has a different consequence. These technological changes are associated with a deep transformation of the postal service job where the selling activity increases. In Austria and in Sweden that is not always felt as an upskilling process. Finally, one should notice that most cases that deal with customer service, customer orientation skills do not appear as new skill requirements.

Secondly, let us analyse what means customer oriented skill in other functions that customer service. In such cases, customer oriented requirements translate the development of commercial activities within occupation which are combined with the use of ICT, whatever the function or sector concerned. In the *Proconsulting* case (ICT function), the IT function support the new orientation of Assedic from a production entity to a service structure. Therefore, the skill structure has to possess a more commercial Profile and to be able to use new technologies implemented. In the logistic function of the *Beer AD* case, besides ICT skills associated with new technologies, the increased role of customers in the work of logistic explain customer orientation of skills. In *CharleTIC* (Belgium, IT, R&D), besides professional skills of researchers, the biggest change has been the fact that each employee has to be commercially oriented. That means that everyone has to be able to make contacts, to spot new opportunities, to represent *CharleTIC*, to 'sell' its activities, to translate a company need into a project, as well as to follow-up the project and the relationships between *CharleTIC* and the customer. In these cases, however, the growing demand for improving social skills are not generated by introducing new technologies but the increasing role of the customers. ICT influence the changes of skill demand indirectly in a doubled way. Firstly, ICT enable to react quickly to the fast changing customer needs and secondly they facilitate the increase of the (global) competitive pressure.

Box 4.3 ICT and customer oriented skills

For transferred staff it was crucial (in the words of a Global representative) to learn 'a new culture of customer service and understanding customer's or ROTA's public access vision'. In addition, learning involved the use of new technology to handle telephone and email enquiries. Customer service agents felt the new Global technology was clever but also that some services needed tweaking. Systems can be slow sometimes, but they are seen as 'easy to use and not stressful'. Interviewees believed that it had not made their jobs more stressful. At Customer, most of the transferred staff had dealt with a very small, specialised area before (for example student loans) and due to the transfer had to develop a knowledge of 400 local government services, demanding a diversification and broadening of existing knowledge. Interviewees considered their new roles to be an upskilling due to broader knowledge and newly learned technology. (Dahlmann, 2007c)

4.3.1.3 *ICT and communication skills*

When new technologies are introduced communication skills are also often required in addition to ICT skills. These kinds of needs are identified in cases from different sectors (food industry, public sector, IT sector) and different function (customer service, IT function, production). Thus, it can be viewed as a quite general requirement associated with technological changes. It is easy to understand this new skills mix when thinking that technologies at stake are information and communication technologies. This need to interact comes for different reason: just communicate, co-ordinate and co-operate. These three dimensions can be identified in case studies.

First, the need to communicate at work can be part of the work and can increase in a period of restructuring. These communication skills are described as good spoken language skills, ability to use the phone (for the case of *DVLA*, Italy). However, interpersonal skills also include knowing to whom someone has to direct when she/he encounters a problem.

The period of restructuring is also a moment when co-ordination needs rise, which generate face to face interactions before entering in a codification process, which may stabilise the new organisation. Interpersonal skill requirements for co-ordination needs are outstanding in the case of *Beer AD* (Bulgaria, food industry). Because the process of standardisation is at a codification stage, communication skills of managers are crucial to set up routines and codes to solve problems. Moreover, in the global restructuring managers have to co-ordinate with headquarters, using English and new technologies. Box 3.3 shows that the lack of these communication skills raises some problems of co-ordination at the operational level and group level.

Finally, increased communication skills combined with ICT skill also relate to the development of co-operation. For instance, at *INIT* (Sweden, IT, production) which introduced software development tools and internet, the knowledge demands are high - from programming and the design of technical platforms to analysing business processes in different kinds of environments. The technical competence also needs to be combined with co-operation skills. Moreover, through the offshoring and the merger, language and culture skills have been increasingly important.

Even if interpersonal skills increase, the process is not necessarily felt as an upskilling process. For instance, at *City Council* (UK, public sector), the ICT-driven centralisation has led to a standardisation of the workflow and to a reduced autonomy for workers. Even if skills that are more interpersonal are required, this process is perceived as a deskilling for some of the transferred staff.

Box 4.4 Interpersonal skills

The restructuring processes in the production impacted differently the intensification of knowledge on the level of blue-collars and on the one of managers. Within the workers' population the changes regarding knowledge intensity could be seen in terms of technological and technical standardisation, according to the brewing group's requirements for quality of production. That change brought to the necessity of increasing the software knowledge of the staff. Another change that influences the knowledge intensity was the increase of the administration in the company. Namely the formalisation of reporting procedures is negatively evaluated by the blue-collars because 'it is an unnecessary bureaucratic' and 'increases the feel of uncertainty to whom and where to report to'. Usually in such situations the implicit knowledge comes into play (especially in cases of emergencies). In other words, although there were explicit attempts for codifying knowledge, it seems that they were not enough in relation to the blue-collars acquaintance with the organisational and subordinate hierarchical structure of the company. On the level of management the codification of knowledge seems to be uneven as well. The new technological, quality, qualification, *etc.* requirements challenged to great extent the performance of the managers. Again, the codification of knowledge seems to be still not sufficient in terms of ways and levels of reporting and subordination. Besides what mostly troubles the performance of the managers is the adoption of the group's policies to the local conditions and the communication with the management levels in the Zone, which are usually expected to be done virtually (on-line) and in English language. At the same time, although difficult to be performed, what is mostly appreciated by the middle level management in the PLV brewery is exactly the transfer of best practices coming from other breweries of the group. (Stoeva, 2007: 12)

4.3.1.4 *What does it mean to adapt to ICT?*

In case of the ICT professionals, it is worth stressing the importance of the combination of 'hard' or technical skills with context-specific knowledge and generic social skills. In the IT industry, three basic types knowledge necessary to execute work tasks are identified, especially in project-based work organisations:

- first is *professional* knowledge (*i.e.* knowing different programming languages and methods);
- second is '*domain*' knowledge which is related to the specific areas of software development (*e.g.* knowing local government systems), and;
- third is *management* skills.

The knowledge pool of an ICT professional (*e.g.* software developer or a project leader) is a combination of these kinds of skills that are based partly on formal qualification and partly on competence. The most problematic areas of knowledge acquisition in this sector

are the competence-based knowledge components that are mainly related to domain-specific knowledge and such social skills like project management capabilities or customer orientation. These skills (competences) can only be acquired via informal learning, especially through experiences collected in the labour process (Makó, Illéssy, Csizmadia, Kirov & Galev, 2009).

The specificity of case studies carried out in the IT sector is to precisely identify the 'technological content' of the skills or job. Therefore, they offer a detailed analysis of what skills in ICT can recover. It appears, that when they adapt to very innovative technological environments, workers develop very heterogeneous ICT skills.

In *Comtel* (France, IT sector, R&D), current skills needs concern all emerging markets and technologies: mobile devices, audiovisual, multimedia, new architectures like IMS, home network, software services, voice over IP. Software skills are a priority. In *UK Lab* (UK, IT, R&D) which is involved in the newest technology (text to speech synthesis and speech recognition), the highly-skilled work force is specialised in the field of speech technology. In *Comp A* (Norway, IT, R&D) which apply technologies appropriate for the development of search engines current skills needs are different: mobile devices, audiovisual, multimedia, new architectures, home network, software services, VoIP. In *Business Software* (Germany, IT sector, production), the newest info-communication technologies are adopted (e.g. intranet and various types of groupwares) enhancing ICT-based teamwork. Finally, at *VR2* (Germany, IT, R&D) which is specialised in computer programming, visualisation techniques, virtual reality, the R&D employee has to have a high level of knowledge of computer programming, visualisation techniques, virtual reality implementation, and a specific knowledge of the software that they use.

4.3.2 New jobs

Technological change is also associated with the creations of new jobs or occupations. For instance, in the *EWA* case study, the creation of new unit within public administration to manage administrative simplification and eGovernment process leads to the transfer of employees from public administration to *EWA*. This new unit has created new job titles, which are disconnected from official administrative title and close to that of private firms (example: system security expert or readability expert). However, it is not clear how much these new job titles correspond to really new job. One can imagine that a significant part of job is new because workers are not transferable to other departments due to their function in *EWA*. In the Swedish *PCC*, a new administrative unit dedicated to customer service was also created. It is a call centre, which receives the crime reports from citizens and has to transfer information to the police officer. The creation of this new unit leads to the creation of new job in administrative area with different skills demand than that for police officer. This job were especially performed by female whereas male are in majority in the police academy. In the *Postpartner* case study in Austria the creation of new job looks like an enlargement of the job. The workers at the post office have to sell non-postal products like cd, dvd, mobile phone and other products related to leisure. This new part of the job is not directly the consequence of technology but of the restructuring process, that is strongly support by ICT. Finally, in the food industry, the restructuring of *Beer AD* generated strong interpersonal and management requirements. Consequently, a new position of shift manager was created, to fulfil these supervision requirements.

4.3.3 Polarisation

Polarisation phenomenon is often observed when the restructuring involves a standardisation of a part of the activity. As argued by Freyssenet (1974) the deskilling of some workers generally comes from the upskilling of others. The intellectual activity get out a huge number of workers concentrate on a small number of workers. Therefore, when analysing polarisation effect, one should identify the level of deskilled operations (that follows generally standardisation) and the level of upskilled operations. Box 4.5 provides an example of polarisation in the food industry. Case studies also qualify precisely the nature of skills involved in this process. Such processes of polarisation are observed in different sectors (public sector, service of general interest, food industry) and different function (customer service, IT function, production). Once again, they appear to be a quite general phenomenon.

Generally, the upskilled group has to use new skills mentioned in the previous section: ICT skills, customer oriented skills or communication skills. For the deskilled group, standardisation empties their core competencies. Several cases show this double tendency in polarisation. At *City Life* (Austria, public sector) part of activities deskilled and upskilled are clearly identified and recovers the division of labour. There is a deskilling of workers at the call centre multical where work tends to be overqualified and an upskilling at *City Life CSC*. The Dutch telecom (the Netherlands, service of general interest) case clearly shows that the deskilling effect comes from the standardisation of the basic work of contact worker, since at this level the knowledge is embedded in technology rather than in human capital. At the opposite, the development of new and complex products led to a process of upskilling in different direction: commercial, marketing, but also ICT skills become more relevant to use new media. *GBA & Easttown* (the Netherlands, public sector) offer another example of polarisation phenomenon which is quite complex. The shift in knowledge led to a shift in skills. The *Easttown* public administrative workers undergo deskilling with respect to the legal-substantial function requirements. A decrease of discretion occurs and a shift to legal substantial function requirements and skills from the public administrative workers to the IT developers and operators. Requirements on the other hand increase with respect to social interactive skills and the operation of the information system. Next to that, public administrative workers cover a broader range of legal regulations, however at decreased depth. These changes at the operational level of the *Easttown* municipal government administration go along with the increasing importance of co-ordination functions at the strategic level. IT co-ordinators face strong communicative skill requirements and they enjoy a high level of autonomy. Stronger substantial knowledge and skill requirements are made upon the IT provider's product developers. They need to integrate public regulation knowledge with IT system knowledge. Because of technological changes, these employees face increasing work autonomy and increasing work requirements.

We should also notice that generally, workers deskilled during this polarisation process feel generally underestimated. This feeling is particularly strong for workers from *Maltco* (Benelux) in the food industry that says that the complexity of work has been underestimated by the management.

Box 4.5 An example of polarisation

The increase in knowledge intensity due to automation only goes so far. Only a very few number of workers actually work with tasks involving extensive IT qualifications and technical skills. The increase in automation and the use of computers in the workflow thus shows classic example of a simultaneous upskilling/downskilling process, where a few workers get significant technical skills and have increased responsibility and influence, where the major part of the workers are less challenged and have fewer learning opportunities on-the-job. There are no formal skill criteria for the selection of workers for the new 'upskilled' type of jobs, workers who show interest and initiative and a positive attitude and have a flair for technical problem solving are often those selected. Women and non-Danish slaughterhouse workers are rare members of the new 'upskilled' [...] As a whole the skill structure has not changed a lot due to restructuring. Slaughterhouse work is still mostly manual and repetitive. Automation had however made an upskilling process available for a few workers, while the change in work organisation and the automation decreases the variety of tasks in each individual job function. Being a matter of the new upskilled group tends to be a matter of social skills rather than formal training. (Gorm-Hansen, 2007)

4.3.4 No skill effect

Besides case studies that do not involve implementation of new technologies, some case studies that involve technological changes do not mention any skill effect. These cases are particularly numerous in the IT function from service of general interest. This absence of skill effect of the technology may be easy to interpret here. Indeed, the ability to adapt to new technologies is part of the work of workers from the IT function. Then, it is not surprising the ICT do not generate a skill effect at IT services (Germany), IT services (Belgium), *IT Health* (Norway), IT business provider (Sweden) or *IT Healthcare* (Portugal). Skills of ICT professionals are substantially technological. So, technological change is part of their basic skills. It does not mean that ICT professional do not learn on-the-job at all.

Three other case studies mention the introduction of new technologies without skill effect: postal services in Greece, *Green SPA* in Italy (clothing industry) and *WW-DK Texteis* in Portugal. It shows that introduction of new technologies does not always involve evolution of skilled required.

To sum up, in assessing the case studies, it is worth to make a distinction between the skill needs of the ICT professionals and users, *e.g.* between those who work with ICT systems for use by others and those to whom ICT are only tools in carrying out their work. The evidences gained from the case studies suggest distinguishing four patterns of skill demands associated with the implementation of ICT. In the first case the ICT use requires only technological (ICT) skills. In the clothing industry the introduction of a CAD-based design and pattern making system serves as an example. In the second case the ICT use is accompanied by the improvement of such social skills like customer orientation. This pattern is typical in the public sector or in the services of general interest, where new ICT tools are directly used for satisfying the customers' needs. It is also present in the business function of customer service, whatever the function or sector concerned. In these cases the driver of the parallel demand for technical and social skills are the increasing and fast changing customer demands. Those case belong to the third category, where soft skills,

especially communication skills are as important as technical (ICT) skills. ICT professionals represent the fourth pattern. In this case the skill set of employees is a combination of technical and skills (e.g. programming languages and methods), context-specific knowledge that is related to the specific areas of ICT-related development activities and social skills like managing projects. Technological change that mainly refers to the implementation and use of new ICT tools are also associated with the creation of new jobs and occupations. It can take a form of labelling existing group of work tasks or job enlargement. The change of the job content and structure also involves the standardisation of work tasks. From this perspective the case studies show a rather heterogeneous picture, where standardisation of work task are accompanied by both deskilling and upskilling. This process is reflected in the polarisation in the division of labour and the changing role of the different types of skills, e.g. technical *versus* social skills.

4.4 Technologies, organisation and training: a qualitative evidence

Do these new skill requirements involve training? What kind of training: formal, informal, both? In almost all case studies that mention a technological change, formal training programs accompany the restructuring to fulfil new skill requirements. Only three case studies do not mention any training programmes and three other cases relate informal training without formal training programme. For all other cases, training programme is a key dimension of the restructuring process to adapt the labour force. We present them in Section 4.3.1 by distinguishing programs viewed positively by workers from those that are judged insufficient. In Section 4.3.2 we focus on the case studies that show only on-the-job training by workers to adapt to evolution of their workstations. Section 4.3.3 analyse case studies where there is no training.

4.4.1 Formal training and technologies

First, it appears that training programs are viewed positively in almost all case studies that cover service of general interest and in the clothing industry, whatever the function analysed (customer service, IT function, logistics, design or R&D). In the public sector and food industry, employees do not always regard training programs as sufficient. These training programme answers the new skill requirements which are generally technical even if skills requirement could encompass just ICT skills, but in some cases, the training also aim to improve customer oriented or communication skills.

Let us analyse case studies where training programs are essentially technical. At *Post-partner* (Austria) training policies are technical. The post office partner received training on the post office software system that is financed by the post office. In the same way, in IT services (Germany), the move to eLearning modules was a change to more training to learn the use of the new IT system rather than a change in content. In public sector further training are offered. Even if, other changes that arise due to changes in work processes (such as electronic document management, central archiving of meeting protocols with editing functions, *etc.*) require learning to work and communicate differently. Many of these processes are simply introduced without special training policies. Such exclusive technical dimension of training programme is also observed at IT services (Belgium), where the introduction of Euterpe did not have any influence on skills structure and

needs but has involved a specific training programme about Euterpe system management. Workers from the IT provider company gave the learning session inside the public administration, along with responsible from the administration. Training programs focused on the use of technology are not specific to the sector of services of general interest. They are also frequently observed in the clothing and food industry. At *WW-DK Texteis* (Portugal) the introduction of the order tracking system required an intensive investment in employees' training. At *Meanswearco* (Germany) regular trainings are organised for pattern makers to stay up to date with the new software. *Copy Fashion* (Hungary) provides regularly training to the employees in order to improve their ICT skills. At *Natural Delicacy* (Italy), numerous courses have been (and will be) organised on product quality, on the use of machineries, on the way they should be cleaned, and on workplace health and safety. In the same way, at *Maltco* (UK), the type of training that is required relates to operating a new machine properly, supporting the work force flexibilisation.

As argued in the previous section, new skill requirement also involve customer oriented skills among firms studied. That is why some firms develop some training programs in that dimension. For instance, at *DB station & Service AG* (Germany) training concern more the new customer oriented services than the use of new technology. In the same way, at *DB Sales* has specialist trainers for travel advisors and the employees at the service point are also trained in service meeting. Such customer orientation of the training programme is also observed in the public sector. At *Customer* (UK, public sector) the upskilling goes through training in customer relations. At *Police Contact Centre* (Sweden) these training programs are combined with weeks of practice under supervision. Finally, some firms combine different forms of training. For instance, *Postpartner* (Sweden) combine both technical training and customer relations training which are more individually and professionally oriented training programme.

Communication skills are also often mentioned in case studies as new requirements. It appears that workers scarcely receive a training to communicate. Only one case study mention such communication programme: *Meat Inc.* (Denmark). In line with its general policy about corporate social responsibility, *Meat Inc.* invest in language courses for workers with little or no Danish language skills. Indeed, automation involves reading and writing skills and some foreign workers, especially women, still do not speak or write Danish.

Some training programs also lead to a certification process that beneficiate to workers. For instance, at *Dutch Telecom* (the Netherlands), firm developed an educational policy that gives permanent employees the opportunity to become a certified agent. At *IT* (UK) this certification process is part of a quite complex programme of training. In the food industry, the *Fishing company* (Norway) has as goal that all employees should have a certificate of completed apprenticeship, especially those who work in fish farming. If they do not already have it at the time when they start working for FC, they are given the opportunity to do it at the workplace. The example of *GBA & Easttown* (the Netherlands) clearly explains how this certification process beneficiate to workers. It aims at attaining increased levels of skill and increased salaries. For a period of one and a half year, training on-the-job was given. Employees were exempted from normal rosters while receiving on the job training. A distinction was made between 'product-oriented' training, aimed at the various legal-substantial fields of work and at the operation of the IT system with respect to the various legal processes. The training was tailored to the individual employee, tak-

ing into account the fields the employee already worked on, their ICT technical skills and the progress that was made during the training programme. The training was initially provided without strong obligations and structure. After this initial period, a tighter training schedule was implemented and the salary increase that went along with increased skill requirements was made conditional upon successful conduct. The product training was combined with a number of workshops on both technical and social interactive issues. In order to assess training success, the training period was concluded by a test. Those who successfully passed the test and appeared able to manage the broader range of products would receive a one level salary raise.

In other case studies, especially, in the function of customer service of public sector, training programs appear less virtuous to the eyes of workers for different reasons. At *City Life* (Austria) initial training at call centre is not accompanied by a real policy after. At *DVLA* (Italy), the low quality of training programme provided at call centre is a source of dissatisfaction. At *EWA* (Belgium) there is various training schemes in general skills without strategic plan. Finally, at *Intermed* (Hungary) it lacks a systematic training programme and training is essentially informal. These kinds of dissatisfactions are also observed in other sectors. For instance, at *IT Health* (Norway) collective training programme are very basic and the initiative for other training is individual. At *Beer AD* (Bulgaria) if training programs exists, their content and the learning opportunities that they offer remain unclear to workers. Finally, in *Maltco* (Benelux) training programme are considered too short and insufficient as regards with new requirements.

4.4.2 Informal training (alone) and technologies

Three case studies report informal training alone, without any training programme. At *Intermed* (Hungary), the unfavourable status of the formal training system in the local labour market offices does not mean the lack of knowledge development, sharing and transfer among the staff members. During the interviews, several staff members indicated the crucial role of such types of training as on-the-job training (OJT). In the same way, training at *IT Healthcare* (Portugal) and *Comp. A* (Norway) is essentially on-the-job. Let us better analyse what OJT means.

The various case studies carried out within the framework of the WORKS project call the attention to the interplay between the different work organisation models and the firms' knowledge use and skill development practices. On the other hand we could also identify the growing importance of OJT in different sectors. OJT practices are characteristic especially in the 'lean' or Japanese production systems, where the organisation relies on knowledge that is rooted in operating routines, team interactions and organisational culture. It is hold collectively and embedded in social structures. In these cases OJT develops task-related and organisation-specific knowledge (Lam, 2002). This type of knowledge acquisition is especially effective in matured sectors, like clothing industry. The Hungarian *Copy Fashion* in clothing industry represents the 'lean production model' with strict production norms, controlled autonomy of employees and increased learning and problem solving capacity. Due to the shortage of qualified workers and the intensive competitive pressure the company is forced to provide the employees OJT. The core question is, however, how the high quality standards can be maintained with relatively low-skilled and low paid labour force. The company's skill development practice is based on a com-

bination of individual and collective learning process. In the latter one, the intensive presence of clients' quality controllers plays a critical role through transferring not just precise quality standards but also technical and organisational skills.

OJT is also present in sectors where 'learning organisations' are dominant and where a the majority of firms reach a 'high-skill equilibrium', which is based on intensive knowledge development and utilisation. In the case of *Domainsoft* in IT industry, the knowledge of ICT workers is a combination of technical-professional and competence-based managerial skills that can be acquired mainly through practical experiences collected in various working situations, especially through participating in various projects. The case, however, highlights the difficulties of knowledge acquisition in project-type work organisations, both in case of technical and social skills. The question here is how to motivate the employees in sharing their mainly tacit knowledge even in situations where they are not interested in doing so, for example in cases when the different organisational units compete with each other in winning or keeping projects. In order to overcome this problem, the *company* invests a lot into the improvement of the employees' knowledge pool. A special intranet-based application was developed for this purpose, which is called *Techno Web*. Its aim is to integrate the *Domainsoft's* developers. If, an employee faces a professional problem, he just needs to post a question and the response usually arrives quickly. Employees' activity on TehnoWeb is regularly measured and positively influences their career opportunities. This form of knowledge management is an attempt to encourage and improve the developers' virtual 'communities of practice'.

Box 4.6 *The importance of the 'community of practice'*

Concerning knowledge management at this company, web systems provide complete methodological background so that the whole company including each colleague is integrated in this knowledge network. So, PSE states that colleagues possess the knowledge that provides value for our customers. Therefore in the world, let us say there is a narrow group of experts who declare what are the trends, and what direction should be followed, the firm does not share this philosophy, but says that each colleague is a technology sensor. Each colleague has a field of interest, a group of friends, or co-operates with several other colleagues on a given field, and a network can be created from this. Therefore, if a colleague is interested in a certain area he can initiate there some activities and he can also advertise himself' (branch leader, Budapest). (Makó, Illéssy & Csizmadia, 2007a)

4.4.3 No training when using technologies

Case studies that do not mention training programme associated are those where is no skill effect associated with the introduction of new technologies (postal service in Greece and *Green SPA* in Italy). One case study refers to an upskilling process without any training programme: the logistic activity of *Beer AD*. In that case, the upskilling is due to use of new technologies and new customer orientation of the logistic function.

4.5 Conclusion

In this section we tried to provide a brief overview about the mutual relations between technology and skills, based on both quantitative and qualitative evidences collected in the WORKS project.

Concerning the link between technology and skills, the statistical analysis shows: (1) deskilling of the work force seems linked to exclusion from the use of ICT rather than to their use; (2) use of ICT lead the workstations of unskilled workers to 'catch up' the workstations of skilled workers; (3) ICT is the privileged tool for transforming the work organisation since it concerns all occupational categories. Concerning the link between technology and training, the quantitative analysis shows:

1. ICT use is always correlated with training, which could be a sign of upskilling;
2. the 'catch up' phenomenon seems mainly realised through on-the-job training.

In assessing the case studies, it is worth making a distinction between the skill needs of the ICT professionals and users, *e.g.* between those who work with ICT systems for use by others and those to whom ICT are only tools in carrying out their own work. The evidence gained from the case studies suggest to distinguish four patterns of skill demands associated with the implementation of ICT. In the first case the ICT implementation requires only ICT user skills. In the clothing industry the introduction of a CAD-based design and pattern making system serves as an example. In the second case the ICT use is accompanied by the improvement of customer orientated skills. This pattern is typical in the public sector or in the services of general interest, where new ICT tools are directly used for satisfying the customers' needs. It is also present in the business function of customer service, whatever the function or sector concerned. In these cases the driver of the parallel demand for technical and social skills are the increasing and fast changing customer demands. Those cases belong to the third category, where communication skills are as important as ICT user skills. ICT professionals represent the fourth pattern. In this case, the skill set of employees is a combination of technical professional skills (*e.g.* programming languages and methods), context-specific knowledge that is related to the specific areas of ICT-related development activities and soft skills like managing projects.

The implementation and use of new ICT are also associated with the creation of new jobs and occupations. It can take a form of labelling existing group of work tasks or job enlargement. The change of the job content and structure can also involve the standardisation of tasks. From this perspective, the case studies show a rather heterogeneous picture, where standardisation of work task are accompanied by both deskilling and upskilling. This process is reflected in the polarisation in the division of labour and the changing role of the different types of skills, *e.g.* technical *versus* soft skills.

Concerning the changing skill requirements generated by the implementation of new ICT, various skill acquisition patterns can be identified in the different case studies. In cases where formal training is provided for the employees, it is mainly technology-oriented or, especially in public services and services of general interests, combined with customer orientation training programmes. As for the informal training practices, the case studies call the attention to the interplay between the different work organisation models and the firms' skill development practices. The informal or on-the-job-training (OJT) is of increasing importance, especially in matured sectors, where lean or Japanese production systems dominate, like in clothing industry cases. In these cases, companies are forced to

provide OJT to their employees due to the lack of qualified workers and vocational training institutions and for cost saving reasons because of the increasing competitive pressure. OJT is also present in sectors where learning organisations are dominant, like software development. In these sectors knowledge is fluid and not codified, therefore it can be developed and acquired mainly through practical work experiences (*e.g.* via learning by doing, learning by using and learning by interacting).

5 Conclusion

In this thematic report, we analyse the relationship between the use of technologies at the workplace, work organisation, skills and training, in a context of the VCR and with in mind the work complexity paradox identified by Greenan *et al.* (2007) in the quantitative pillar of the project. We combine the very rich material developed during the WORKS project: quantitative data (at the individual and organisational levels), qualitative data (at the occupational and organisational levels), and finally the theoretical and policy reports that put in perspective main findings. We organise the report around the interplay between technology and the restructuring of value chain (Chapter 2), work organisation (Chapter 3), skills and training (Chapter 4). Each section includes a quantitative part based on the 2005 edition of the EWCS and also the most recent Eurostat data. It frames the qualitative findings of case studies. During the WORKS project, 57 case studies were conducted in fourteen countries. They focus on different functions: R&D and design, production, logistics, IT, customer service. They cover five industries: clothing, food, IT, public services and services of general interest.

ICT and restructuring of value chain

The first main result is that VCR generally implies the use of ICT. We identify two different groups of ICT. The first one includes ERP, supply chain management technologies, workflow management technologies and call centres technologies. These ICT are 'generic' in VCR and frequently mentioned in the cases. The second group of is more mixed. It includes traceability technologies (which are recent) and intranet (which belongs to older vintages of ICT). From a quantitative point of view, there is no harmonised European data including questions on the use of this set of ICT that started their diffusion in the mid-1990s, with the internet revolution.

A second important finding in Chapter 2 is that networks evolve in many different directions in the context of VCR: centralisation (29 cases), decentralisation (thirteen cases), and mutual dependence (three cases). Twelve cases do not mention any evolution. The centralisation is the most frequent case. It represents different kinds of changes: creation of new centralised networks, reorganisation or restructuring of the network. Control over the activity of the business partner is obtained through standards applied to services, quality, routine tasks or work process. The unit that generates standards, often embedded in ICT, is most of the time the central component of the network, which reinforces its dominant position. This is why standardisation generally comes before and enables outsourcing. Different types of network decentralisation are also observed: the creation of autonomous units, the outsourcing of a non-core activity, decentralised co-ordination. Cases of decentralisation show that when a firm contracts out a process or a module of its production, it implies a loss of control on the activity. ICT often enable outsourcing by

contributing to the quasi-integration of the new business partner and in particular, when there is no existing financial link.

ICT and work organisation

The statistical assessment of relation between ICT diffusion and the work organisation show that correlation coefficients varies more across sectors than across countries. It also shows a positive correlation between use of a computer or internet with the complexity of work and market constraints. We do not uncover the complexity paradox by assessing with quantitative data the organisational characteristics of the work of computer and internet users. However, using the available data at a European level we cannot distinguish between different uses of internet or of computers. In particular, we are not able to identify users of VCR technologies or work characteristics of employees affiliated to an organisation that is restructuring its network of business partnerships. The WORKS organisational and occupational case studies, focusing on VCR, allow us to overcome this limitation of the quantitative assessment.

Case studies point out that the main organisational change associated with ICT diffusion is a higher standardisation of work and in less extent an increase of work control through electronic systems. Standardisation could concern several areas: services, quality, routine tasks and work processes. In the service sectors and public administration, technology supports offshoring, outsourcing of non-core activities to private partners like call centres, or delegation of services to the final customer (electronic ticket, eAdministration). ICT highly simplify and standardise the task to facilitate the transfer to partner or to the customer. These trends partly come from the development of eAdministration in public services and from cost reduction strategies in other services sectors. The introduction of ICT changes the job contents of operators in the manufacturing sector: standardisation goes with enlargement of tasks in some case, with more monotony in other ones. As far as the job content of managers is concerned, the introduction of ICT involves more coordination and less direct and more ICT-supported control. However, the link between ICT and work organisation is not linear. The role of management is important and can change the impact of ICT on working conditions. One can distinguish 'participative firms', where the introduction of ICT leads to job enrichment from 'non-participative firms' where ICT implementation goes with decreased task complexity and increased monotony.

ICT, skills and training

Statistical analysis shows that the deskilling of the work force is linked to the exclusion from the use of a computer or internet rather than to their use. ICT seem to be the privileged tool for transforming the work organisation since it concerns all occupational categories. However, this statistical analysis does not allow discussing the nature of skills requirements.

Case studies identify four categories of skills requirements associated with ICT implementation: ICT user skills, customer-oriented skills, communication skill and professional ICT skills (for IT workers). Customer-oriented skills and communication skill refers to soft skills while ICT user or professional skills constitute 'hard' skills. According to the case

studies, these skills combine differently. Training programs mainly focus on hard skills and sometimes on customer-oriented skills (commercial skills) during the implementation phase of the technology. This training content contrasts with new skills requirements and it allows to identify the kind of problems that can occur during the restructuring. Workers often mention relational problems.

The implementation and use of new ICT are also associated with the creation of new jobs and occupations. It can take a form of labelling existing group of work tasks or job enlargement. The change of the job content and structure can also involve the standardisation of tasks. From this perspective, the case studies show a rather heterogeneous picture, where standardisation of work task are accompanied by both deskilling and upskilling. It can generate a polarisation in the division of labour.

The complexity paradox

What have we learned about the complexity paradox throughout this report? WORKS organisational and occupational case studies give some interesting insights about consequences of VCR. First, since the mid-1990s external and internal boundaries of organisations opened up, making the shape of networks relating business partners a crucial element of organisational designs. Some sectors, like the clothing industries restructured their value chain even earlier. However, outsourcing or subcontracting part of an activity implies a loss of control that can put the business at risk. In the globalisation era into which knowledge-based economies have entered, control over the activity is an important issue.

This is where ICT enter the story. VCR technologies described in the WORKS case studies contribute to the quasi-integration of business partners, making it possible to restructure value chain and to keep control over the activity. A prerequisite of ICT use is standardisation. According to the sector and the business function, standards apply to what is produced, to some tasks or to the whole work process. Standardisation of the activity generates routine tasks (whether manual or cognitive) that are then outsourced or offshored. ICT play a role at two levels: they embed standards and they structure the flow of information about the outsourced activity between business partners.

The decrease in work complexity appears to be strongest in the UK, in Germany and in Spain. In the UK and in Germany, a rising polarisation of work has also been observed (Goos & Manning, 2007; Spitz-Oener, 2006). The two phenomena could well be connected and indirectly linked to technological progress. As we have showed it in our quantitative analysis in Section 3, computer and internet use are positively correlated to work complexity. But ICT also contribute to the global restructuring of value chain. In this process, outsourced or offshored tasks and work processes are standardised. If these tasks were previously performed by occupations with intermediate skills, global VCR could play a central role both in work polarisation and in the decreasing work complexity. This thesis would require further assessment both theoretically and empirically. The trade-off between control over the activity and knowledge accumulation about the production process should be another important area of investigation for further analysis.

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- This report investigates the relationship between the use of information and communications technologies (ICTs) at the workplace, work organisation, skills and training in a context of value chain restructuring.

ICTs are examined in two groups: those that are generic in the value chain, such as supply chain management, workflow management technologies and call centres technologies; and more mixed ICTs. Even if networks evolve in many different directions in the context of value chain restructuring (centralisation, decentralisation, mutual dependence or no evolution), centralisation is the most frequent outcome. ICTs often enable outsourcing by contributing to the quasi-integration of the new business partner. Control is obtained through the application of standards, reinforcing the dominance of the unit that generates standards. This is why standardisation generally comes before and enables outsourcing. Standardisation and increases in work control constitute the main organisational dimensions of technological changes. Their impact on job content and working conditions varies according to the role played by management and may involve both deskilling and upskilling, reflected in polarisation in the division of labour and the emergence of new jobs and occupations.

Four types of skill are involved: ICT user skills, customer oriented skills, communication skill and professional ICT skills.

