



**Information Society, Work and the
Generation of New Forms of Social Exclusion**

Final Report

June 2002

**Gerd Schienstock
Co-ordinator
Work Research Centre
University of Tampere
Finland**

FINAL REPORT

RESTRICTED

Contract No: SOE1-CT97-1070 (DG 12 – SOLS)

Project no.

Title: Information Society, Work, and the Generation of New Forms of Social Exclusion

Project

coordinator: Prof. Dr. Gerd Schienstock, WRC, University of Tampere, Finland

**Partners: Work Research Centre (WRC), University of Tampere, Tampere, Finland
Forschungs-und Beratungsstelle Arbeitswelt (FORBA), Vienna, Austria
Hoger Instituut voor der Arbeid (HIVA), K.U. Leuven, Belgium
Institute for Employment Studies (IES), Brighton, United Kingdom
Istituto di Ricerche Economiche e Sociale (IRES), Rome, Italy
Institut für Technikfolgenabschätzung und Systemanalyse (ITAS), Karlsruhe, Germany
Nexus Europe Limited (NEXUS), Dublin, Ireland
Fundação da Faculdade de Ciências e Tecnologia da University Nova de Lisboa (FCT-UNL), Lisbon, Portugal**

Reference

period: from 1 January 1998 to 3 December 2000

Starting

date: 1 January 1998 Duration: 3 years

Date of issue of this report: 31 June 2002

**Project funded by the European Community
under the
Targeted Socio-Economic Research Programme (TSER)**

TABLE OF CONTENTS

	Page
PREFACE	1
SUMMARY	3
EXECUTIVE SUMMARY	5
1. INTRODUCTION	13
1.1 Background and objectives of the project	13
1.2 The structure of the project	14
1.3 Methodological aspects	15
1.4 Reorientation during the lifetime of the project	17
2. CONCEPTUAL FRAMEWORK	19
2.1 The global information economy	19
2.1.1 Different perspectives on the information society	20
2.1.1.1 The old information society debate	20
2.1.1.2 Informatisation of work	20
2.1.1.3 The old and the new information economy	21
2.1.1.4 A process perspective: Globalisation as the driving force	21
2.1.2 A new organisation logic?	22
2.1.2.1 Neo-Fordism or post-Fordism?	22
2.1.2.2 The network as a new Leitbild of industrial renewal	24
2.1.3 Conclusion	25
2.2 Technological practices and new forms of social exclusion	25
2.2.1 Co-evolution of ICT applications, organisation forms, cultural patterns and strategic goals	25
2.2.2 The social shaping of modern ICT	26
2.2.3 Technological practices	28
2.2.4 Social exclusion risks	28
2.3 The regional aspect: divergence or convergence?	30
2.4 Conclusion	31
3 INFORMATION AND COMMUNICATION TECHNOLOGY INFRASTRUCTURE AND ITS UTILISATION	33
3.1 New trends in the development of ICTs	33
3.2 The technical system	34
3.2.1 Computer hardware	34
3.2.2 Computer software	35
3.2.3 Communication technology	38
3.2.4 ICT systems in use	39
3.3 Aims and functions of modern ICT	42
3.3.1 ICT as a tool	44
3.3.2 ICT as automation technology	45

	Page	
3.3.3	ICT as process-control technology and as surveillance system	46
3.3.4	ICT as information-providing device	47
3.3.5	ICT as organisation technology	48
3.3.6	ICTs as communication technologies	48
3.3.7	Conclusion: multifunctionality	51
3.4	Process aspects of technological practices: decision-making, barriers and participation	52
3.4.1	ICT strategy discourse	52
3.4.2	Barriers in the introduction process	53
3.4.3	User participation and union involvement	54
3.5	Conclusion	55
4.	ORGANISATION FORMS IN THE INFORMATION ECONOMY	57
4.1	General restructuring trends	57
4.1.1	Organisational change as a cumulative process	57
4.1.2	Holistic organisation models	60
4.2	Single restructuring measures and the use of ICT	62
4.2.1	ICT and (de)centralisation	62
4.2.2	Cost and profit centres and flattening hierarchies	63
4.2.3	Work groups and cross-functional design teams	64
4.2.4	Outsourcing and geographical location	66
4.2.5	Restructuring of the supplier chain and virtual organisations	69
4.2.6	Strategic alliances	69
4.3	Co-ordination forms and business culture	71
4.3.1	Discursive co-ordination as new governance forms	71
4.3.2	Changing organisation culture	72
4.3.2.1	Turning distrust into a trust-based organisation culture	72
4.3.2.2	Virtual company culture	73
4.4	Organisational changes taking place on the workplace level	74
4.4.1	The changing character of work	74
4.4.1.1	The increasing importance of information work	74
4.4.1.2	Reflexive work	75
4.4.2	Autonomy versus control?	76
4.4.3	Workload and stress	77
4.5	Telework	79
4.6	Conclusion	81
5	SKILLS AND COMPETENCIES IN THE INFORMATION SOCIETY	83
5.1	The de-skilling versus re-skilling debate	83
5.2	Conceptual aspects	85
5.3	Skill demands in the information economy	86
5.4	Restructuring and new skills and competencies	88
5.5	Training aspects	93
5.6	Conclusion	95

	Page
6. SOCIAL EXCLUSION IN THE INFORMATION ECONOMY	97
6.1 Skill deficits and social exclusion risks	97
6.2 Flexible work and social exclusion risks	99
6.3 Automation, outsourcing and downsizing as risk factors of social exclusion	102
6.3.1 ICT and automation	102
6.3.2 Externalisation and downsizing	103
6.4 Employment aspects of the information economy	104
6.5 Long-term unemployment	106
6.6 Conclusion	107
7. TECHNOLOGICAL PRACTICES IN THE INFORMATION SOCIETY AND THE SPATIAL DIMENSION?	109
7.1 The network hypothesis	109
7.2 Why is the ICT-based network organisation not widespread?	113
7.3 The regional perspective of the information economy	115
7.3.1 Regional diversity	115
7.3.2 Some critical remarks	118
8. CONCLUSIONS AND POLICY IMPLICATIONS	121
8.1 The two pillars of the information economy	121
8.2 Technical restructuring	122
8.3 The organisational dimension	123
8.4 Skills and competencies	124
8.5 Cultural change and employers' participation	125
8.6 Individualised strategies to combat social exclusion	126
8.7 General strategies to combat social exclusion in the information economy	127
8.8 Co-ordinating various policy areas	128
8.9 The increasing importance of the regional level	129
8.10 Alternative paths into the information economy and policy learning	129
REFERENCES	131

LIST OF FIGURES

		Page
Figure 2.1	Technological practices	28
Figure 3.1	Applied computer system by region	35
Figure 3.2	Office tasks carried out using software applications by region	36
Figure 3.3	Application of communication technology by region	38
Figure 3.4	ICT systems by region	41
Figure 3.5	The importance of different aims for the introduction of modern ICT	43
Figure 3.6	The importance of 'co-ordination and communication function' and 'control function' by region	44
Figure 4.1	Share of organisationally restructuring companies and average number of organisational changes by region	58
Figure 4.2	Types of change by region	60
Figure 4.3	Types of telework by region	79
Figure 4.4	Workforce profile of (any kind of) teleworkers	80
Figure 4.5	Workforce profile of different kinds of teleworkers	81
Figure 5.1	Demand for skills, competencies, knowledge and work orientations by regions	87
Figure 6.1	ICT-related employment change in different departments or functions	105
Figure 6.2	ICT-related employment growth by types of affected workers	106

LIST OF TABLES

Table 1.1	Number of cases by region, size and sector	16
Table 3.1	ICT typology developed by Brousseau and Rallet	40
Table 3.2	ICT systems by region	42
Table 3.3	Various perspectives on ICTs	51
Table 3.4	Main factors hindering the introduction of ICT	53
Table 3.5	User involvement in the implementation and development of ICT systems by region	55
Table 4.1	Organisational restructuring measures by region	59
Table 4.2	Organisation form, type of information and form of information diffusion	61
Table 4.3	Elements of the new organisation logic and aspects of process integration and vertical integration	70
Table 5.1	Demand for specific skills and competencies by region	88
Table 5.2	Techno-organisational restructuring and new qualification needs	93
Table 7.1	Use of ICT by organisational restructuring	103
Table 7.2	Techno-organisational systems and functions of modern ICTs	111
Table 7.3	Technological practices and employments effects	112
Table 7.4	Dimensions of technological practices	113
Table 8.1	The process of social exclusion and options for political intervention	127

PREFACE

This final report of the SOWING project is based on the national reports of the participating countries. It is a synthesis of the national reports and was drawn up Gerd Schienstock. Furthermore, data analysis as well as the tables and figures included in the report were produced by Tapio Rissanen, WRC, Finland. The language was checked by Joan Lofgren and Marjukka Virkajarvi, WRC, Finland.

SUMMARY

INFORMATION SOCIETY, WORK AND THE GENERATION OF NEW FORMS OF SOCIAL EXCLUSION

This research project combines two research areas which so far have rarely been linked with each other: companies' restructuring processes based on modern ICT (Information and Communication Technology, hereafter ICT or ICTs) and the demand for related new skills and competencies, on the one hand, and social exclusion risks on the other hand.

Our empirical findings show that the application of modern ICTs within the companies of the regions participating in the project has progressed significantly; increasingly more complex technical solutions are introduced. However, this does not automatically imply a change in the usage of ICTs, there is no clear trend from automation and control technology towards information and communication technology, as is often assumed. Instead, we have to stress the multi-functionality of modern ICTs: they can serve several functions at the same time. Due to the fact that modern ICT represent multi-functional technologies, we cannot identify a clear trend towards a new organisation logic represented by the Leitbild of a network organisation. Instead, companies apply different types of techno-organisation structures: low-tech Fordism and high-tech Fordism as well as low-tech network organisations and high-tech network organisations. These can be seen as evolving paths of techno-organisational restructuring. The ICT-based network organisation is actually not very widespread yet; our research suggests the conclusion that companies in the participating regions are structurally more conservative.

Concerning demands for new skills and competencies, we can conclude that digital skills play a less significant role in the current transformation process compared with social and learning skills. Consequently, missing digital skills rarely represent a risk of losing one's job and becoming excluded from the labour market. Temporary work contracts and processes of outsourcing and downsizing carry a much higher social exclusion risk, although companies in general try to cope with the related employment problems in a socially beneficial way. Less skilled elderly workers represent a social group which is particularly at risk of becoming downgraded and even expelled from the labour market, as adapting to new techno-organisational structures is often beyond their capability.

So far, it can be concluded that we are just at the beginning of the transformation of the economy into a network-based information economy with little evidence of massive exclusion and segmentation problems. Of course, there are regional differences with respect to both the dynamic of techno-organisational restructuring on the one hand and labour market structuration and social exclusion risks on the other. There is no one European path to the information economy. The fact, however, that ICT-based organisational restructuring is more an emergent than a completed process makes it very important to further monitor employment risks but also possible opportunities associated with the emerging information economy. This will give us the time to warn policy makers about the potential exclusion risks for specific social groups in the information economy.

EXECUTIVE SUMMARY

Results from the research project: "Information Society, Work and the Generation of New Forms of Social Exclusion"

- 1) It is widely agreed that we are currently in the middle of a fundamental and very rapid economic and social transformation process. There is, however, great uncertainty about the contours of an emerging new economy and society, as the variety of different models, such as notions of a service society, knowledge society, science society, or learning society indicate. In recent years, the term 'information society' has set the tone in the scientific and, particularly, the public debate about the formation of the socio-economic future.
- 2) The old information society debate pointed to a shift, implicit in the notion of an information society, to a post-industrial society, in which the largest part of new value added is being created in the non-industrial sectors of the economy. While earlier the service sector was seen as the wave of the future, replacing industrial production, it is now the information sector whose growth is seen as central to economic development. Indicators suggested to measure the radical transformation of the economy, such as the share of information workers in the whole labour force, the share of the information sector of GDP, or the use of information technology, all have major disadvantages, making it extremely difficult to analyse the transformation from one economic structure to another.
- 3) One can have serious doubts as to whether the development of a new industrial sector is the most crucial characteristic of the current transformation process. The informatisation of work and the efficient use of modern ICT within production processes may have even greater transformation power than the emerging new IT sector. Therefore, when analysing the emerging information economy, it is important to concentrate on the informatisation of the production process as the core phenomenon of the current economic transformation process.
- 4) The argumentation that the industrialised countries are in a process of transformation towards an information-based economy is misleading as information and knowledge are always applied in production processes. The appropriate distinction is not between industrial society and information society, but between two forms of information and knowledge-based production. When talking about informatisation of work and production, we have to step away from prioritising technology as the centrepiece of change and therefore also from the 'technology push approach'. Nowadays the focus is on information - rather than information and communication technologies - as the key source of change. Informatisation is no longer seen as a technological concept, but is used to highlight the penetration of information activities such as collecting, processing, interpreting and disseminating information into all economic sectors and industries. In contrast, the role modern ICT plays in the transformation of the economy is regarded as a minor one when compared to the major part played by information.
- 5) Information is an important asset for companies, as the economy is becoming increasingly uncertain and, therefore, the productivity and competitiveness of units or agents to a great extent depend upon their capacity to generate, process, and apply knowledge-based information efficiently. It is obvious, however, that due to these changes, companies' economic success fundamentally depends on the application of modern ICTs, as they can be used to rationalise, accelerate and support information and communication activities. Modern ICTs can play a key role in restructuring social relationships – interpersonal, inter-group and institutional; they have transformative potential.
- 6) The argument that the broad application of modern ICT causes organisational restructuring has been questioned recently. Actually increasingly organisation forms are given priority, meaning that modern ICT has to be implemented in the existing organisational framework and has to be formed according to organisational needs. Here we neither adhere to technological determinism, nor do we

support arguments based on weak social determinism. Instead, modern ICT and organisation forms are viewed as truly homologous forms; ICT creates new organisation forms and new organisation forms, in turn, provide new opportunities for technology design. Neither technology nor organisation is fixed, but both are changing in relation to each other, driven by other factors. Modern ICTs offer 'occasions' for manipulating technology and organisation structure according to other drivers of change. Economic globalisation is seen as the main driver of the current transformation process.

7) Due to the globalisation of markets, companies must be capable of producing high-quality products on a low-cost basis, of selling them for a reasonable price and delivering them in time. But at the same time, companies have to embody a philosophy of continuous improvement and innovation. Organisational restructuring, however, does not take place due to objective economic pressures; it is always based upon an interpretation of these pressures by organisation members informed by a specific techno-organisational 'Leitbild'. The 'network economy' or 'network firm' can be seen as the new Leitbild in the emerging information economy.

An organisational Leitbild can be characterised as a set of general ideas about effective production and business structures. It also has a normative dimension, which partly forms the basis of practical restructuring processes. A major advantage of a Leitbild is that it allows for diversity, as the transformation of a Leitbild into reality can result in different trajectories.

8) In recent years, a shift from data processing (administrative, centralised mainframe computing) and management information systems (MIS), to individual and office support on PCs and office systems, and then to electronic data interchange (EDI) and inter-organisational systems, organisational 'platforms', and network computing has taken place. Systems in many firms have been developed in such a way that they increasingly relate to and interact with each other. On the other hand, in a great number of companies, the use of ICTs is still very basic. There are many examples of SMEs (small- and medium-sized enterprises) in which the use of ICTs is restricted to a PC for simple functions and in which the technical basis for network forms of organising production processes is missing. Nevertheless, our empirical findings demonstrate that the majority of companies have developed the technological basis for installing organisational network structures.

9) But the simple fact that modern ICTs diffuse throughout the economy does not necessarily lead to organisational change. It is not the technology itself and its transformational potential that determine both the nature and extent of benefits gained from modern ICT. Instead, it is the functions ICT is chosen to perform, which influences social structures and relationships in the first place. Companies associate ICT primarily with the tool function of improving quality, but they also quite often use modern ICT as a mechanism to control production processes and as a communication device.

There is, however, little evidence that the character of ICT usage is clearly shifting from automation and control technology towards communication and network technology. Instead our findings demonstrate the multi-functionality of modern ICTs; they can serve several functions at the same time. Companies often combine the communication function with the surveillance and control functions. On the other hand, they allow intensive information and knowledge exchange between organisational sub-units, while top management can monitor production processes and even single machines.

10) Organisational restructuring is a common practice and often modern ICTs are seen as playing an important role either as a driving or a facilitating factor. Organisational changes are in most cases of a cumulative nature. This means that restructuring companies in general introduce a variety of different measures; companies very seldom introduce only isolated organisation measures. Group and team work, geographical relocation, strategic alliances, downsizing and outsourcing as well as

profit and cost centres are introduced slightly more often by companies than flatter hierarchies or subcontracting networks. Although there is an increasing outward orientation in organisational restructuring, generally companies focus more on internal than external changes. However, the most common pattern of organisational change is the concurrent restructuring of internal processes and external co-operation forms.

11) The new organisation logic is associated with new forms of co-ordinating and controlling work processes. We can identify a change from traditional bureaucratic co-ordination to what can be called discursive co-ordination. Discursive co-ordination means that units are no longer centrally controlled; instead, co-ordination takes place through mutual adjustment or continuous discourse on a decentralised basis. Discursive co-ordination is not intended primarily to create consensus among actors, but it is intended to initiate collective learning processes.

The new co-ordination and control form includes the following key elements: systemic discourse, performance agreements and benchmarking via automatically generated performance standards. The aim of the systemic discourse is to reach an agreement on general strategic orientations concerning markets, output, human resources, and planned budgets. The rationale behind a performance agreement between headquarters and organisational sub-units is that the involvement of the latter in the process of setting performance standards will lead to their stronger commitment. Thus we can speak of a normative integration of employees. The use of modern ICT also plays an important role. Technology becomes less a means of dictating control than a means to stimulate competition among work groups and sub-units. Performance data are used for intra-organisational benchmarking. Objective data become the basis for future performance agreements, as they are more accepted by workers than abstract performance standards set by management.

12) The belief that modern ICT applications and new organisation forms create communication and knowledge exchange seldom produces the expected results. Modern technological infrastructure supported by new organisation rules allows people to post information and gives access to all available information, insofar as it is a necessary prerequisite for extensive information and knowledge exchange. But values and norms, which make up the company's culture, are the principal determinants influencing communication patterns. Techno-organisational structures alone cannot create an environment which fosters continuous exchange of information and knowledge, they must be based on a supportive business culture.

In a network organisation, we have to abandon the idea of a unifying organisation-wide corporate culture. An organisation culture in the traditional sense of a system of values which glues the organisation network together, can hardly be found in the new techno-organisation structures. Instead, we can speak of a multifaceted, virtual culture, which is the outcome of continuous processes of negotiation. Increased functional and process integration throughout companies and within firm networks, made possible and supported by modern ICTs, creates high interdependency among the components of a company or a firm network. Without a common model of reality, organisation members will not be able to interpret data produced by the technology in such a way that they can become the basis for collaborative work and joint decision-making. The use of modern ICTs, transcending the boundaries of departments and companies, therefore, depends at least partly upon the assimilation and uniformity of subcultures within a company or a firm network. However, techno-organisational restructuring always includes the development of new non-standardised and unstructured tasks, which are not subject to the logic of a unified culture. The need, however, to homogenise diversified subcultures within companies, forced by the use of modern ICTs, does not imply totally giving up views, orientations and schemes of interpretation that are specific for single work groups and departments within a company or for single companies within a network.

13) The application of modern ICT and organisational restructuring do not always follow the same restructuring logic. This is due to the fact that organisation structures are not only designed to process information effectively, they also embed power relationships, for example. Therefore, there is no linear development process from Fordism to network forms of organisation. Furthermore, not all companies are exposed to global innovation competition to the same extent. For many companies, costs are still the dominant competition criterion. This makes it unlikely that the transformation of production will be dominated by only one (new) techno-organisational restructuring logic.

The analysis of our firm survey suggests distinguishing between four patterns of techno-organisational systems. The first group of companies has not taken steps to restructure their organisation form and use ICT only as an information processing tool, if at all. We can characterise these companies as conservative concerning their restructuring strategy; they represent a low-tech Fordist model. The second group of companies focuses its modernisation strategy on the use of ICT in the modern form as a communication device, while the third group of companies concentrates on organisational restructuring, hardly using ICT in a modern way.

We can characterise the second group of companies as technically oriented modernisers and the third group as organisationally oriented modernisers. The first model can be described as high-tech Fordism and the second as low-tech network organisation. Only a minority of companies seems to orient its restructuring strategies towards the new Leitbild of a network organisation; together with the massive introduction of modern ICT, they have developed new organisational practices. We interpret our results in a more dynamic way. The four models can be seen as evolving paths of techno-organisational restructuring instead of well-established organisation structures.

Internal and external restructuring are closely linked. Conservative companies, which make little use of ICT and have only minimally restructured their organisation forms, have also introduced external changes very seldom. On the other hand, a great majority of companies, having restructured their organisation forms fundamentally, including the massive introduction of modern ICT, has also gone through external restructuring processes.

14) Under conditions of increasing uncertainty, we cannot interpret the selection and use of modern ICTs as a strategic decision-making process. The strategy concept applies an unproblematic rational approach to management, organisation and change, involving a set of rather mechanistic assumptions about how organisations function and how managerial and non-managerial employees behave. ICT applications and their embedding into organisation structures seem to be a more bottom-up and incremental process. The introduction of modern ICTs has in most of our case studies been gradual and evolutionary. Furthermore, processes of using and developing ICT-systems are much more intertwined, particularly as companies often have to adapt standardised software to the specific needs of the company.

15) In general, technical aspects are seen as more important barriers to introducing modern ICTs than organisational and human aspects. In our research, the difficulty of controlling costs, incompatibility with existing technical systems, a lack of required qualifications to handle ICTs, and difficulties in acquiring adequate software were seen as the key factors that hinder the introduction of ICT systems. The fact that new solutions become available in ever shorter time periods often causes delays in purchasing decisions. Resistance from union representatives, from management and from workers as well as rigid organisation structures, on the other hand, were mentioned less often as hindrance factors. Usually older people having greater responsibility resist the introduction of modern ICTs more often because they do not understand how they can make use of the technology.

16) Our research indicates the importance of user involvement in the implementation process of modern ICT. The majority of the companies report that they practice user involvement. Compared to this direct participation, involvement of union representatives is low. Only a minority of companies involves representatives of unions in the process of implementing and developing modern ICT. And only a minority of companies practising user involvement also integrate union representatives into the implementation and development process.

17) The scholarly discussion of demands for skills and competencies in the information economy is highly controversial. It was dominated for a long time by the de-skilling versus re-skilling debate. However, it is now widely agreed that new technologies add rather than subtract from the skills of workers. Particularly the thesis of a 'skill-biased technical change' links re-skilling with the widespread use of modern ICT. One should not, however, relate shifts in skill demand to the use of modern ICT only; instead, one has to highlight the central role of IT-enabled organisational change in a cluster of complementary and mutually reinforcing innovations to understand the shifts in skill demand.

Our findings give support to the thesis that there is an increasing demand for higher educated people. Quite many of the companies studied seem to be 'asking more' from newcomers currently than a couple of years ago, both in terms of educational and other requirements. Employees with high qualifications are not always selected because of increased skill demands for filling the available jobs, but because they are assumed to have social competencies and the right personal characteristics.

The re-skilling thesis, however, is somehow missing the point. It is not more or less of particular skills or competencies that count; instead, ICT-based restructuring processes demand a number of new skills and competencies. Technical or digital skills represent only one dimension of a new profile of skills and competencies needed in an information economy. There is a great demand for social competencies, including capabilities to communicate. There is also a great demand for management skills, practical knowledge, and international skills, but also work virtues such as reliability and trustworthiness as well as creativity and entrepreneurship. Particularly "learning-to-learn" capabilities are becoming increasingly important.

18) It is quite obvious that a great number of skills and competencies mentioned above will not be acquired in a formal education process separated from the production process. Instead, they have to be developed continuously in learning processes taking place within day-to-day work activities. By performing their tasks, workers will gain specific knowledge and skills and take on new work virtues. Social skills and competencies, tacit knowledge, awareness of quality and entrepreneurship are some examples of those skills that workers acquire mainly while going about their day-to-day business and co-operating with other people. These skills are most effectively learned within the framework where they are obtained. Certain other qualifications, such as theoretical or abstract knowledge, technical knowledge or international skills can, at least partly, be learned in formal training institutions. What has been said so far implies that the company is becoming an important place for promoting human capital and acquiring new skills, knowledge, competencies, work attitudes and work virtues. But the need for new impulses coming from formal training in specialised institutions still exists. What is needed is a diversity of learning places with different teaching and learning focuses.

19) The information economy does not abolish traditional social exclusion risks and does not dissolve traditional risk groups. Instead, it may also lead to new forms of segmentation and social exclusion. Due to decentralisation, functional integration, and direct communication, supported by the use of modern ICTs, middle management and functional specialists may become new risk groups. The growth of a group of highly skilled and very flexible knowledge workers, on the one

hand, and the increasing codification of knowledge on the other hand, may lead to a process of increasing segmentation in society. Furthermore, not being linked up to information networks necessarily implies being locked out of the efficiency gains associated with the use of ICT.

We found, however, little evidence that missing skills associated with the use of modern ICT increase the exclusion risks significantly. In many companies, social skills are considered to be more important than digital skills. Furthermore, lacking knowledge of particular ICT applications does not necessarily have to lead to otherwise promising job seekers being turned away. That is because digital skills, needed in most jobs, can relatively easily be acquired through training.

20) Rapid technical progress and associated organisational changes demand the preparedness of workers to become involved in continuous learning processes. There is always a period of adaptation and every change in software brings along new changes in the way of working. The average worker, it is argued, is continuously confronted with new tasks and problems and has to develop new skills and competencies more frequently than before. To learn new skills and, even more, to learn how to learn, is becoming more critical. Our case studies indicate, however, that it is certainly not a widespread phenomenon that people lose employment because they cannot cope with the pace of organisational and technological development. On the other hand, people lacking specific digital skills can be deprived of the most interesting jobs in their units. Older people then have to end their working career in so-called secondary jobs. It means that, while the introduction of ICTs rarely results in direct social exclusion risks, it can bring along or enhance a kind of social polarisation or differentiation in the workforce between the employees who have and those who do not have digital skills.

21) Another phenomenon often associated with the emerging information economy is a fundamental transformation of work regulations: the individualisation of work in the labour process associated with contractual flexibility. The traditional form of work, based on full-time employment, a career pattern over the life cycle, clear-cut occupational assignments, standardised working hours and a collectively agreed wage is shrinking continuously. The fastest-growing categories of work are temporary labour and part-time work.

Although the usage of contractual flexibility has increased in recent years, the practice rarely assumes extreme proportions in companies. The overwhelming majority of the workforce still has a contract of unlimited duration. We cannot speak of serious casualisation of labour, let alone an evolution towards the 'flexible firm model'. There are even companies that reduce flexible working hours and particularly the number of temporary workers.

22) Outsourcing and downsizing as new phenomenon of business restructuring have a rather high level of social exclusion potential. ICTs do not play a crucial role in the decision-making about outsourcing, but they obviously support the process, as they facilitate communication and information exchange between companies. Outsourcing, which can be associated with layoffs to reduce costs, not only threatens low skilled workers with becoming unemployed, but possible redundancies caused by these restructuring measures also affect middle management and narrowly trained experts.

Outsourcing, as our case studies demonstrate, rarely results in crude dismissals, but it remains a very delicate problem containing inherent social exclusion risks. Companies aim at dealing with the problem in a socially acceptable way. But, of course, all depends on the economic situation. Earlier, the growth of the company facilitated the internal transfer of employees to other jobs. In times of economic slowdown, however, it is much more difficult to guarantee employment security after outsourcing. In such situations companies apply (early) retirement schemes and they do not prolong contracts of limited duration.

23) Employment is one of the key aspects of the information society discourse. However, it is quite clear that all anticipations are based on a great degree of uncertainty. It is extremely difficult to calculate the impact of ICT use and related restructuring processes on employment. Difficulties in anticipating employment effects result from the complexity of the subject. Based on our firm survey, we have analysed employment effects related to the introduction and use of modern ICT. Companies particularly relate employment changes in their core processes to the application of modern ICTs and increases in employment more than decreases. ICT-related changes in employment mainly affect male workers, with respect to both increases and decreases in employment. The majority of the companies associate the ICT-related increases in employment with younger workers and the decreases in employment with older workers. The number of highly qualified workers was seldom reduced in these companies and over half of the companies having increased employment had hired especially highly qualified workers. Increases as well as decreases in employment have more often affected permanent and full-time workers than temporary and part-time workers.

24) There is no single path towards the information economy which all regions or countries are following, but there are different options for designing the emerging information economy depending on the institutional setting in a region or a country. Our argument here is, however, only based on companies' restructuring practices. We have not been able to clearly associate specific development paths of organisational restructuring with specific national institutional settings that can be seen as the key path-forming factor. This might be explained by the fact that institutions are becoming increasingly fragile, as they are themselves under pressure to adapt to the changing environment.

1. INTRODUCTION

1.1 Background and objectives of the project

The discussion about the emerging information society, its structures, mechanisms and social implications had its first peak as early as the 1970s and 1980s. It was widely agreed upon that, together with the emerging information society, fundamental transformation processes would take place. However, contradicting assumptions concerning the concrete development trends existed. While some scholars had a very optimistic view about the emerging new society and economy, predicting revolutionary ways of living and working, enlarged economic opportunities, growth in employment, and increasing equality, others were more pessimistic predicting job losses due to automation, a more stressful working life and more intensified control in the sphere of working as well as in private life. The Club of Rome argued that the information economy could develop in both directions: it could become a curse as well as a blessing, all depending on how we design it.

In the 1990s the notion information society became increasingly a political term. The development of the information society was presented as a strategy to overcome the growing socio-economic stagnation. Particularly the European Community popularised the term aiming at transforming Europe into an information society (Commission of the European Community 1993). In the course of the nineties, the notion of information society became an extremely important topic in the European Community debate and policy framework. A discussion of the technological challenges generated by new information and communication technologies was initiated by the fear of lagging behind the USA and Japan. This fear resulted in the necessary pressure to accelerate the development and diffusion of ICTs in Europe (Europe and the Global Information Society 1994).

Together with the ongoing harmonisation of the European labour market, policy interest gradually shifted from the technological underpinnings towards the economic surroundings of the information society. Special attention has been given to national regulatory frameworks in the field of telecommunications, which turned out to be seriously out of date when the new potential of ICT became evident (see e.g. Commission of the European Community 1994).¹ The basic message was that deregulation would free market forces that would provide essential stimuli for the realisation of the information society's great potential to promote steady and sustainable economic growth and increasing employment.

As the necessary deregulation and liberalisation has reached completion in most EU countries, the debate has entered a third phase, focusing on the often neglected social implications of the emergence of an information society. In a remarkable contrast to the previous EU documents and conclusions, the High Level Group of Experts (1996) in its report pointed to the open character of the future development of the information society, repeating more or less the argumentation of the Club of Rome. The group stated that economic cohesion could be enhanced through the use of electronic networks by improving access to markets and sources of information, by bringing work to areas of high unemployment, by increasing the competitiveness of business on a regional level, and by reinforcing positive externalities. The Group of Experts, however, made it very clear that the emerging information society would not automatically produce positive results. It also mentioned the possibility of an even stronger centralisation of jobs and services and of a fast- and slow-track information society.

The earlier documents of the EU included the sphere of working life and business restructuring based on the widespread use of modern ICT to some extent, but did not systematically analyse the transformation taking place in this part of society. In addition, the argumentation was often dominated by technical determinism, not taking into account the great potential offered by modern ICT of shaping work and work organisation. However, in one of its more recent documents,

¹ The agenda was first put down in the Green Paper on Telecommunications in 1987

the European Commission (1997) stressed that, together with the introduction of modern ICT, organisational restructuring has become a more open process and organisational choice has become more obvious.

Our project focused on the economic sphere of the information society. The aim was to bring together the two important aspects of the emerging information society: business restructuring and social exclusion/cohesion. Focusing on the restructuring processes in the business sector, the project aimed at answering the question whether the emerging information economy leads to converging or diverging developments in European regions and whether there is only one best way to the information economy, or whether the information economy opens up different development options.

1.2 The structure of the project

The SOWING project, carried out from 1998 to 2001, was co-ordinated by the Work Research Centre (WRC) in Tampere, Finland. Research institutes from eight European countries participated in the project. Besides co-ordinating and steering specific thematic aspects of the entire project, each partner group executed the crucial research phases in its own region. There were following partners in the project consortium:

- (1) Work Research Centre (WRC), University of Tampere, Finland;
- (2) Forschungs- und Beratungsstelle Arbeitswelt (FORBA), Vienna, Austria;
- (3) Hoger Instituut voor de Arbeid (HIVA), K.U.Leuven, Belgium;
- (4) Institute for Employment Studies (IES), Brighton, United Kingdom;
- (5) Istituto di Ricerche Economiche e Sociali (IRES), Rome, Italy;
- (6) Institut für Technikfolgenabschätzung und Systemanalyse (ITAS), Karlsruhe, Germany;
- (7) Nexus Europe Limited (NEXUS), Dublin, Ireland; and
- (8) Fundação da Faculdade de Ciências e Tecnologia da University Nova de Lisboa (FCT-UNL), Lisbon, Portugal.

A major criterion for the selection of the partners was to guarantee regional diversity. The participating regions² can be characterised in the following way:

- in Niederösterreich (Austria) the agricultural sector is very large and developed compared with the industrial sector;
- in West London (England) and Lazio (Italy) the service sector is the most developed due to the presence of important urban areas;
- the Tampere region (Finland) and the Stuttgart area (Germany) are very industrialised with respect to European and national averages; whereas Flanders (Belgium) is in line with national and European averages;
- the agricultural sector in Portugal and Ireland is more developed and the service sector less developed than the European average, reflecting the delayed development of the industrial sector in these countries.

² In the following we will use the term region although the territories included in the project represent regions, countries and cities.

1.3 Methodological aspects

The project did not follow the traditional positivistic approach looking for an appropriate dependent variable as a way to study ICT-based restructuring processes within companies. Instead, it followed the recent trends in ICT research which can be characterised by two aspects: a heightened sensitivity to the social context of technical applications and an increasing acceptance of interpretivism as a basis for studying ICTs in organisations.

For the research project, case studies were seen as most suitable as they allow deeper insights into how ICT-based production structures develop and how they are shaped by external factors. Furthermore, they can reveal whether technological practices are designed to suit employees and whether ICT-based restructuring processes have triggered processes of social segmentation and exclusion. The aim was to conduct ten case studies in each region. It was left to the partner institutes to decide how to select the case study companies, but it was agreed to focus mainly on companies with extensive use of IC technology, while the sample was also to include some cases in which modern ICT had a lesser impact. The aim was not to obtain a representative selection of companies, but to identify typical cases.

While case studies have the advantage of providing a deeper understanding of how technological practices are developing in companies, there is always the question to what extent findings from case studies can be generalised. Furthermore, the case study method is often viewed as a less desirable form of inquiry than surveys, as it is coupled with the question about process rather than variance. Therefore, the project also included quantitative research: a company survey was conducted in each country. A questionnaire was designed to be administered in the region selected by each project partner. The questionnaire addressed the extent and nature of ICT use, aims and barriers related to introducing ICTs, companies' organisational restructuring practices and human resources management as well as managers' attitudes towards modern ICTs. The questionnaire could be administered in different ways: by telephone, by mail or in face-to-face interviews.

It was agreed that the samples should be drawn from a database with a good coverage of employers in the respective region, should spread across industrial sectors and be equally divided between two size bands (fewer than 50 employees and 50 or more employees). The company survey was conducted on the establishment level. It must be stressed, however, that although specific selection criteria were applied (quota basis), most of the regional samples were not fully representative of the employers in the region. The small number of respondents did not allow constructing a representative sample. As the data have not been weighted, the findings should be treated as indicative rather than as representative. Table 1.1 gives an overview of the main characteristics of the regional samples.

Table 1.1 Number of cases by region, size and sector

Region Size Sector	Flanders		Lazio		Nieder- österreich		Portugal		Republic of Ireland		Stuttgart area		Tampere region		West London area			Total	
	20-49	50+	20-49	50+	20-49	50+	20-49	50+	20-49	50+	20-49	50+	20-49	50+	20-49	50+	20-49	50+	Total
1. Light manu- facturing	9	6	10	6	7	7	1	7	1	12	9	5	12	11			49	56	105
2. Heavy manu- facturing	9	6	19	19	7	8	10	14	8	8	7	8	13	21			90	92	182
3. Other manu- facturing	9	9	10	6	7	6	6	5	11	6	4	5	4	5			55	60	115
4. Con- struction	9	4	3	1	7	7	5			5	7	10	5	4			39	39	78
5. Sales, hotel, etc.	5	8	3	1	8	7	8	11	5	10	6	8	5	3			55	53	108
6. Trans- port & finance	6	5	5	11	7	7	3	1	13	8	6	8	5	5			42	68	110
7. Busi- ness services	9	6	1	5	7	8	2	5	3	3	9	8	6	1			59	43	102
Total 1.-7.	56	44	51	49	50	50	35	45	55	65	48	52	50	50			389	411	800

Besides conducting case studies and a company survey, we prepared regional/national profiles, including in them the legal framework, the labour market, ICT-related policy, the education system, the industrial relations system, and socio-economic structures. The aim of the regional profiles was to reveal the way in which environmental factors influence ICT-based restructuring processes and whether these factors trigger different regional/national development paths of techno-organisational renewal.

1.4 Reorientation during the lifetime of the project

The project plan was based on a highly complex conceptual framework. Not all the ambitious aims of the project could be achieved because of time pressure resulting from several delays in the fieldwork. The changes that occurred during the project are described below.

The project produced an environmental profile for each region. However, connecting these profiles with ICT-based restructuring processes in the regions turned out to be difficult for the following two reasons: (1) regional differences concerning companies' restructuring processes were less obvious and (2) it became difficult to develop a regional typology necessary to explain differences in companies' restructuring processes on the basis of the collected material.

To do justice to the concept of technological practice, the application of an ethnographic approach would have been necessary, including continuous monitoring of processes of interaction and change on the shop-floor level through participant observation. This is a very time-consuming procedure, which could not be applied in the project. Therefore, the idea of a bottom-up approach was only partly realised. However, the case studies often included interviews on the shop floor level in addition to expert interviews with managers.

To analyse processes of social exclusion, a limited framework was applied. The analysis concentrated on the work sphere, which means that social exclusion as a multidimensional phenomenon was not studied. Again, to do full justice to the concept of social exclusion would have been too time-consuming. We did study, however, exclusion risks produced by ICT-based restructuring processes.

The idea of identifying good and bad practices through regional benchmarking could not be realised fully. The concept of benchmarking is as such very disputed. To agree on good or bad practices would mean that there are clear criteria for judging restructuring processes. These, however, do not exist, as restructuring is, first, a very complex, open process which cannot be judged at a specific point in time; second, restructuring processes often serve different aims, a fact that rarely allows comparison. But for illustration we have presented some aspects of restructuring from our cases studies in small boxes.

While various aims could not be achieved due to the complexity of the approach, the project still produced a variety of interesting results. The project itself should be understood more as an attempt to gain a better grasp of a still very under-researched field rather than as a contribution to a clearly structured theory of industrial transformation.

The report is structured in the following way. Chapter Two first discusses the conceptual framework applied in the project, referring also to earlier research work in the field. The focus is on the two main concepts: technological practices and social exclusion. The next chapter deals with the application of modern ICT as the main component of technological practices. Chapter Four takes up the aspect of organisational restructuring practices in companies. Chapter Five addresses the development of human resources and the needed skills and competencies in the information economy. Chapter Six analyses social exclusion risks in the emerging information economy. Chapter Seven brings the various aspects of technological practices together and discusses the extent to which the network concept has become the new paradigm of business restructuring. We also take up the problem of convergence and divergence by analysing the regional practices of techno-

organisational restructuring. The last chapter summarises the results of the project and discusses some policy aspects.

2. CONCEPTUAL FRAMEWORK

The following chapter introduces the various scientific discourses related to our research project, thus outlining the conceptual framework that has guided research in the project. We also refer to earlier research work done in the field.

In our project we focused on informatisation of production and work and related models of organisation as the key aspects of the emerging information economy. Informatisation is understood here as the penetration of information activities into all work processes supported by the increasing use of modern ICT. While information and knowledge have always been essential for economic activities, the explicit recognition of information as a key asset of companies and a systematic approach to the organisation of information and knowledge flows can be seen as a new phenomenon in the emerging information economy. We also take up the argument that the network concept is becoming the new paradigm of techno-organisational restructuring in the emerging information economy. And global innovation competition is discussed as the driving force behind the current transformation process.

The concept of technological practices is used to analyse restructuring processes in companies. The argument here is that a holistic approach taking into account the interdependent nature of ICT applications, organisation forms, cultural patterns, companies' strategic goals and human resources can maximise synergies to be gained from the emerging information economy. We then deal with the concept of social exclusion risks, assuming that the emerging information economy is not a positive sum game but produces also disadvantages for different employee groups. In the end we take up the question whether there is a trend of convergence or divergence in companies' techno-organisational restructuring practices. We discuss whether the countries and regions that participated in the project take one and the same path or different paths into the information economy.

2.1. The global information economy

There seems to be widespread agreement that we are currently in the middle of a fundamental and very rapid economic and social transformation process. It is sometimes argued that the changes associated with the current transformation process may become even more dramatic than the one caused by the replacement of the agrarian society with the industrial one (High Level Group on the Information Society 1994).

The argument of a radical socio-economic change, however, is not a new one. Some thirty years ago, Daniel Bell (1973) and Allan Touraine (1969) wrote about the transformation of the industrial society into a post-industrial society. Bell himself subsequently claimed knowledge as the new axial principle of the emerging society. Other authors, often following Bell's argumentation, characterised the new developing socio-economic formation as the service society (Gershuny 1983), the information society (Porat 1976), the knowledge society (Böhme and Stehr 1986), the science society (Drucker 1969), or the learning society (Lundvall and Johnson 1993). Lately the concept of the 'new economy' has entered the debate (Soete 2001). Nevertheless, the term 'information society'³ (Brotchie, Hall and Newton 1987) has set the tone in the scientific and particularly in the public debate about the future socio-economic formation of society, not least due to the publication of the so-called Bangemann Report and the following political initiatives in various countries.

³ In the following we will use the term 'information economy' instead of 'information age' or 'information society', as the focus is on changes in economic affairs.

2.1.1 Different perspectives on the information society

2.1.1.1 The old information society debate

How can we conceptualise the information economy? Recently Soete suggested a return to the issues raised in the old 'information society debate'. In this debate a shift, implicit in the notion of the information society, towards a post-industrial society in which the largest part of the new value added is being created in the non-industrial sectors of the economy, was identified as main characteristic (1996: 47). The old information society debate is based on the idea that the development of economies takes place within longer phases in which the dominant sector of the old phase will be replaced by a new, emerging sector. The conclusion is that the industrial sector, having replaced the agrarian sector, will now meet the same fate. While earlier publications saw the service sector as the wave of the future replacing industrial production, it is now the information sector whose growth is seen as central (Miles and Robins 1994).

The idea of a 'march through the sectors' has faced major criticism. For example, it is argued that one cannot speak of the vanishing of the industrial sector; actually, the widespread use of information technology contributes to the stabilisation of the production sector. And how can we decide whether we are still living in the industrial society or already in the information society? Indicators such as the share of information workers of the whole labour force, the share of the information sector of GDP, or the use of information technology suggested to measure the radical transformation of the economy have major disadvantages. One can have serious doubts about their usefulness in proving the radical transformation argument (Webster 1995).

2.1.1.2 Informatisation of work

It is often stated that the information economy should be associated primarily with a change in the 'mode of production' and not with an emerging new sector. There is no doubt that being a leading producer of modern ICT will have a positive effect on the competitiveness of companies as well as countries. However, the informatisation of work and the efficient use of modern ICT within production processes may have an even greater transformation power and can become more important for increasing economic competitiveness in the emerging new economy than being a leading producer of ICT-based products or services. Therefore, the project concentrated on the informatisation of production processes as the most important phenomenon of the current economic transformation.

In a research area mainly concerned with new technologies there is always a danger of falling into a perspective of technological determinism, as Miles and Robins (1994) argue. Such a technology-push perspective is expressed by Nora and Minc (1979), for example, who argue that the penetration of social spheres by modern ICTs is the key characteristic of the emerging new economy. According to Robins and Webster, however, there has occurred in the last few years a decided step away from prioritising technology as the centrepiece of change and therefore also from the 'technology-push approach'. "... nowadays the focus is on information - rather than information and communication technologies - as the key source of change" (1997: 3). Informatisation is not seen as a technical concept, but it is used to highlight the penetration of information activities into all economic sectors and industries (High Level Group of Experts 1994). As the economy is becoming more and more uncertain, information develops into an important asset for companies; productivity and competitiveness of units or agents in this economy (be it firms, regions, or nations) depend increasingly upon their capacity to generate, process, and apply efficiently knowledge-based information" (Castells 1997: 66). In contrast, the role modern ICTs play in the transformation of the economy is regarded as a minor one when compared to the major part played by information. It is obvious, on the other hand, that due to this change in the character of work, companies' economic

success to a great extent depends on the application of modern ICTs, which can be used to rationalise, accelerate and support information and communication activities.

2.1.1.3 The old and the new information economy

The idea of a new emerging economy may be misleading, however, as information and knowledge are essential not only for a potential new mode of production, but were also essential for the preceding ones (Webster 1995). "In many ways", as Miles and Robins argue, "all human societies have been information economies, in that all economic activities depend upon human beings and their abilities to bring information to bear on their tasks" (1994: 2). Castells, therefore, suggests distinguishing between two types of information-based industrial, agricultural, and service production (2000: 219).

But how then does the old information and knowledge economy differ from the new, emerging one? As some scholars argue, it is not the growing accumulation of information and knowledge in the first place that characterises the emerging new economy. Instead, it is the increasing acceleration of this process, the quick outdateding of knowledge-based information, as well as the rapidly growing availability and transferability of information and knowledge (OECD 1998). While knowledge-based information is not a new phenomenon in the economy, the explicit recognition of it as a corporate asset as well as the understanding that it needs to be organised and managed with the same care paid to getting value from other, more tangible assets, are new phenomena. Therefore, the organisation aspect of information flows has become crucially important.

Together with the organisational aspect, skills and competencies become a key topic in the information economy debate. While the earlier debate focusing on the control and automation aspect of modern ICT assumed a de-skilling tendency, there seems to be widespread agreement nowadays that new technologies add rather than subtract from the skills of workers. Castells, for example, associates the re-skilling argument with the emergence of the networker as a new role in ICT-based production processes (1997: 242).

However, the skill and competence aspect is discussed controversially depending on whether technology or information is seen as the dominant characteristic of work in the information economy. A technically oriented interpretation gives priority to digital skills, because the capability to make efficient use of modern information technology is seen as the key competence in the information economy. An interpretation focusing on the penetration of work with information activities and on information exchange, on the other hand, stresses the importance of social competencies and particularly that of communication competencies.

2.1.1.4 A process perspective: Globalisation as the driving force

Terms like 'informatisation', 'innovation' or 'learning' may address important aspects of the future socio-economic formation. However, the various aspects of the emerging new economy are more or less imprinted by the process of economic globalisation⁴. This process has gained

⁴ Globalisation can be characterised as a new stage in the development of economies; while internationalisation points to an increasing border crossing of economic activities, globalisation implies the merging of national markets into one unbounded world market. It signals a growing integration and interpenetration of economic activities on a worldwide scale. The flash term 'globalisation', which has become something of a buzzword especially among industrial trend-watchers needs to be used with some caution, however. Whether the globalisation of the economy and markets has become reality up to now is very debatable. Sometimes it is even argued that globalisation is nothing but a myth (Ruigrok and van Tulder 1995). This conclusion, however, underestimates the dynamic of economic development in recent years and is definitely an exaggeration as even citizens of large industrial countries are affected by economic processes and by events taking place on a trans-national level outside their region.

momentum through the liberalisation and deregulation of markets as well as through a change referred to as information technology revolution. By understanding the information economy as an emerging process instead of a well-established structure, we may realise that the current economic transformation is much more open than the various concepts and models of the future economy assume (European Commission 1998).

Globalisation is of particular importance for the current socio-economic transformation, as it changes 'the rules of the competition game'. This is not only because national monopolies or oligopolies are beginning to erode, and price and cost competition are becoming even stiffer, but also because new competition criteria, like quality or time, have gained importance at the same time. Nowadays not only large global players but also SMEs must be capable of producing high-quality products on a low cost basis, of selling them for a reasonable price and of delivering them in time (Stahl *et al.* 1993: 15). The slogans towards 'quality-based' and more recently 'time-based' competition expresses this shift (Murray and Willmott 1995: 166).

However, the criteria mentioned above develop more often into entrance barriers to the global market, whereas economic success in the first place depends on companies' capability to innovate rapidly and to continuously develop new products that meet the demands of the customers. Companies can no longer expect that their successful products and practices of the past will keep them viable in the future but are forced to embody a philosophy of continuous improvement and innovation. Instead of focusing only on cost cutting, which is usually associated with downsizing and lean strategies, they also have to think in terms of growth and value added through knowledge creation and application in innovation processes. Customised innovation is the number one factor in global competition, particularly as the life cycles of products in some industries are decreasing quite drastically.

The process perspective introduced by focusing on globalisation as the driving force of change puts the discussion about a fundamental and rapid transformation of the economy into a new light. This argument, as Miles and Robins (1994: 15) state, "is based on a more general tendency to look at historical transformation in terms of the shift from one 'phase' or 'stage' of development to another, more superior one. ... Rather than seeing economic and social change in this linear way, a more appropriate metaphor might be one of cumulative developments in which the new developments form 'layers' across the old with new and old always co-existing" (Miles and Robins 1994: 17).

2.1.2 A new organisation logic?

2.1.2.1 Neo-Fordism or post-Fordism?

When it is information and knowledge that make organisations function, an efficient organisation of their flows as part of production is then crucially important. In this respect, Castells identifies the emergence of a new organisation logic. The nature of the informational work process calls for co-operative work, teamwork, workers' autonomy and responsibility, without which new technologies cannot be used up to their potential (Castells 1997: 242). Of course, the argument of a paradigm shift in the organisation of work is not new. It goes back to the post-Fordism debate (Coriat 1990), in which the dissolution of Fordist production structures and a trend of organisational evolution towards a new, more flexible and decentralised organisation of work was identified. What is new, however, is that organisational change is closely linked with the introduction of modern ICT.

The Fordist production model is based on two important principles: functional specialisation and hierarchical integration. Functional specialisation implies an intensive division of labour. It is

seen as contributing to productivity, as workers specialising in narrow tasks can develop specific skills that will help them to work more effectively. In the Fordist organisation model, specialisation is linked with a high degree of vertical integration. Decision-making power is centralised, which means that final decisions are made at the top of a hierarchically organised company, while the last rank components are not involved in any decision processes. The centre can impose common co-ordination and information principles based on formal rules.⁵

The Fordist model includes built-in mechanisms to block information flows; due to its bureaucratic structure and far-reaching division of labour, the model produces too many interfaces both hierarchically and vertically that become a hindrance to communication and information exchange. There is a risk that within the Fordist production model too much information gets lost, particularly because in the bureaucratic control system the broad middle management mainly deals with the routine filtering of information.

Post-Fordism turns the traditional production logic upside down as it is based on functional integration and hierarchical de-integration. (Piori & Sabel 1984, Kern & Schumann 1984). The latter, realised through increasing contracting with outsiders, is seen as an important feature of post-Fordism. This strategy of outsourcing is often pursued together with downsizing. Instead of producing as much as possible within a single organisation, companies specialise in their core competencies and become increasingly dependent upon the supplying companies. A second important feature of the post-Fordist model is functional integration realised through the institutionalisation of autonomous working groups and cross-functional teamwork (Piori and Sabel 1984, Kern and Schumann 1984).⁶

Outsourcing as well as the establishment of autonomous work groups and cross-functional design teams depend upon a sophisticated infrastructure of communications and computer facilities to allow the co-ordination and control of dispersed activities and to support rapid and direct information exchange. The increasing informatisation of work also has an impact on skill demands: multiskilling and social competencies are becoming more crucial. Sabel (1982) speaks of a radical break with the repetitious and low-skilled labour of Fordism and assumes an increase in the skills of employees.

One has to be careful in linking the widespread use of modern ICTs in an insoluble way with post-Fordist organisation structures, however. Murray and Willmott, for example, argue that organisational changes facilitated by the increased diffusion of ICTs are more plausibly interpreted as an extension of the ambitions of scientific management and Fordist production structures rather than a departure from them (1995: 164). Lutz (1987) also argues that modern ICTs can be associated with Fordist production structures as well. We can speak of an ICT-based neo-Fordism. But in contradiction to other authors (Braverman 1974), Lutz (1987, see also Greenbaum 1998) does not interpret neo-Fordism as the only possible path of development opened up by modern ICTs; it is one option of business restructuring, the other being the development of new more decentralised and flexible organisation forms.

Castells associates this new organisation logic with the network concept, speaking of the emergence of network organisations and of a network economy. Other authors using the terms 'virtual organisation' (Davidson and Malone 1992) or 'relational organisation' (Keen 1991) also point to a new intra- and inter-organisational governance form as a key element of the emerging information economy. The new network-based organisation forms develop together with the application of a new network-type technology. Sometimes the term 'reflexive production model' (Lash 1994) is used as modern ICT and new organisation forms add a new dimension of reflexivity.

⁵ The logic of hierarchical integration is explained by transaction-cost theory. The argument here is that hierarchical integration will reduce companies' control expenses.

⁶ We here understand the 'flexible specialisation' school and the 'new production concepts' debate as specific approaches within the post-Fordist theory.

2.1.2.2 The network as a new Leitbild of industrial renewal

We do not conceive of the network concept as a concrete description of the structures characteristic of the emerging new economy and its organisations, but we understand it as a new paradigm or Leitbild of organising production. Economic and business restructuring, while triggered by global innovation competition, does not take place because of objective economic pressures. Instead, organisational renewal is always based upon how organisation members, who are informed by a specific techno-organisational 'Leitbild', interpret these pressures.⁷

The network as the new Leitbild changes the focus of organisational restructuring. A single workplace or isolated work processes on which traditional restructuring practices focused are no longer the only target of current transformation processes. It is obvious that concentrating on traditional punctual and piecemeal change strategies will not guarantee companies' survival in a global, innovation-driven economy. Those restructuring practices cannot produce the leaps of productivity increase and the stream of incremental innovations needed for companies and regions to emerge as winners in the global competition.

Another aspect of the new Leitbild of a changing pattern of organisational restructuring is its open-ended character. It is not possible to simply take an already existing organisation model out of a toolbox and implement it in a company through a top-down strategy. Instead, restructuring implies a continuous process of organisational renewal and learning in which all members of a company have to be involved. As the Green Paper 'Partnership for a New Organisation of Work' states, we can identify a shift from fixed systems of production to a flexible, open-ended process of organisational development (European Commission 1997). This means that new production practices have to be developed, reproduced and/or changed according to the changing needs of production.

We can further differentiate between organisational networks and market networks (Teubner 1990). The latter have their basis in the contractual domain, meaning the formalisation of 'exchange relationships', but integrating hierarchical elements. They do so because of failures related to contractual arrangements that come to light when setting up and controlling a joint market system and when exchanging information on local facts and events. The problem can be solved, however, by integrating hierarchical elements into contractual arrangements. Organisation networks, on the other hand, integrate market elements to overcome the rigidities of central decision-making and hierarchical control. This distinction is crucial as it not only draws our attention to new forms of intra-organisational governance in the emerging information economy but also points to the emergence of new inter-organisational forms of governance.

We can conclude that the new organisation logic emerging in the information economy manifests itself in two network structures:

- an intra-organisational network structure which develops among firms' sub-units, replacing the bureaucratic governance regime;
- an inter-organisational network structure which develops among companies, replacing the market as the traditional mode of co-ordinating exchange.

Both network types increasingly include global production structures, as companies on the one hand break down their value chains and locate discrete functions in different regions all over the

⁷ A Leitbild is defined as symbolic scheme for creating reality (Berger and Luckmann 1967). An organisational Leitbild can be characterised as a set of general ideas of effective production and business structures. It also has a normative dimension, as which it becomes the basis of practical restructuring processes. A major advantage of a Leitbild is that it makes communication among social actors possible, even if they have different interests and preferences. It further allows for diversity, as the transformation of a Leitbild into reality can result in different trajectories.

world and on the other hand search more extensively for co-operation globally. This development is supported by modern ICTs, as the dominant characteristic of these technologies is that they are able to bridge time and space. The distinction between market and organisation networks, however, is often hard to sustain as boundaries between companies become more mobile and often get blurred.

2.1.3 Conclusion

The term 'information economy' is highly controversial. As scholars argue, there is nothing new concerning the mode of production, as production has always depended upon the exchange of information among knowledgeable people. The term 'information economy', the critics continue, signals a break with the traditional mode of production which in reality does not exist, however. One can argue, though, that it is not the accumulation of information and knowledge that characterises the new emerging information economy but the fact that it is generated and directly used within technological practices through learning processes. Due to the global innovation competition, the need to accelerate information and knowledge flows within production processes has increased and presses for the development of a new network-based organisation logic.

However, this linear argumentation has attracted a lot of criticism. It has been argued that economic structures should be seen as a cumulative development in which the new developments form as 'layers' across the old. We would then not understand the network as the only efficient organisation model in the emerging information economy which all companies have to apply but would instead speak of the network as a new Leitbild, which informs but not determines business restructuring. Such an understanding allows new and old ways of organising production processes to co-exist in different constellations. This holds true for manufacturing, as well as for administration and services, as these processes are becoming more and more alike (Castells 1997: 242).

2.2 Technological practices and new forms of social exclusion

2.2.1 Co-evolution of ICT applications, organisation forms, cultural patterns and strategic goals

Research on the nature and social consequences of technological change within the emerging information economy is highly fragmented and often applies only very simplistic concepts.⁸ Particularly the leading role of modern ICT in the process of organisational renewal is seldom questioned. Modern ICTs seem to have the capacity to radically change organisation structures and to shift demands for employees' skills and competencies. This kind of technological determinism does in no way justice to the flexibility of modern ICTs and the complexity of change processes.

The argument that the broad application of modern ICTs causes organisational restructuring has been questioned recently (Fulk and DeSantis 1995). Actually organisation forms are given more and more priority by scholars who state that modern ICTs have to be implemented in the existing organisational framework and have to be formed according to organisational needs (Brousseau & Rallet 1998: 245). Here we neither adhere to technological determinism nor support a weak social determinism. Instead, we view modern ICTs and organisation forms as truly homologous forms; ICTs create new organisation forms, and new organisation forms in turn provide new opportunities for technology design (Berger 1993). Neither technology nor organisation is fixed, but both are changing in relation to each other (Lucas and Barondi 1994: 9), driven by other factors.

⁸ Only few attempts have been made to develop a systematic framework for analysing technological change and organisational restructuring within the emerging information economy (see Castells 1996, Murray and Willmott 1995, Brousseau and Rallet 1998).

The literature also points to the importance of business culture, which together with techno-organisational practices will be transformed in the emerging information economy (Murray and Willmott 1995). Organisation culture can be understood as a network of interlocking rituals, norms, assumptions and values developed out of continuous interactions among the members of an organisation. It functions as a general mechanism to guide the behaviour of organisation members as it has proved itself successful in solving problems of adaptation to a changing environment and of mediating internal conflicts (Schein 1986).

Again we can identify mutual interaction and re-enforcement. While organisation culture is steering actions and work behaviour, it is influenced by the role structure and resource allocation within an organisation. Furthermore, organisation culture influences the meanings and functions attributed to modern ICT. Modern ICT is a pipeline and storage system for knowledge exchange, but it does not on its own bring about that information and knowledge exchange. In a corporate culture not favouring information and knowledge exchange no knowledge sharing will take place, not even if the firm has the most modern ICT applied (Davenport & Prusak 2000). At the same time, however, network technology enables the development of trust, as it supports intensive information and knowledge exchange.

Concerning the drivers of change, we have to mention the strategic goals of companies as their primary goals. We have argued above that together with the globalisation of the economy, quality, time, and innovation have emerged as new competition criteria. To be able to stay competitive in global markets, companies have to adapt techno-organisational structures to these new drivers of change. Of course, increasing productivity and reducing costs remain strategic goals. There is no doubt that techno-organisational structures will vary depending on whether companies produce standardised mass products, aiming at cutting costs, or whether they produce complex, knowledge-based products, aiming at continuous improvement of their products.

While modern ICT allows companies to manipulate their techno-organisational structures according to the needs of new strategic goals that become dominant in a global economy, ICT-based production processes also open up opportunities to re-position companies in the global market and to strive toward new goals. Often the benefit gained from ICT-based production processes is improved product or service quality. They are also seen as a supporting factor for accelerating and improving innovation processes. But as control technology, ICT may also support cost cutting and productivity increases as strategic goals. Instead of assuming that ICT applications result from strategic goals of companies, we here understand the relationship between technical artefacts and company goals as a process of co-evolution.

Modern ICT applications, organisation forms, cultural patterns and companies' strategic goals or achievement criteria, we argue here, co-evolve in the developing information economy, mutually influencing each other. It seems obvious that only a more holistic approach, taking into account the interdependent nature of these dimensions, can maximise the synergies to be gained from a fundamental transformation process (Murray and Willmott 1999: 167). Analysing the information economy implies applying such a holistic approach.

2.2.2 The social shaping of modern ICT

Modern ICT, as Castell argues, is not only a tool to work with but it is also a process to be developed (Castells 1997: 32). "Users and doers", Castells continues, "may become the same. Thus users can take control of technology as in the case of the Internet.... It follows a close relationship between the social processes of creating and manipulating symbols ... and the capacity to produce

and distribute services” (ibid. 32). While producing things or providing services through experiment processes, users can develop their technology (Brousseau and Rallet 1998: 255).⁹

The fact that Castells conceptualises ICT as a process characterises him as a representative of the social 'shaping approach' (Wyatt 1998).¹⁰ However, the author distinguishes his approach from the traditional social shaping concept insofar as he does not differentiate between the process of technology generation and the process of technology application. Instead, he emphatically stresses both generation and application of technology being one and the same process. While applying ICT, users also develop the technology.

This demonstrates the dialectic relationships between technological structures, on the one hand, and workers as creators and users of technology on the other. Giddens' 'structuration theory' can be seen as a general attempt to resolve the dualistic grouping of objective conditions and subjective actions and interactions and to integrate the actor and the structure perspectives into one theoretical framework (Giddens 1979, 1983). According to Giddens, agents and structures¹¹ represent a duality; yet they are not independent sets of phenomena, but mutually influence each other. While, on the one hand, rules and regulations are produced and reproduced by social actors, these at the same time generate and regulate social processes providing specific routines of action.¹²

We can argue that ICTs and their use practices, organisation forms, cultural patterns, and strategic goals interact with social actors and call for specific skills and competencies in the workforce. The new technologies are often associated with a 'skill-biased technical change' (Bresnahan *et al.* 1999), which implies the replacement of low-skilled labour with higher-skilled labour. However, based on our arguments above, we can conclude that skill demands not only depend on ICT applications, but also on the complete cluster of the above-mentioned associated complements. Furthermore, the linear argument of ICT-based production processes calling for higher-skilled labour seems to be too simplistic, as we have to take into account the interactive relationships between the various dimensions of technological practices.

⁹ Kling (1987) stresses the conflict element in this development process. Participants in this process of developing ICT systems are not only users but also system developers, the senior management of the company, and any other individuals or groups affected by the computer-based information system. Some of them are interested in the development process because it can result in leverage such as increased control, speed, discretion over work or bargaining power, while others will oppose specific computing arrangements, as they fear losing control and bargaining power. They will try to push alternative systems, which serve their interests better.

¹⁰ This approach rejects any kind of technological determinism. It focuses its attention to social relationships and interactions between individuals but also among collective actors involved in innovation processes to improve technical artefacts. The concept of 'technology frames' developed to analyse these processes mentions goals, key problems, problem-solving strategies, theories, tacit knowledge, testing procedures, design methods, users' practices, and the perceived substitution function of the new artefact as intervening factors (Bijker 1995: 123-4). This approach still provides a limited perspective, as it only analyses how relevant social actors involved in the process of technological innovation perceive users' practices. It does not pay attention to the actual use of technological artefacts.

¹¹ Structures, according to Giddens, do not exist in reality; they only exist as memory traces in human minds. People internalise the rules that are made manifest only in the instances when they are drawn in social action and interaction (Walsham 1993: 61). Structures exist insofar as they are produced and reproduced in social practices. Therefore, we can also speak of 'virtual structures.'

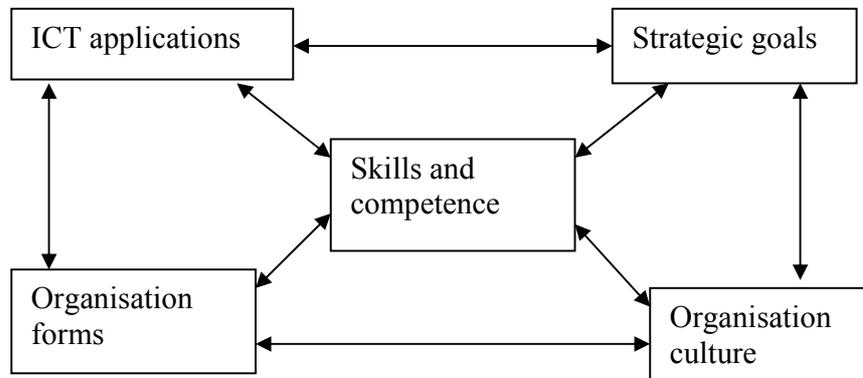
¹² Giddens has not paid particular attention to technological structures. Modern ICTs, however, are not mere social constructions that can be reduced to a set of social relations. While social relations are undoubtedly present, they do not comprehensively or essentially describe what those technologies are. ICT possesses an objective set of rules and resources that both enhances and constrains the roles of workers within organisations; they have an influence on the social fabric of the organisation (Sampler 1996: 10). To conceive of a social order as resting solely on interactions between human beings is to ignore the role that material resources play in shaping and substituting social relationships (Kavangh and Arujo 1997).

2.2.3 Technological practices

In the following we will use the concept of 'technological practice' (Parcey 1983) to analyse the complex interaction between the cluster of variables associated with ICT applications. Technological practices develop around a bundle of work activities in communities of practice, in which the use of modern ICT plays an important role. But they involve far more than applying modern ICT. When analysing technological practices, we have to highlight a cluster of complementary variables which go together with the technology-in-use. Besides the applications of modern ICT, as we have argued above, technological practices also include organisation forms, companies' strategic goals and specific cultural patterns. As the elements of technological practices are closely linked and mutually influence each other, we can speak of a process of co-evolution.

As a result, the skills of the practitioners involved in technological practices are also affected. As the concept of technological practices aims at integrating structural and actor variables, we have to conceive of skills and competencies as a part of technological practices, co-evolving together with the other variables. Technological practices can be analysed on different organisational levels. In general, there exist a variety of technological practices in companies; we can therefore speak of a fractional organisation. Each practice creates a specific potential way to use modern ICTs. Our research, however, mainly focused on the analysis of technological practices on the organisation level, taking into account the need for systemic restructuring.¹³ This means that we do not interpret companies as consisting of stable techno-organisational and normative structures, but as reproduced forms of action, shaped by existing technological practices.

Figure 2.1: Technological practices



2.2.4 Social exclusion risks

Social exclusion¹⁴ is not a new phenomenon caused by the emerging information economy and by the widespread use of modern ICT. But together with the ICT-based restructuring practices, new forms of social exclusion may occur. Social exclusion¹⁵ is often defined as "breaking of the social

¹³ We here refer to the argument of actor-network theory that complexity needs to be 'black-boxed' and 'translated' for practical reasons (Law 1992).

¹⁴ Here we will not discuss the distinction between poverty and social exclusion. See, for example, Chapman *et al.* (1998: 3), Room (1999: 167)

¹⁵ The list of attempts to define social exclusion is endless. All observers of this phenomenon agree that it is difficult to give an exact definition. The concept is very vague and ambiguous because it includes various economic, social and political aspects. In recent years more and more aspects of social disadvantages have been covered by the concept of

ties" (Xiberras 1993). This definition, however, assumes some kind of clear line dividing the 'inside' and the 'outside'; it understands social exclusion as a monolytic phenomenon. On the basis of such understanding, no gradual scale of membership in a social system seems to be possible but only an abrupt, definitive exclusion. To avoid such a strong demarcation, the pair of opposing terms 'exclusion/inclusion', or 'exclusion/integration', has been introduced (Luhmann 1994). The fact that various degrees of integration can be identified makes it possible for us to speak of exclusion/inclusion as a relative concept (Xiberras 1993: 25).

Normal life takes place in various social spheres: work, education, health care, free time activities, housing, and cultural life, for example. This means that there are many ties that link people with society; social exclusion is therefore seen as a multi-dimensional and cumulative phenomenon (Stichweh 1997). Social integration, according to Chapman *et al.* (1998), depends on civic integration, economic integration, social integration and interpersonal integration. Not participating in one of these spheres does not automatically imply exclusion. For example, the lack of employment does not in itself necessarily lead to exclusion, but only in interaction with or in a sequence of collapses of various inclusions. Only those people that do not participate in all or at least the majority of the various social spheres can be characterised as excluded. Nevertheless, being excluded from one of these spheres can be seen as a pathway to full exclusion.

The process character of social exclusion is also stressed very often. Paugam (1993) defines exclusion as a process of 'social disqualification' that occurs in three consecutive stages: fragility (under/unemployed but retaining links with society); dependence on social aid (discouraged from work but filling other social roles); and then complete breakdown of social bonds. Castels (1992) also characterises exclusion as a dynamic three-stage process running from full integration through precarious, vulnerable employment and fragile relations to disaffiliation or exclusion. The zone of vulnerability is strategically important as it "designates the crumbling of the social tie before it breaks" (Castels 1992: 138). Exclusion is then conceived of as the accumulation of various disadvantages, as the last stage in a process of social disqualification (Paugam 1993).

On the basis of what has been said so far, the notion of social exclusion implies a relative and process-linked vision of degradation with respect to a certain status experienced previously, at the end of which people find themselves cut off from all circles of social exchange. Therefore, in general, the state of social exclusion pinpoints a situation that manifests certain deterioration with respect to a previous situation. Integrated subjects can become vulnerable because of organisational transformation in the working environment and these vulnerable people can fall into the precipice of social exclusion. The excluded people would then occupy the fringes of social life, first characterised by loss of employment and then by social isolation.

Although recognising the complexity and multi-faceted character of the phenomenon of exclusion, we will here focus on the sphere of work (see also Nasse 1992). Employment is seen as the core of the social ties that link people to society, as our modern societies have privileged economic exchange and thus remunerated work (de Foucauld 1992: 6). Our argument is that besides having positive employment effects, informatisation of work and new forms of organisation may also threaten social cohesion and social transaction to some extent. Changing technological practices in the information society, we argue, may reproduce old forms of social exclusion, but they can also produce new social exclusion risks. We focus on social exclusion risks associated with companies' restructuring processes, which means that we limit our analysis to the first stages of the social exclusion process. This also implies a change in the perspective. Instead of concentrating on the

social exclusion, and an increasing number of people have been characterised as socially excluded. Some critics have been arguing that the concept can be made to express almost anything.

processes in which individuals become excluded, we here concentrate on the exclusion risks associated with particular ICT applications and related organisation forms.

2.3 The regional aspect: divergence or convergence?

As the Bangemann Report (1994) states, there is a risk that Europe will fall behind the US and Japan, its main competitors in the globalising economy, with respect to the development of an information society. The report goes on to argue that the first countries to make the transition to the information society will reap its best benefits, while latecomers may actually be confronted more with some negative sides of the new emerging economy and society.

The argument places great hope in modern ICTs and associates a dazzling potential with these technologies to solve many of today's economic problems in Europe. The report seems to assume that national responses to current problems have to be more or less similar to effectively regain global competitiveness. It is important for European countries, as the report concludes, to speed up the introduction and broad diffusion of modern ICT within companies. Following the leading countries in the use of modern ICT can enhance the continent's competitiveness and thus stimulate economic growth and generate new job opportunities.

The Bangemann Report assumes, at least implicitly, a trend towards convergence. We can speak about a specific version of a 'theory of convergence', which sees technology as the driving force behind similar developments. All theories of convergence, as Regini argues, have something in common in that they consider "the role of the processes of change affecting all the advanced economies to be so powerful that they drastically reduce the possibility of alternative responses. At the basis of all convergence theories is the idea that the modernisation of advanced economies and societies must follow established paths essentially dictated by exogenous factors" (1999: 2). According to the Bangemann Report, modernisation in advanced economies must rely on the rapid informatisation of all economic and social processes, equating informatisation with the use of modern ICTs.

The neo-institutionalist school rejects the argument that there is only 'one best way' of developing and designing the information society that all countries have to follow to stay competitive in a globalising economy. The basic idea of neo-institutionalism is that pre-existing institutions play a key role in shaping responses to exogenous factors by acting as a filter, or intervening variable, between external pressures and the responses to them. "Since institutional contexts vary from one country to another, being rooted in their histories, the neo-institutionalist perspective has no difficulty in recognising and explaining the divergence among responses to common challenges: different alternatives are pursued because the pre-existing institutions, and their role in mediating the impact and direction of change, are different" (Regini 1999: 5).¹⁶

Taking the argument of institutional shaping seriously, we have to reject the implicit assumption of the Bangemann report that there is only one way to the information economy, which all territories have to follow to stay competitive in the global competition. Instead, we can assume that there are different options of designing the newly emerging economy.

¹⁶ The societal effect approach, associated particularly with the work of the 'Aix group' (Maurice *et al.* 1986, Sorge *et al.* 1986, Maurice 1995) and the concept of national business systems developed by Whitley (1992) argue in a similar way.

2.4 Conclusion

The argument that the emerging new organisation structures and practices in the information economy can be explained by a broad application of modern ICT has been questioned recently. But a weak social determinism assuming organisation forms as the determining factor also needs to be rejected. Instead, we have to understand organisational changes as an evolving process of several factors mutually influencing each other. We have used the concept of technological practice to highlight a cluster of complementary variables which go together with the technology-in-use, including organisation forms, companies' strategic goals, specific cultural patterns, and the skills and competencies of the workforce.

Technological practices not only call for specific skills and competencies, but also produce social exclusion risks for specific worker groups. Our analysis of social exclusion here is restricted to the sphere of work, as employment is seen as the core of the social ties that link people to society. We focus on the first stages in the process of social exclusion, analysing mainly social exclusion risks produced by emerging new technological practices within companies. Concerning the regional aspect, we have argued that we cannot assume a trend towards increasing convergence in companies' restructuring practices due to the widespread use of modern ICTs. Instead, we follow the thesis of neo-institutionalism that different institutional settings in various regions may open up different paths into the information economy.

3. INFORMATION AND COMMUNICATION TECHNOLOGY INFRASTRUCTURE AND ITS UTILISATION

This chapter deals with the application of modern ICTs within companies. First we discuss some new trends in the development of this technology. We then analyse the extent to which ICT is used within companies by relying on our company survey data. Are the application and use of modern ICTs influenced by the new Leitbild of an ICT-based network organisation? Do companies use modern ICTs in such a way that they can support the development of organisation networks? We discuss the technical infrastructure that companies are using in their service, manufacturing and administration processes: the computer hardware and software as well as communication technology applications. Based on the components mentioned above, we develop a typology for ICT systems and analyse their diffusion.

It is however not the technical nature of modern ICT but the functions they are used for that influence the gains which can be derived from this technology in the first place and that impact most on business restructuring practices. The new quality of modern ICT is that the functions for which the technology can be used are not rigidly predefined but that they are only activated by the specific demands of working processes. Modern ICTs are viewed as interpretatively flexible (Bijker 1987: 16); different companies may apply modern ICT in different functions depending on the meaning given to the technology¹⁷. It is important to mention that the increasing application of network-based computer systems has added a new function. The new technical developments allow workers to use computers as a means of communication. In the end we will deal with the process aspects of ICT applications; with a particular emphasis on the barriers of introducing ICT, the forms of user participation and union involvement.

3.1 New trends in the development of ICTs

Modern ICTs have developed dramatically during the last decade. The technical performance of modern ICTs has increased significantly. Particularly the speed of communication has improved, with more multi-frequency information travelling simultaneously down a common line than ever before. Due to a sharp rise in communication bandwidth, high volumes of data are moving from one location to another in a very short time. Also the price-performance relation in information and communication has improved dramatically; cheap storage, processing and transmission capacity is available almost everywhere.

Microprocessors, communication intersections, system components and user software have been standardised, which allows for the compatibility of various technical subsystems, forming a larger platform that can be used by everybody. Furthermore, together with the digitalisation of information, it has become possible to combine text, voice, video, data and/or graphics within a multimedia communication system (Fulk and De Santis 1995). And due to processes of dematerialisation and miniaturisation, connected ICT devices can be made small enough to be portable, increasing the mobility of ICT users. The use of modern ICT is no longer limited to certain fixed locations (Lillrank 1996).

Central data management has to be considered as another enabler of advanced computing solutions. This means that all data on the structure and elements of organisations, as well as company processes, are saved in one databank. Although the terminals at which employees access data no longer have to be stationary, the consistency and integrity can be guaranteed as soon as data are inserted into a central data repository, regardless from which location or terminal the access is gained. So far, low technical merits, mainly the lack of openness, compatibility, and bandwidth, still hinder the diffusion of mobile computing concepts and devices into business applications, however.

¹⁷ One cannot deny, however, that the way in which ICT is applied within companies also depends upon its technical nature. Stand-alone computers, to give a simple example, cannot be used as communication or network technology.

In the literature a trend towards ICT applications supporting and enhancing organisation networks is identified. While the fundamental emphasis was earlier on computation, it has now shifted to communication and co-ordination of activities (Sampler 1996: 19). Ward *et al.* argue that technology is shifting from data processing (administrative, centralised mainframe computing) and management information systems (MIS), to individual and office support on PCs and office systems, and then to electronic data interchange (EDI) and inter-organisational systems, organisational 'platforms', and network computing (1990).

The change from computation to communication and co-ordination of activities concerns the gradual shift from incremental, partial uses of ICT to the creation of integrated organisationwide and inter-organisational information systems. It reflects a change from a technology-driven use of ICT to a market- or user-driven use (Murray and Willmott 1995: 169). Network computing will lead to new forms of business, namely electronic commerce. Novel areas such as 'customer relationship management' become central to business processes. In the following we take a closer look at the two dimensions of the ICT systems: computer technology (hardware and software) and information technology.

3.2 The technical system

3.2.1 Computer hardware

Concerning the computer technology installed by companies, we have differentiated between the following systems: stand-alone PCs, mainframes with terminals, and local area networks (LANs) together with other network technologies. A stand-alone PC represents a limited operational capacity; it is basically a separate working unit, supporting individuals in their work. Mainframes can be characterised as a centralised computer system. Users are connected by terminals to the main computer, its software, and databases. The main computer frames the tasks that can be conducted. Users are connected to the main computer, but not directly to other users.

Local Area Networks (LANs) represent a totally different, more decentralised type of computing. They can be described as client/server architecture. LAN and similar technologies connect the users to a network, shared software, databases and other users. Software is not limited to one machine but can be processed co-operatively on various computers in the network. The computer, as Tapscott (1996: 100) argues, becomes the network and the network becomes the computer. LAN systems leave space for more autonomy at work. Being integrated into a local area network, users do not have to rely solely on the capacity of their own computers or of the mainframe. Together with the changing nature of modern ICT an information space is emerging in which people work instead of working on mainframe systems. Whereas automation-oriented mainframes are still characterised by "rigid, closed function chains" and by "clear, predefined input-output relationships", work in information space, as Braukowitz argues, is characterised by "the variability of informatic references" (1996: 70f).

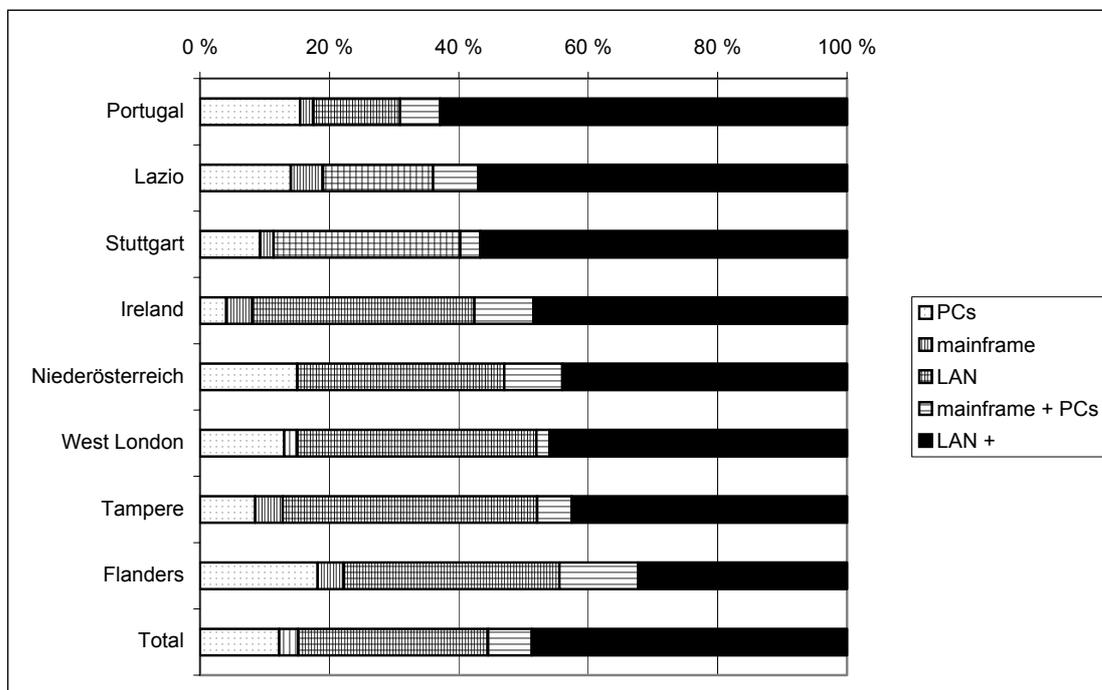
More than half of the companies studied dispose of a computer infrastructure with more than one system. This often results in fairly bizarre and complex ICT configurations. It also indicates that the introduction of modern ICTs is in general a gradual and evolutionary process. Yet many companies are actively working on obtaining more uniformity in their ICT systems. This has also increased the pace of technological change in recent years. Especially the usage of stand-alone PCs, leftovers of 'ancient times', is rapidly decreasing. In general, we can identify a trend from isolated computer systems to network applications with each unit being connected to central data repositories.

An infrastructure limited to stand-alone PC's or mainframes with terminals can be found rather seldom. Some longer-established companies, however, still have such limited infrastructure. The use of LAN or WAN systems that connect companies with other organisations is typical of the youngest

companies on the one hand. As Figure 3.1 shows, the share of companies applying only stand-alone PCs is largest in Flanders, Portugal and Niederösterreich. On the other hand, LAN as the single applied computer system is most widely used in the Tampere region and in the West London area. And over 80% of all companies in the Stuttgart area, Ireland, the West London area and the Tampere region include a LAN system in their computer technology.

The use of computer technology in companies is influenced by their affiliation to specific sectors or size groups. But even among the small manufacturing companies with less than 50 employees, the share of those using stand-alone PCs and/or mainframes is only about 25%, while among large service as well as manufacturing companies this share is less than 10%. Network technology, on the other hand, is used by less than 70% of the small manufacturing companies but by about 80% of all companies belonging to the three other categories.

Figure 3.1: Applied computer system by region



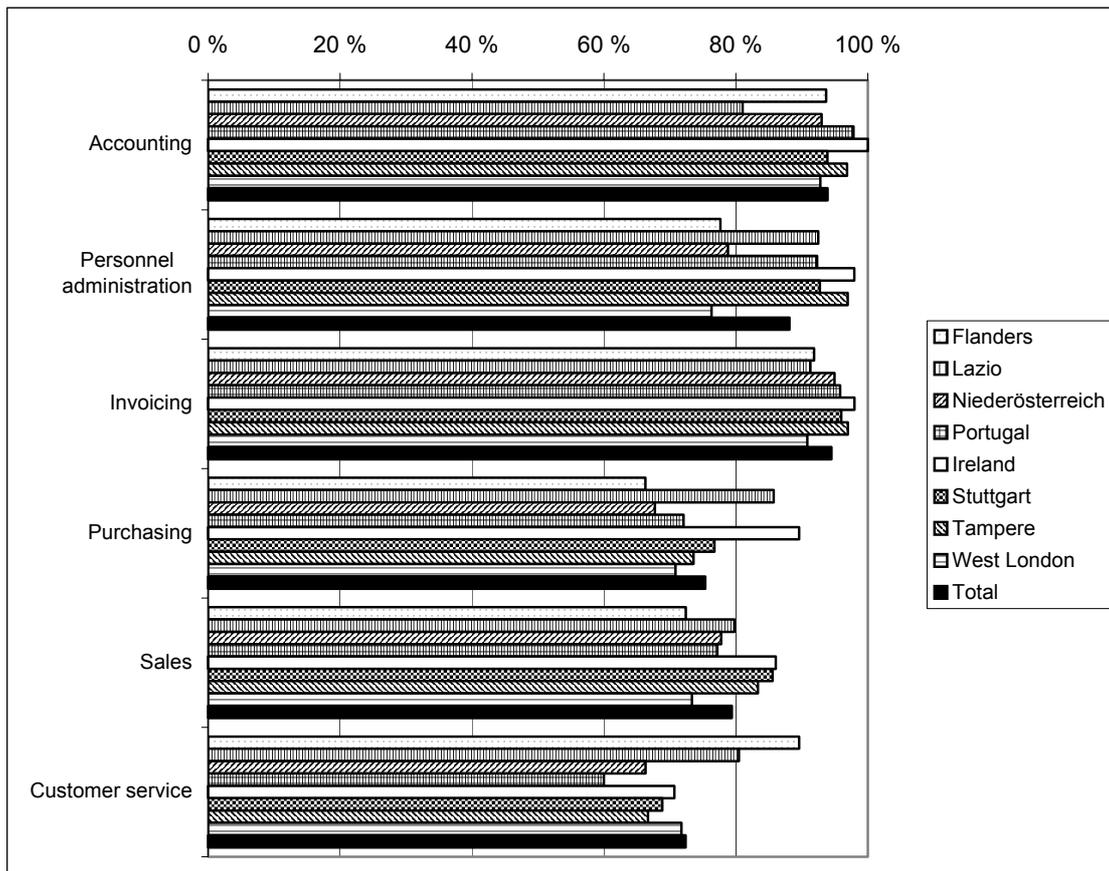
3.2.2 Computer software

Computer technology not only consists of hardware but also of software. The application of standard software packages is a very widespread phenomenon among the studied companies. Particularly for conducting traditional administrative tasks software support is quite common: more than 90% of all companies use it for accounting, personnel administration and invoicing. Customer-related functions, on the other hand, are less supported by software. About 25% of all companies, for example, do not use software to support customer service. Concerning traditional use of modern ICT in administrative functions, some differences between the two size groups exist, as larger companies have applied more often modern ICT to support administrative processes than small ones. And naturally, customer service is more often automated in the service sector than in the manufacturing sector.

Concerning the software support for accounting, personal administration, purchasing and customer service, regional differences are significant. Generally Irish companies seem to be most advanced concerning the support of office tasks. It is worth noting that with respect to software support in customer service, companies in Flanders and Lazio are ahead of the other regions studied.

Figure 3.2: Office tasks carried out using software applications, by region

Relatively new is the extent to which the various functions are becoming technically



integrated; trans-functional use of office software has become quite common nowadays. Under the slogan of computer-supported co-operative work (CSCW), software for non-routine administration processes has been developed, which alongside the explicit support of communication among the staff made it possible to work on common documents and to access common databanks. This system architecture provides the option of co-ordinating temporally and spatially distributed work. Two out of three studied companies have automated nearly all their office functions; isolated software support of one or two functions can hardly be found. Smooth functioning of office processes increasingly depends upon ICT support, or rather upon ICT domination. Large production and service companies have more often automated all their office tasks than smaller companies from both sectors.

There are, however, big differences concerning the number of employees involved in office automation. In about 30% of all studied companies, less than 10% of the employees are involved in office automation; on the other hand, in more than 20% of all companies the share of involved employees amounts to more than 80%. Regional differences concerning the intensity of use are significant, with Portugal, the Stuttgart area, the West-London area, and Flanders having the largest

share of companies in which more than 80% of the workforce are involved in office automation. Sector differences are also significant; naturally in the service sector and particularly in business services the share of employees involved in office automation is much larger than in manufacturing industries.

Software support has progressed less rapidly in production processes than in office functions. In more than 50% of all companies the design of products as well as the planning and preparation stages are supported by software. Transportation and warehouse management is the least automated function; in that case, only about one third of all companies use software support. But also concerning the treatment of products, process control, maintenance planning, and quality management, the share of automating companies is below 50%. Companies often rely on in-house solutions but, due to the emerging production networks, companies are increasingly forced to use software applications that are compatible with those of other companies. There are, however, also examples in which a great number of stages in companies' production processes have been automated, as the following two examples show.

In the retail store (LON 4), stock control is becoming increasingly computerised. Mostly using scanners, which are linked to a central system, it is possible to know where any item of stock is, from warehouse to the store. The tills record sales and returns and stock control is much more precise. Assistants should be able to immediately tell whether or not any product is in stock. And if not, whether items are available at the warehouse. This was about to be extended, which means that assistants in one store could identify, in which other local store a particular garment or product is available, and could order this. Before assistants had to telephone around other stores to track down products. These stock control mechanisms also enable sales of all products to be closely monitored. Poorly selling products can be withdrawn, moved to stores where they will sell or have their price reduced. This use of technology enhances the ability to deploy stock efficiency. Technology is also used to control losses. For example, products are tagged and scanned; the number of times each till is opened and whether or not each opening is associated with a transaction is tracked.

In one way or another, all stages of the company's (FLA2) production process are computer-supported or automated: (1) the design of products (by means of CAD, CAE); (2) systems for planning and preparation of the production (especially line balancing: this is a very complex optimisation problem, completely software-supported); (3) computer-controlled systems for the actual treatment of products (especially in the body and paint shop, to a lesser extent in the final assembly); (4) computer-controlled systems for process control (e.g., the robots and machines are steered via Programmable Logic Control (PLC) and connected to alpha computers); (5) systems for the transport of products or stock & warehouse management (e.g. pick & place robots, automatic storage systems, JIT supply by means of EDI); (6) computer support in maintenance planning & quality management (cf. the plant maintenance software package Maximo). The different stages of the production process are also technically integrated. On the one hand, this increases oversight and control over the production process. On the other hand, the dependence on information processing systems ever increases. Since everything becomes closely interconnected, a small IT problem can rapidly spread out and have serious implications in the entire production process.

Automation of the production process in manufacturing is the most advanced in Portugal and in the Stuttgart area. Companies in Lazio and in Niederösterreich, on the other hand, are lagging behind in the overall automation of the production process. Large manufacturing companies¹⁸ as could have been expected, automate more production stages and they also apply more integrated systems than small companies.

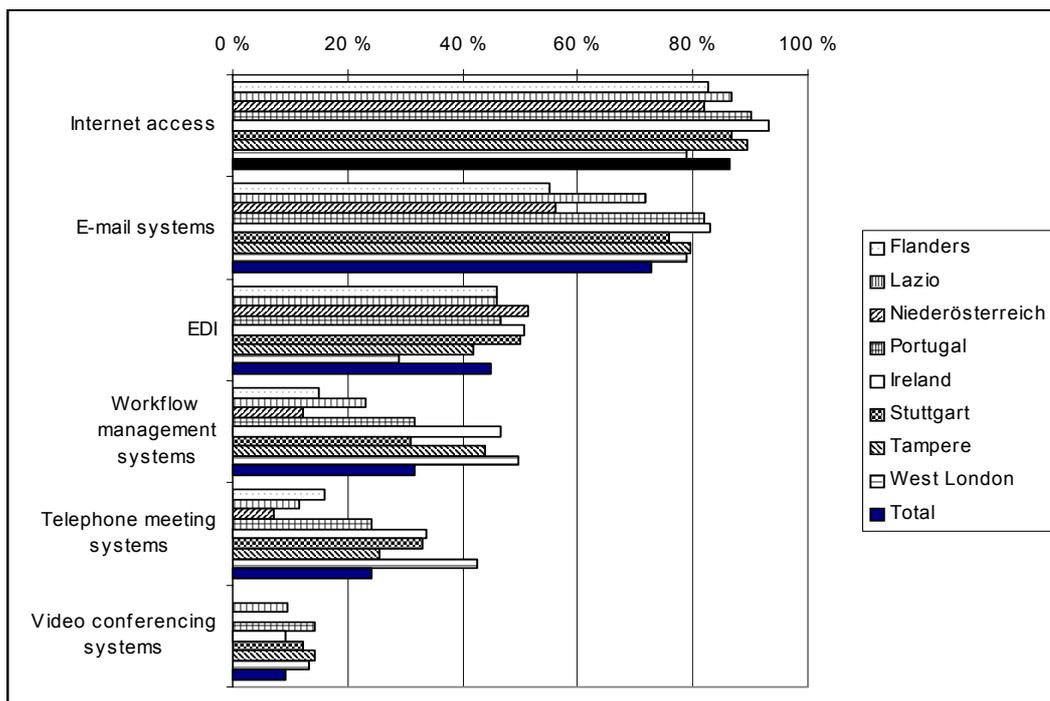
3.2.3 Communication technology

¹⁸ Because automation of production processes did not very often apply to the service companies, we do not provide data for this sector.

So far we have discussed computer hardware and software, the information processing part of modern ICT. Now we turn our attention to transmission technologies. Here it is important to differentiate between person-to-person communication and unit-to-unit communication. The first type of communication requires solutions such as e-mail, whereas unit-to-unit communication can be supported by a remote solution, such as background processes based on electronic data interchange (EDI). Nearly all companies engage in electronic communication and have the technology to do so. About 90% of all companies in the survey have Internet access and about 75% use e-mail. Less applied are EDI (45%), workflow management systems (32%) and telephone meeting systems (24%). Only one out of ten companies participating in the survey make use of video conferencing systems.

Concerning the use of Internet, e-mail systems and EDI, the main communication technologies, regional differences are not significant, but with respect to all other communication technologies, the application rate differs regionally, as Figure 3.3 shows. There are major differences concerning the use of communication technologies with respect to sector and size. In general, service companies and particularly the large ones are the most intensive users of modern communication technology, followed by large manufacturing companies, while small manufacturing companies are lagging behind. For example, among the small manufacturing companies only every second is using e-mail, while in general about 80% of all companies do so.

Figure 3.3: Application of communication technology by region



The number of communication technology users varies considerably from company to company. In general, in most companies only a minority of employees makes use of e-mail. In every fourth company, less than 10% of the workforce have access to e-mail, while at the same time, in about 20% of all companies, all employees have access to the technology. The most extensive use of electronic mailing systems among employees can be found in the West London area and in

Portugal¹⁹. On the other hand, companies in Niederösterreich seem either to reduce the use of the e-mail to a small number of employees only or to switch their entire internal communication system to e-mail.

In the service companies that participated in the company survey it is often the case that almost everybody has access to e-mail. In manufacturing companies, on the other hand, e-mail is predominantly preserved for white-collar employees. In some industrial companies, blue-collar workers can also use e-mail via the collective team PC. However, in most cases, the workers in question can hardly make use of e-mail, as they have to be able to free themselves from the production process and the team PC itself has to be available. On average, the number of e-mail users in manufacturing companies varies from 10% to 25% of the total workforce.

The share of people having access to the Internet tends to be much smaller than the number of e-mail users. Only in a few companies do all employees have unlimited access to the Internet. In most companies, the right to surf the web is given only to people in managerial functions and to those employees who 'really need it functionally'. The share of Internet users, nevertheless, has increased significantly in recent years and this tendency is likely to continue. Most case study companies have realised that together with organisational restructuring processes the extension of Internet usage becomes inevitable in the near future. However, at the same time, they do not want to take rash steps out of the fear of misuse.

Besides e-mail and the Internet, we want to briefly point to some other modern communication media. Telephone meeting and video conferencing systems are used in a minority of companies, particularly in the large ones. Those media are predominantly used for communicating with colleagues abroad who belong to the same global company. The share of users tends to be very small, especially with regard to video conferencing. On average, attitudes towards the latter medium are not very positive. The argument is that less important things can be discussed on the telephone, and for more important matters one has to go abroad anyway. It is obvious that for the time being ICT does not replace travelling and face-to-face meetings. In many circumstances, face-to-face communication in a group seems to be more effective than technologically mediated communication.

3.2.4 ICT systems in use

We now bring the two technology strands together and analyse the use of ICT systems. There are no standardised methods for classifying ICT systems. Here we have used a typology which integrates the two aspects of modern ICT: computers as information processing and management tools, on the one hand, and the type of transmission and switching capacities that are used to link these tools on the other (Brousseau and Rallet 1998). The typology differentiates between (1) isolated computer systems, which can further be divided into those that are neither internally nor externally linked (isolated on the workplace level) and into those which are internally but not externally linked (isolated on the organisational level); (2) telecommunication systems; and (3) telematic systems, the latter two being connected externally.

In telematic systems, information exchange takes place without human interference. EDI, defined as a "set of message standards to enable the exchange of commercial transaction data between autonomous application systems without human intervention" (Pfeifer 1992), can serve as an example of automated information exchange between organisation units. E-mail systems, on the other hand, belong to the category of telecommunication systems. Human beings are still largely

¹⁹ The distribution of values in these variables significantly deviates from the normal curve and the share of users in the companies was classified in quartiles.

involved in the process of exchanging information and interpreting messages. Table 3.1 characterises the three types of ICT systems in more detail.

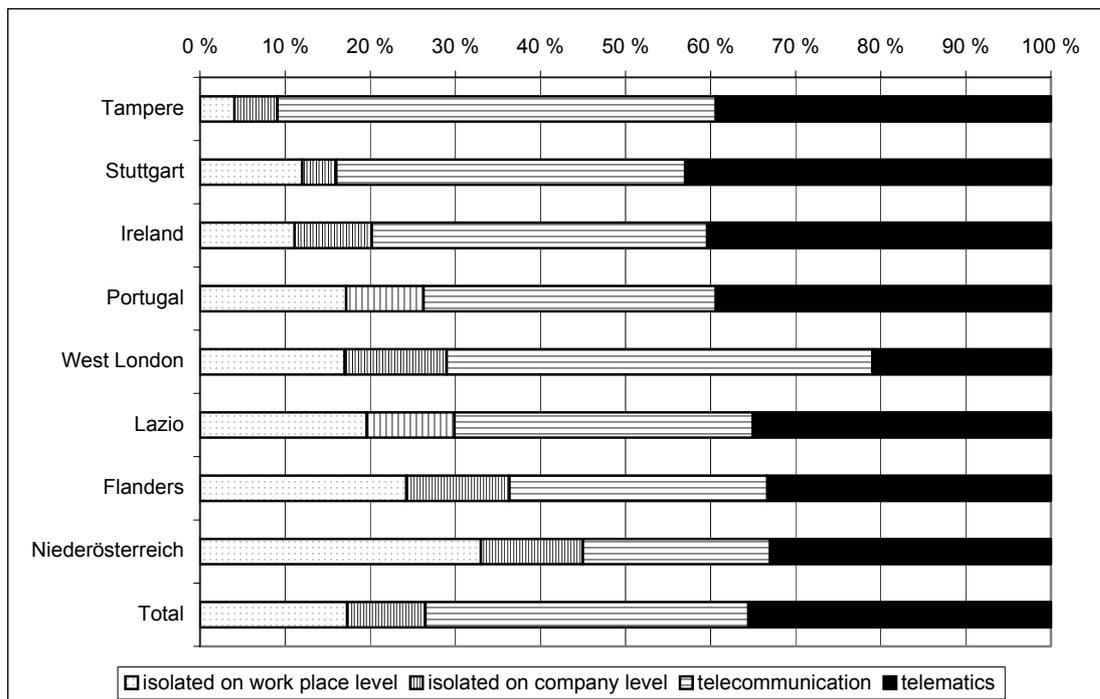
Table 3.1: ICT typology developed by Brousseau and Rallet (1998)

Isolated computer system	
Information management tools	computing system to automate or support local decision processes
Transmission and switching capacities	automated information management tools are not linked by automated and dematerialised communication capacities
Consequences	these systems are not used in synergy to support, automate, or integrate decisions on the collective level
Telecommunication systems	
Information management tools	only terminals, no computing systems that automatically process information
Transmission and switching capacities	communication is automated
Consequences	interactions are not bound and structured, content of the message is humanly managed; the system supports both natural language communication and formal communication; the aim is to accelerate information flows and decrease information costs
Telematic systems	
Information management tools	automated information management systems in all components of organisation
Transmission and switching capacities	integration of information management tools through a telecommunication system that enables automated exchange of information and to process it in synergy; support and automation of co-ordination
Consequences	automation of decision-making; process integration on the organisational level; results are communicated to human beings

Of all ICT systems applied in companies, 25% can be characterised as isolated, if the company as a whole is chosen as a reference point. If we move to the individual workplace, only about 15% of all ICT systems can be characterised as isolated computer systems. Here employees are technically connected neither to the inside nor to the outside the company. On the other hand, about three out of four companies are externally connected. This means that the great majority of the companies have the technological capacity for developing intra- and inter-firm networks. In every second externally connected system, information exchange takes place between organisation units without human interference. These can be characterised as telematic systems. The other part of the externally connected companies has no automated information exchange; human beings are still involved in the process of the information exchange (human-to-human communication).

Regional differences are quite significant. In the Tampere region (4%) and in the Stuttgart area (12%) there are few companies that have applied only isolated computer systems with no technical connection either within the company or with outside partners. In Niederösterreich, on the other hand, we can find the largest share of companies with no technical connection to the outside world (33%). Of the studied regions, telecommunication systems are most often applied in the Tampere region (52%) and in the West London area (50%), while telematic systems are most widespread in the Stuttgart area (44%), as Figure 3.4 shows.

Figure 3.4: ICT systems by region



Our company survey reveals that concerning the use of ICT systems size and sector are very influential factors. Isolated systems on the workplace level are particularly applied by small manufacturing companies. The use of telecommunication systems, on the other hand, is most widespread among small service companies. And, as could have been expected, telematic systems are most often used by large companies independent of the sector to which they belong.

The second ICT typology used in the project is basically a judgement of the intensity and modernity of ICT use. On the basis of a cluster analysis of all kinds of ICT applications, we differentiated between the following dimensions: ‘low use of ICTs’, ‘traditional use of ICTs’ and ‘advanced use of ICTs’. Traditional use of ICTs is characterised by a high degree of office automation and, if applicable, production automation, while automation of communication is rather low. Advanced use of ICTs also includes high automation of communication. The survey results show that on average about one third of all companies is making little use of ICTs. Almost half of the respondents use modern ICTs in an advanced way, whereas the remaining companies use ICTs mainly for office, and if applicable, for production automation.

In West-London the low use of ICT is rather widespread. Also in Flanders about 50% of all companies make little use of modern ICTs. And in Lazio and Niederösterreich as well as in the Tampere region the share of companies that do not use ICTs extensively is comparatively big (about 40%). Advanced use of modern ICTs is dominating among companies in Portugal, Ireland, and the Stuttgart region. Here about 50% of all companies have automated extensively not only their office and production functions but also communication tasks. Advanced use of modern ICTs is lowest among companies in Flanders and Niederösterreich.

Table 3.2: ICT systems by region

Region	ICT use		
	Low use of ICT	Traditional use of ICT	Advanced use of ICT
Flanders	50%	27%	23%
Lazio	34%	34%	32%
Niederösterreich	56%	24%	20%
Portugal	40%	14%	46%
Ireland	23%	27%	50%
Stuttgart	37%	18%	45%
Tampere	35%	29%	36%
West London	69%	6%	25%
Total	39%	25%	36%

There are also significant differences concerning the intensity and modernity of modern ICT applied within companies with respect to size and sector. For example, the share of small companies, making only little use of modern ICTs is nearly twice as great as among bigger companies. The greatest share of advanced users of ICT can be found among the large service companies, whereas low use of ICT is rather widespread among small manufacturing companies.

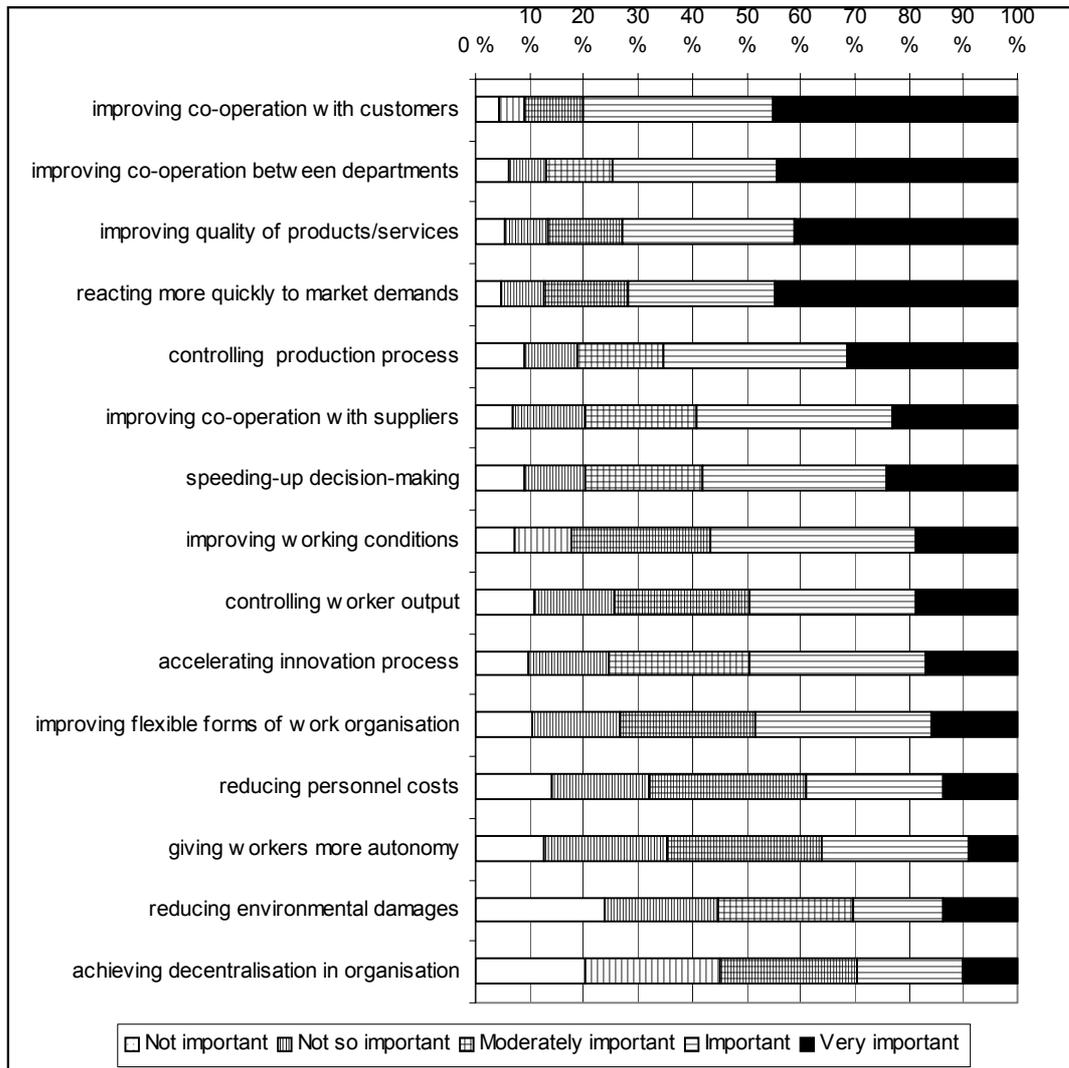
3.3 Aims and functions of modern ICT

The literature on ICT, as we have argued above, suffers from a dearth of theoretical reflection, as it concentrates on the technology itself. There is no doubt that ICTs can "play key roles in restructuring major social relationships – interpersonal, inter-group and institutional" (Kling 1991: 344). They have a transformative potential, but they do not necessarily transform social relationships. This is because those technologies are 'consumed' (1991, 1992) rather than simply deployed.

There is no single logic of applying modern ICT which can be derived from the technology itself. It is not the 'technical nature' of modern ICT - its technical characteristics and capacity - but the functions it is chosen to perform within companies that determine both the nature and extent of benefits being gained from this technology. In our company survey we asked companies about the importance of various aims for the introduction of modern ICTs. As can be seen from Figure 3.5, the aim to improve co-operation within and between companies is the most important one which prompted companies to introduce modern ICT. The aims of improving both time-to-market and quality also quite often motivate the decision to introduce modern ICTs, while innovation in general is not a primary aim. Modern ICT is also used very often to control production process, but companies are less concerned with monitoring workers and their work when introducing modern ICT. Humanisation aspects are hardly mentioned by companies as an aim to introduce the new technology.

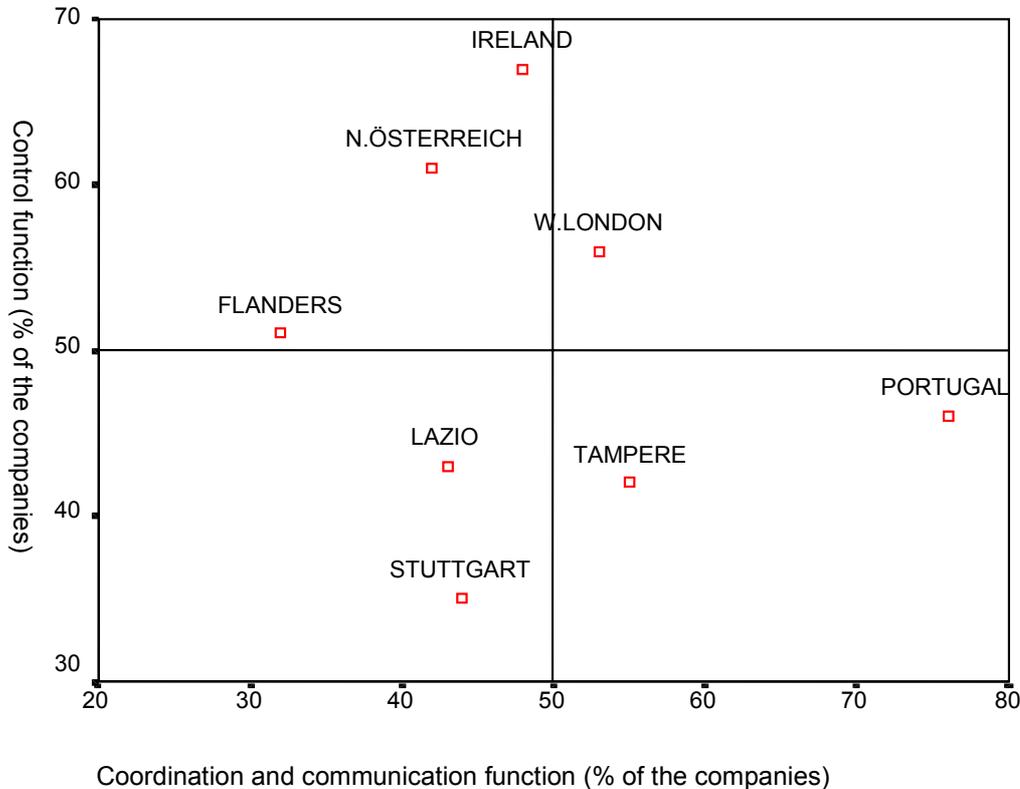
Summing up we can argue that modern ICTs are primarily used in their function as tools to improve quality, as technology to control production processes and as information and communication technology, whereas their use as surveillance technology and organisation technology is less widespread. Size and sector do not matter that much when we analyse ICT functions.

Figure 3.5: The importance of different aims for the introduction of modern ICT



It is of particular interest to analyse to what extent ICT is used by companies in the various regions as control and as communication technology. The regions can be assigned to four different categories. First, there are the Stuttgart area and Lazio, in which companies do not regard either of these two functions as important, compared to companies in other regions. In Ireland, Niederösterreich and Flanders, over half of the companies regard only the control function as important. The majority of companies in Portugal and the Tampere region, on the other hand, recognise the co-ordination and communication function of ICT. And for companies in the West-London area, both functions are highly relevant. In the following we will enrich our quantitative analysis with findings from our case studies.

Figure 3.6: The importance of 'co-ordination and communication function' and 'control function' by region



3.3.1 ICT as a tool

Like all other technologies, ICT can first be characterised as a tool to work with (Eason 1988). The introduction of modern ICT then refers to single sub-processes or tasks. Through modern ICT companies intend to support people in their work; the aim is to enhance task performance, for example, or to enable people to work more rapidly and more exactly. The computer can be regarded as a tool which enables its users to carry out their work effectively, as an extension of their skills rather than as a replacement for skills (Ehm 1988). Modern ICTs can function as hand tools. For Piore and Sabel, the computer is an important part of the production model of flexible specialisation; they characterise it as a 'craftsman's tool' (1984: 261). ICT systems, however, cannot be equated with traditional machines that are integrated into work processes as tools to transform material objects but that do not change decision-making processes or information and communication processes significantly. ICT only indirectly manipulates the material conditions of the product; mainly it syntactically manipulates the internal state: data are processed and new data are created. Therefore, the computer is characterised as mainly 'brain technology' (Krämer 1989).

The fact that ICTs can duplicate and process all symbolic artefacts and that they can easily be re-programmed makes them a very flexible and unique tool. Nowadays they are used to assist in design and planning and to support managers in decision-making processes, making it easier to quickly rehearse various alternative solutions. And it would not even be possible to conduct specific tasks without the use of modern ICT. Simulation of complex decision-making processes, for

example, cannot be done without a technology that can store and handle a huge amount of information.

The tool aspect is seldom reflected upon, but it is an increasingly dominating aspect with respect to Workflow Management Systems. The ultimate goal of this technology, namely the total automation of business processes, has not been achieved. But when launching the products, the trend towards intelligent work support on the tool level is still continuing because such contextual information or fundamental processes of information gathering and pre-structuring are performed by using today's tools. While the basic underlying reason for using ICTs is in most cases that they are a tool which can be used to improve efficiency, productivity and competitiveness and to provide better services to customers, it is often expanded or rationalised as further uses in different situations emerge.

3.3.2 ICT as automation technology

Modern ICT makes it possible to transfer the knowledge of workers into machinery and thereby to reduce the need for human labour. Codification of knowledge leads to the automation of production functions and processes. "The most important impact of new ICTs," according to Soete, is that "they move the border between tacit and codified knowledge. They make it technically possible and economically attractive to codify kinds of knowledge which so far have remained in tacit forms" (1996: 49). The result is the systematic substitution of computer decision-making for human decision-making. Calculable operations are taken over by machines and they can, for example, be integrated into process-overlapping, computer-integrated manufacturing (CIM) architectures.

Different types of work and decision processes are more or less amenable to automation. As ICT has grown cheaper and more powerful, the number of work processes that can be automated has increased. But even if we recognise advances in artificial intelligence, the codification of tacit knowledge and, therefore, the substitution of ICT for human work is limited. More complex and cognitively demanding managerial work or professional work has proved to be less amenable to computerisation. Similarly, tasks that require judgement, creativity and frequent exceptions have also proved to be remarkably difficult to automate with modern computers (Bresnahan *et al.* 1999:11).

In most cases, routine work tasks as well as simple decisions closely related to individual transactions or other operational actions have been the target of computerisation and automation. However, even in the case of routine production processes, automation was associated in our study with tasks which could not be planned and structured. The paradox of automation is that while expelling human beings from direct production and decision-making processes, it also creates demand for new and often more qualified work, because data produced by modern ICT need to be assessed and interpreted.

In blue-collar jobs, the effects of automation are clearly visible: manual work that no longer has to be done because of ICT. In service or administrative jobs, automation effects are not that visible. Here we cannot speak of a one-shot, very visible automation operation. We can rather point to the ongoing penetration and improvement of ICT results into a more latent increase in efficiency and slumbering automation of previously human activities.

In FLA 5's business process rating and factoring, manual work is very gradually fading away. ERP packages can sometimes make previous human work unnecessary. Of course, there will be an initial period of getting acquainted with the new system and the new way of working. After the 'teething troubles' get solved, however, less time should be needed for the input of data. Based on the principle 'input once, use many times', the same information (e.g., about a client order) can be used in the warehouse, for factoring purposes, in accounting, etc. Furthermore, ERP can facilitate and thereby accelerate the looking up of information (as all information is transparently grouped in one and the same system). Also the creation of standard reports and overviews (e.g., periodic sales figures) can be automated to a great extent. In a way, these are all examples of automation because of ICT.

3.3.3 ICT as process-control technology and as surveillance system

By abstracting from the specificity of single work processes, the computer can monitor systematically integrated production processes. ICT can be used, for example, to record progress in improving quality both within and between companies (Murray and Willmott 1995: 171). Apparently, effective monitoring of interrelated operations depends upon interconnected ICT.

Compared to some years ago, the PC steering of the robots and machinery has increased significantly. Instead of working with local installations and separated machines, the whole process can now be followed up and steered on a PC more closely. This increases overview and control over the production process. FLA 3's ICT-infrastructure and applications make it possible to follow up perfectly where every single car is located in the factory, which operations have been done already and which still have to be finished, whether there have been problems and other aspects.

A centralised information system, for example, being part of an ERP package, is opening the door to more central control and steering possibilities. In fact, being able to gather as soon as possible very detailed (performance) figures from different units, departments or establishments within a company or group is often the major goal of introducing standardised software packages and information systems. Unit-specific information can no longer be masked and is reaching the company top very quickly, often on-line. As information is the key to power, introducing a centralised information system is often the forerunner of more central decision-making.

By imposing information in the form of programmed instructions, management can control work activities. Events in the work process are transformed into events in the technical system and then passed on to the individual as concrete instructions. The individual then becomes integrated into a chain of events within an automated production process; actions are unequivocally prescribed by the technology. Users cannot decide autonomously how to proceed in their work process; instead, they have to follow the instructions given by the technical system (Seltz and Hildebrandt 1985: 98).

At the same time, it becomes possible to monitor the work process and individual work behaviour directly and continuously. We can actually identify a change from controlling results to process monitoring. The foreman can follow on a screen what precise actions the workers take at exact points in time (Bresnahan *et al.* 1999: 15). Additionally, interactions between employees and customers can be monitored and systematically recorded. When needed, immediate intervention into the work process is possible. At the same time, this kind of monitoring of work behaviour allows for information-enabled decentralised workers, who have access to all the information needed to accomplish their tasks.

It is the use of ICTs to trace faults immediately back to the individual's responsibility that acts as a powerful disciplining mechanism. "... the development and continued refinement of electronic surveillance systems using computer-based technology," Sewell and Wilkinson argue, "can provide means by which management can achieve the benefits that derive from the delegation of responsibility to teams whilst retaining authority and disciplinary control through the ownership of

the superstructure of surveillance and the information it collects, retains and disseminates" (1992: 283).

Not only work operations, but also the concrete use of ICT can be controlled. E-mail traffic, however, is only controlled in some companies. Internet use or misuse, on the other hand, is controlled more often. This predominantly happens at random. In most cases, not the content but the capacity seems to be the major problem, since drives filled up with downloaded data can slow down the whole network. In fact, content-based control is often too time-consuming; it can also create problems in terms of privacy.

The work of the call centre (A2) operators is controlled to a great extent. Firstly, the operators are the only employees whose working time is registered and controlled for systematically. This happens when they log in or off the computer. Once logged in, every single action of the operators is controlled for and monitored systematically. There are daily automatic statistics about the amount of calls and their average duration, which are compared from operator to operator. Recently, a survey-option has been made for clients, in which they can score the operator on things like friendliness, quality of the service, etc. The results of this survey are also used to evaluate the operator in question.

There is no doubt that the penetration of production processes with modern ICT opens up new potential for surveillance. For example, the speed of response, quantity of work, and working hours can all be recorded. But the use of ICT as a surveillance device in monitoring individual actions and work behaviour has been less important than its use in monitoring production processes and diagnosing technological failures and breakdowns. Human interventions recorded together with the process of monitoring are documented in such forms that it becomes very time-consuming and costly to be able to draw any conclusions concerning the work behaviour and work effort of single workers.

3.3.4 ICT as information-providing device

Modern ICTs, Zuboff (1988) argues, are qualitatively different from traditional machine technologies. Contrary to traditional technologies, modern ICTs can not only automate activities and work processes, but also informate. They accomplish tasks as traditional technologies do, but they also translate them into information. ICT works on and changes its object but, at the same time, it generates information about the underlying production and administration processes. While contributing to the development of the product, it also reflects back on its activities and on the system of activities to which it is related (Zuboff 1988). This means that modern ICT is reflexive in the sense that it generates additional information, and by this it supersedes the logic of automation. The masses of accumulated data can systematically be exploited to make previously inaccessible activities and work processes more transparent.

Castells (2000) associates the informing function of modern ICTs with decentralised processes of innovation and learning. He points to the fact that ICTs produce new information in the workplace which can become immediately practical if used by workers; modern ICT as information-producing devices can lead to processes of continuous learning and innovation activities. Working and learning are becoming one and the same activity (Tapscott 1995: 67). In that sense, we can argue, modern ICTs are adding a new dimension of reflexivity.

Companies also increasingly make use of modern ICT to get a clearer and more structured picture of their environment. Here we have to refer to the methods of 'data mining' and 'text mining', which are used to discover and structure the knowledge about companies' environments that is so far present in the existing structured and unstructured data sets of the company only in a latent form. The increased use of modern ICTs allows a broad, efficient and often automated storage of a huge amount of data related to the environment of the company, such as customer-related data, but they are often used in a very rudimentary way. Intelligent algorithms can help in searching for striking

structures and patterns even within big data sets (Gentsch 1999). Using strategies of knowledge discovery, companies can cope with the growing stream of data in a more efficient way, being assisted in drawing a more informative picture of their environment. Data mining is often part of a strategy to improve customer relationships. As companies put a lot of effort into developing approaches and mechanisms which meet the requirements of client groups, data mining becomes increasingly important because it can create new data about customers' demand and preferences.

3.3.5 ICT as organisation technology

The function of organisation norms is co-ordination. The term organisation is used to designate a co-ordination device which produces and stabilises relationships among people or organisation units. Through organisation norms, processes become standardised, which is necessary for co-ordinating activities. Modern ICTs directly impact on the co-ordination device, because they are designed to solve the co-ordination problems that depend to a larger extent upon information management problems (Brousseau and Rallet 1998: 245). When we discuss modern ICTs as organisation technology, we refer to the co-ordination function. Companies applying modern ICTs are able to implement new types of co-ordination devices.

Standardisation can be seen as an important precondition for technically integrating tasks, functions, processes, departments, organisations, or organisation networks. As such, modern ICTs perform the same function as organisational norms and rules. It is possible to achieve close integration of production processes in regard to time and to contents through both organisation norms and computer-supported production technology. We can characterise modern ICTs as an objectivation of the work organisation, because they incorporate elements of social relations between various actors. By introducing modern ICTs which increase their computation, information management and transmission capacities, companies at the same time implement an alternative type of co-ordination device (Brandt *et al.* 1978).

This means that modern ICTs can form a platform for people to work collectively; they are developing as a collective tool (Baukowitz 1996). The fact that modern ICTs increase dramatically an organisation's memory, defined as stored information from an organisation's history that can be brought to bear on present decisions (Walsh and Ungson 1991: 61), is important for using ICTs as a collective tool. R&D and manufacturing bases dispersed globally may be connected with each other as well as with a central corporate file through the database network system. For example, designers may retrieve information from the central file about the availability of parts with derived specification for product development. Any engineering change occurring at a certain factory is fed back and incorporated into the original design stored in the central file and made available to any factory which uses the same global design (Aoki 1989: 18).

3.3.6 ICTs as communication technologies

The role of ICT as communication technology is seen as enabling, facilitating and supporting information flows. This means that ICT changes from an inwardly oriented technology forming islands of information and automation to an outwardly oriented technology supporting the formation of inter-firm networks electronically. Fax, electronic mail, or local area networks, to mention just a few technologies, have accelerated communication dramatically.

It is a major advantage of modern ICTs that, as a communication device, they bridge both time and space, the traditional key barriers for information and knowledge exchange. Electronic communication technologies offering capabilities to overcome constraints on time and distance are enablers of rapid communication across geographic space and organisational boundaries (Fulk and De Santis 1995: 337). Nowadays it is no longer necessary that all competencies and resources needed for carrying out a specific order are available in one and the same place. Instead, the network

character of modern ICTs makes it possible that in extreme cases people from different parts of the world with different expertise work together to solve specific problems. Furthermore, by increasing people's accessibility to the work environment from home and by redefining how employees can perform their duties across time-space boundaries, modern ICTs are changing the traditional notion of the workplace (Sahay 1997: 248).

One of the major impacts of modern ICT as a medium is the further acceleration of the innovation process. The communication and storage capacity of network technology makes it an innovation-enabling technology. In this respect, it is important that modern ICTs support both natural language communication and formal communication, or, to put it differently, that they support the exchange of codified and tacit knowledge. ICT no doubt accelerates the codification of knowledge which makes the application of knowledge cheaper and reduces transaction costs. The fact that modern ICTs open up access to information bases and electronic networks is important for companies' innovation processes.

Because of codification, knowledge-based information is much more accessible than before to all actors that are linked to information networks or have the knowledge of how to access such networks (Soete and ter Well 1999; 9). "Knowledge is from this perspective a non-rival good. It can be shared by many people without diminishing in any way the amount available to one of them" (Soete 1999: 16). Actually modern ICT is becoming the first global technology the more the potential for international codification and transferability increases.

The fact that information and knowledge is globally available does not mean, however, that access to and the effective use of information and knowledge is equally spread worldwide. To the contrary, this depends on the competence available to access international data bases and information networks. While codification is a precondition for modern ICTs, in order to function as global information technology, tacit knowledge is needed to make effective use of the global access potential (ibid.). When it is no longer important to have all the 'know-how' necessary to develop a new product, such tacit knowledge of which 'know-how' is needed, where it is available and how it can be combined with other kinds of knowledge becomes increasingly important.

The fact that ICT as network technology permits universal availability of all knowledge stored in digital form is one aspect that supports companies' innovation activities; the other is the universal reach of knowledgeable persons. Concerning the second aspect, modern ICTs are used to deal with communication that is not formalised. Here the focus is not upon the capability of modern ICTs to substitute for tacit knowledge; from this perspective, the emphasis is on their potential to reinforce human interaction and interactive learning, as Ernst and Lundvall (1997: 28) argue, and on how they can support and mobilise tacit knowledge.

As a part of a global concern, the unit (STU 8) belongs to a huge multinational group. As a consequence, management is spread all over the world. For co-operation among the company's sectors, the most important medium of communication within the company is the Intranet, which provides an enormous amount of information. The result is that the selection of this information becomes more and more a problem. Vertical communication takes also place via various meetings, a TV channel and personal letters. E-mail and phone are important media for quick requests between employees. The Internet supports intensive communication in teams that can be spread all over the world. Communication has become more informal, but this is not so much due to ICT but to a self-reflexive creation of a new culture within the company. But without the electronic communication technologies, a global organisation of the company would not be possible.

The latest trend concerning the media perspective is the integration of company-internal digital information systems into a worldwide public information space. Two technological developments are important here: interactive multimedia telecommunication applications, on the one hand, and the use of the Internet for commercial purposes, including the development of new services, on the other. The Internet, for example, offers an interesting platform for companies to

advertise their products and services. At the same time, a great demand for new information and communication services is developing. Also, communication with customers via Internet plays a crucial role, although there are significant differences between industries and there is still great potential to further exploitation of the communication potential of the Internet. It seems that engineering companies increasingly rely on technological communication with their clients exchanging design ideas and configurations of products. Banks seem to be more reluctant to make use of the Internet as communication medium with their clients.

For the time being the disadvantage of the Internet is that the problem of protecting access to the companies' internal information systems does not yet appear to have been solved. The actual answer to this problem can be seen in Intranets, company internal networks established on the basis of the Internet. They use the services of the Internet but they are protected against the public-like private nets at the same time. We can expect in the future that interactive multimedia applications will be developed which will support tele-co-operation within companies, co-operation within supplier networks and increasingly communication and co-operation with customers.

The fact that ICTs are increasingly used for information exchange and communication purposes does not imply that they have completely pushed aside the more traditional media such as the fax or phone, face-to-face contacts, or regular mail. The exchange of distance-sensitive knowledge, for example, still needs face-to-face contacts. In all these cases, the aim of the system development is not to replicate technically whole work processes but to support collective work behaviour through a collective tool and joint access to information. Only in some companies, as our case studies indicate, has electronic communication become more important than other forms of communication. Most companies have imposed some limitations on the use of e-mail. More traditional forms of communication are still preferred in a variety of situations. Especially oral communication – by phone or face to face - is believed to have an important value surplus.

When we look at the usage of ICT for communication purposes, we have to conclude that ICTs are far from displacing traditional communication forms in the case company (FLA 2). Face-to-face interaction remains dominant, since most people sit together in one room and since ICTs are not suitable for things like discussing, brainstorming, exchanging ideas, etc. The telephone is constantly used, especially for really urgent matters. If one has to know something immediately—the business is characterised by sharp deadlines—then e-mail is too slow, as people very seldom react immediately. Internally, e-mail is only used to reach absent persons, to reach a group of people simultaneously and for general information supply purposes. More official or really important things are still distributed by means of written documents, as people just coming to the building for a short time do not have to log on and look for the only important mail in the middle of 50 irrelevant ones. E-mail is more often used externally, e.g., in communication with customers or with fellow-workers abroad for a longer time. Other field-workers, only away from the company for a day or a couple of hours, are reachable by mobile phone. In contact with freelancers, management bureaux of celebrities, public relations staff, etc., e-mail is also very common, be it in a more exploratory way: looking for the right person, organisation... Once found the more concrete arrangement and contracting mainly happens by fax or face-to-face interaction.

In most companies, a mix of communication media is in use; e-mail is only one alternative. Product development teams, for example, have to meet face to face to clarify things. If product specifications are only circulated and discussed via e-mail, misunderstandings may occur because information can be understood differently. Only face-to-face communication in a group meeting is seen as effective under such circumstances. Given the increasing amount of communication tools, the real problem is to know which medium to use in which situation and this requires a learning process.

3.3.7 Conclusion: multi-functionality

Modern ICTs, we can conclude, can be characterised as multi-functional technology; they can be used for various functions simultaneously and the way of using modern ICTs can change over time. The following table summarises the various functions of modern ICTs in a schematic way.

Table 3.3: Various perspectives on ICTs

Metaphor	Function	Aim
Tool	to support work processes	to increase quality, speed up work process, cope with increased complexity
Automation technology	to eliminate human labour	to cut costs
Process control technology	to control production processes	to stabilise flow of production process, avoid defects
Surveillance device	to monitor work behaviour	to guarantee proscribed work behaviour, make work more efficient, immediately correct failures
Information technology	to collect, process and distribute information	organisational learning, transparency, continuous innovation
Organisation technology	to co-ordinate work processes	to eliminate uncertainty by stabilising co-operation
Communication technology	technically mediated communication	quick and intensive exchange of knowledge-based information

We can demonstrate the multi-functionality of modern ICT by referring to the introduction of standard information systems and software packages such as ERP. Because it is basically one big information system, an ERP package obviously serves the function of better information supply: it helps the different companies or concerned units and persons to be better informed about the general running of the business and each other's activities. This also allows different units/persons to grow closer together and to match their activities better to one another. The potential to link tasks and people in a more systemic way, thereby acting as a kind of organisational technology, is also very important. Furthermore, a centralised information system is opening the door for more central control and steering possibilities. This is often one of the major purposes of introducing ERP: to be able to gather as soon as possible detailed (performance) figures of different units, departments or companies. ERP not only creates a more logical and integrated entirety, but also provides a more central overview of the business. Finally, we can mention the potential rationalisation effect resulting from the introduction of an ERP package.

The elaboration of ERP packages proves that ICT can simultaneously serve many different functions existing next to one another. Instead of technological determinism, our research seems to support the idea of ICTs being multi-functional technologies, which are 'consumed', rather than simply 'deployed' (Kling 1991). In this view, it is not the technical nature of modern ICTs, their technical characteristics and capacity but the functions they are chosen to perform within companies that determine both the nature and extent of benefits being gained from such technology. In general, the empirical data give little support to the popular idea that the character of ICT use is 'clearly shifting from automation and control technology towards communication and network technology'. Communication and networking are indeed extremely important functions of ICTs, but they are not replacing rationalisation and/or control functions.

3.4 Process aspects of technological practices: decision-making, barriers and participation

In the following we focus on the process of implementing modern ICT. We first discuss the strategy concept which has been the dominating approach in the discussion on ICT implementation. The concept, as we will show, is open for criticism. On the basis of our company survey, we deal with some major aspects of the introduction process of modern ICT. We analyse barriers that hinder the introduction of ICT and we discuss user participation and union involvement.

3.4.1 ICT strategy discourse

The assumption underlying the ICT strategy discourse approach is, "that problems can be analysed and broken down into their component parts, whereupon rational solutions are devised and imposed upon the organisation through top-down executive decisions and imperatives" (Knights *et al.* 1997: 16). Various aspects of this approach can be criticised. One precondition for developing ICT strategies is the existence of a stable business strategy based on long-term objectives. In that case, the information needed by the company and the functions it has to carry out will remain unchanged, which makes it possible to develop ICT systems that can serve the overall goals of the company (Goldsmith 1991). However, a globalising economy does not provide a stable environment; therefore, the enterprise cannot be modelled. Furthermore, in a globalising economy companies have to aim at different goals simultaneously: productivity and time, quality and innovativeness, which makes it difficult to develop a consistent business strategy. At the same time, due to their multi-functionality, modern ICTs can serve different aims and functions, which contradicts the idea of a clear, focused ICT strategy. All these aspects lead to the conclusion that ICT strategies cannot easily be deduced from business strategies.

The strategy concept also assumes that management is searching extensively for information on ICT systems and methods to evaluate them, to choose the best technology available. However, due to a limited capacity to deal with complexity, management in general searches for satisfying solutions, including reduced search strategies and limited evaluation practices. Furthermore, rational decision-making may actually become counterproductive as far as implementing ICT solutions is concerned. In this respect, Brunsson (1985) distinguishes between 'decision-making rationality' and 'action rationality'. Extended decision-making processes increase uncertainty and they make it unlikely that the chosen solution can be implemented without major difficulties. When management decides about ICT applications, it always has to have in mind the implementation phase and possible resistance from management fractions and the workers in order to avoid long delays. From this perspective, it may be rational to aim at finding a satisfying solution and thereby to limit the search for an ICT system and to reduce the time needed for decision-making.

Attention must also be given to the fact that ICT systems have to be embedded into organisation forms. This means that ICT strategies have to be brought into line with organisational renewal strategies. No significant benefits will be achieved from the introduction of modern ICTs as long as computers are used on top of traditional business processes and corporate structures. Modern ICTs are applied not only to automate processes and reduce costs, but also to support and stimulate organisational renewal processes.

Modern ICT, we have argued earlier, must be understood as a continuous development process, which means that compatibility with existing technological systems is an important problem. We also have to take into account that ICTs exist as hardware and software. The benefits of modern ICTs, however, depend upon easily usable software in the first place and to a much lesser extent on hardware.

From what has been said so far, we can conclude that the strategy concept applies an unproblematic rational approach to management, organisation and change, involving a set of rather mechanistic assumptions about how an organisation functions, and managerial and non-managerial staff behave. Organisations are seen as the planned outcome of rational decisions made by senior managers. Employees are presumed to behave in accordance with detailed demands by their seniors "as if they were simply the pieces of a jigsaw that form a coherent picture designed by the strategic planners" (Knights *et al.* 1997: 14). This view, however, seems to be quite unrealistic. ICT applications and their embedding into organisation structures seem to be a more bottom-up and incremental process. The introduction of modern ICTs has in most of our case studies been gradual and evolutionary. Furthermore, processes of using and developing ICT systems are much more intertwined than is assumed in the strategy approach, particularly as companies often have to adapt standardised software to their specific needs.

3.4.2 Barriers in the introduction process

What has been said so far suggests examining in more detail the barriers which hinder the introduction of modern ICTs. In the company survey the difficulty of controlling costs, incompatibility with existing technical systems, the lack of required qualifications to handle ICTs, and difficulties in acquiring adequate software were seen as the key factors that hinder the introduction of ICT systems. The fact that new solutions become available in ever-shorter time periods often causes delays in purchasing decisions. On the other hand, resistance from union representatives, management and workers as well as rigid organisation structures were mentioned less often as hindering factors. As Table 3.4 demonstrates, technical factors are most often seen as hindering factors followed by management and strategy problems, whereas problems related to organisation structures and human resources are seen as less relevant.

Table 3.4: Main factors hindering the introduction of ICT

Hindering factors	Important
Lack of strategic relevance	19%
Resistance within management	15%
Lack of co-operation from suppliers or customers	13%
Difficulties in acquiring adequate software	31%
Resistance from workers	12%
Resistance from union representative	8%
Rigid organisation structure	15%
ICT costs difficult to control	35%
Incompatibility with existing technical systems	34%
Lack of information about ICT	25%
Deficit in availability of IT consultation	24%
Fear of dependency on information service functions	19%
Lack of required qualifications to handle ICTs	27%
Data security and data protection legislation	23%

Our case studies suggest that a shortage of appropriate skills is often the key factor that is hindering the introduction of modern ICTs. There is empirical evidence that skill shortage is hampering the introduction of e-commerce, for example. In some cases also resistance to taking on new ways of working and new skills associated with ICTs caused some problems, although most people welcomed the opportunity to become more computer literate. Managers have approached this problem through providing individual support and training and through bringing people gradually to the new ways of working. Resistance never caused serious delays in applying modern ICTs.

The adoption of modern ICTs is more difficult where inappropriate or incompatible systems are introduced. These are not barriers to change in the first place, but rather factors which make the whole process more lengthy and painful. Inappropriate systems can be introduced for several reasons. There can be a lack of understanding between the technical expert and those in the business purchasing the system. There may also be a lack of information and understanding due to the newness of various technological solutions. The pace of change in technology adds to these difficulties. New solutions become available very quickly, making purchasing decisions difficult. In addition, the fact that in many companies technical systems have developed bottom up causes serious problems when attempts are made to establish integrated systems.

Concerning barriers to introducing modern ICT, there are only a few sector-related differences. Manufacturing companies see the difficulty of controlling ICT costs as a major hindering factor, while service companies, and in particular personal services (sales, hotel), seem to be more bothered by problems in data security and data protection. The availability of ICT consultation and the lack of required qualifications are also mentioned by companies in the sales and hotel industries as major hindrance factors in introducing modern ICT. Small manufacturing and large service companies seem to have difficulties in acquiring the adequate software. And for small manufacturing companies, the lack of information about ICT systems seems to be a major problem. Resistance from management is seen as a major hindrance factor in bigger companies.

Whether a factor is seen as a barrier in the innovation process also differs with respect to the regional dimension. In general, companies in Lazio and Niederösterreich interpret various factors less often as barriers than companies in other regions. Technical problems seem to hinder the introducing of ICTs more often in companies in Portugal, the Tampere region and Ireland. ICT costs and other non-technical problems have had a negative effect on the implementation process in particular in companies in Portugal and Ireland.

3.4.3 User participation and union involvement

Earlier we mentioned the fact that computerisation is a cumulative process which typically develops and extends over a period of time and in which users play an important role that can result in the improvement of the ICT system (see also Zuscovitch 1983, and Kling 1987). This means that learning processes will take place due to participation measures. Here we can identify two learning processes. The first is related to the fact that modern ICTs to a large extent are in a pre-paradigmatic situation when they are used within organisations (Abernathy 1977). It is very likely that a process of experimentation and discovery will lead to new and more efficient ICT applications, as users in the beginning do not know all the potential of the technology (Brousseau and Rallet 1998: 255).

Furthermore, organisational problems and co-ordination failures connected to the use of modern ICT can be identified. They become visible as ICTs, by accelerating information flows and automating decision-making processes, contribute to 'putting the organisation under pressure'. During the process of continuously developing the technical system, an increasing disclosure of the organisation takes place, revealing its failures and making co-ordination more 'fluid'. Those two processes can initiate a continuous learning process about co-ordination devices and they stimulate continuously organisational renewal processes.

Our company survey indicates the importance of user involvement in the implementation process of modern ICT, as about two out of three companies practice it. Compared to this direct participation, the degree of involvement of union representatives is low. Only about one out of five companies involve representatives of unions in the process of implementing and further developing modern ICTs. And only a minority of companies practising user involvement also integrates union representatives into the implementation and development process.

There are clear regional differences concerning user involvement in processes of implementing and developing ICT systems as Table 3.5 below demonstrates. Particularly in the Tampere region (89%), the Stuttgart area (87%) and Niederösterreich (85%), companies involve their workforce in these processes, whereas in the West London area (33%) and Lazio (44%) less than half of all companies practice user involvement. In half of the companies in the Tampere region and the Stuttgart area union representatives are involved in the process of implementing modern ICTs. In all other regions less than 25% of all companies practice this kind of involvement; in Portugal, the share is particularly small (4%).

Table 3.5: User involvement in the implementation and development of ICT systems by region

	User involvement	Union involvement
Flanders	61%	9%
Lazio	44%	13%
Niederösterreich	85%	20%
Portugal	69%	4%
Ireland	54%	12%
Stuttgart	87%	43%
Tampere	89%	50%
West London	33%	24%
Total	66%	22%

User involvement is practised more often in large service and manufacturing companies, but also among the small manufacturing companies more than 50% involve their workers in the process of implementing and further developing modern ICTs. The degree of involvement of union representatives is lowest among small manufacturing companies.

3.5 Conclusion

Modern ICT, characterised by the merger of computer and information technology, has developed dramatically during the last decade. There is evidence of a shift over the past five years from data processing and management information systems (MIS) to individual and office support on PCs and office systems, and then to electronic data interchange (EDI) and inter-organisational systems, organisational 'platforms', and network computing. Systems within companies have been developed in such a way that they increasingly relate to and interact with each other.

Our empirical findings demonstrate that the majority of companies have developed the technological basis for installing organisational network structures. But there are different types of technically connected systems supporting intra-organisational and inter-organisational networks. While telematic systems automate both the processing of information as well as information transfer, telecommunication systems only automate the transfer processes, leaving the process of information processing to the employees. The first technology represents the technisation of company-to-company relationships, while the latter represents the technisation of person-to-person relationships. In our company survey less than half of all companies have fully automated their information exchange with other companies. And there are still a significant number of companies

which have hardly applied modern ICT and miss the technical basis for network forms of organising production processes. Particularly small manufacturing companies are often making less use of modern ICTs. Indeed, there are many examples of employers for whom the use of these technologies is restricted to a PC for word-processing, spreadsheets and databases, with the possible additional use of e-mail.

Here we have argued that it is the functions ICT is chosen to perform that determine both the nature and extent of benefits gained from modern ICT. Companies associate ICT primarily with the tool function to improve quality, but they also use modern ICT as a mechanism to control production processes and quite often as a communication device, the latter indicating that the new Leitbild of a network organisation is influencing companies' restructuring practices.

The case studies, however, give little support to the argument that the character of ICT usage is clearly shifting from automation and control technology towards communication and network technology. Instead, the case studies demonstrate the multi-functionality of modern ICTs; they can serve several functions at the same time. Companies often combine the communication function with the surveillance and control function. On the one hand, they allow intensive information and knowledge exchange between organisational sub-units, while top management can monitor production processes and even single machines (Flecker and Schienstock 1994: 633-634).

The introduction of modern ICT cannot be conceived of as a rational decision-making process. First, as the introduction of modern ICTs takes place in a highly uncertain environment, the development of implementation strategies is very difficult. Second, one can hardly distinguish technological changes from organisational restructuring. Third, the analysis of the implementation process needs to include possible problems related to the introduction of modern ICT. Our research shows that technical factors are more often seen as barriers in the implementation process than human factors. User participation is practised in most companies, which often leads to some kind of re-invention of the ICT system. Union representatives, on the other hand, are less involved in processes of implementing modern ICT.

4. ORGANISATION FORMS IN THE INFORMATION ECONOMY

Our analysis of ICT applications has shown that many companies that participated in the company survey have applied modern ICT in such a way that it can become the backbone of a network organisation. In the following we will analyse to what extent companies have used this technical potential and introduced flexible and decentralised organisation forms as the core element of business networks. Later on we discuss the linkage between ICT use and organisation forms and the extent to which both co-evolve.

In the following we analyse the organisational changes that have taken place in 1994–1999 in the studied companies. We focus on both the organisational and the inter-organisational levels, as restructuring processes increasingly take the whole picture into account, not just concentrating on the workplace level. The data gathered through the company survey provide information about the extent to which companies have introduced various organisational measures such as group or teamwork, geographical relocation, strategic alliances, downsizing and outsourcing, and the establishment of profit or cost centres. On the basis of quantitative data we analyse whether the network concept has become the dominant paradigm to influence organisational restructuring or whether elements of traditional organisation forms are still dominating. Using our material from the case studies we then turn our attention to individual restructuring measures and analyse the impact they have on work processes in the companies. Particular emphasis will be given to decentralisation strategies, outsourcing and relocating as well as group work. We also discuss new forms of governance and changes in the organisation culture.

Analysing restructuring processes that have taken place on the workplace level we first focus on the changing character of work. We then discuss whether and to what extent stress and workload has increased in ICT-based work processes. Attention will also be given to the relationship between workers' autonomy in work processes and technical control. In addition, telework as a new form of work in the emerging information economy is analysed.

4.1 General restructuring trends

4.1.1 Organisational change as a cumulative process

Our survey data indicate that organisational restructuring is a common practice within companies. About 75% of all companies that took part in the survey underwent organisational changes during the period 1994–1999. And modern ICTs seem to have a great impact on business restructuring. In more than 50% of all cases in which restructuring has taken place, modern ICTs were seen as playing an important role, either as a driving or facilitating force.

Organisational changes, as our survey demonstrates, are in many cases of cumulative nature. When companies get involved in organisational changes, they generally introduce a variety of different measures concurrently. In Lazio, Niederösterreich and Flanders, as Figure 4.1 shows, organisational restructuring was less pervasive; the share of companies that had introduced organisational changes and the number of changes being carried out in those restructuring companies were smaller than in the other studied regions. In contrast, in Ireland and the West London area, the degree of change is comparatively high as the restructuring companies were undergoing several changes simultaneously. The number of companies involved in restructuring processes is biggest in the Stuttgart area, Portugal, and the Tampere region, as more than 80% of all companies in each region had introduced organisational changes. But companies' restructuring practices in the Stuttgart area were less complex and multi-dimensional. In the Tampere region we can find a great number of companies that had more fundamentally restructured their work organisation.

Figure 4.1: Share of organisationally restructuring companies and average number of organisational changes by region



There is little difference in the introduction of various features of organisational restructuring. Companies had introduced group work and teamwork, geographical relocation, strategic alliances, downsizing and outsourcing as well as profit or cost centres slightly more often than flatter hierarchies or subcontracting networks. But none of the various measures of organisational restructuring had been introduced by more than 50% of all companies. Regions differ according to the focus of restructuring. Concerning the introduction of most dimensions of organisational change, companies in the Tampere region are in a dominating position. This is particularly the case with respect to the introduction of group work or teamwork and flat hierarchies. Companies were most often downsized or split in Portugal, while in the Stuttgart area more than 50% of all companies had subcontracted or geographically relocated some tasks or functions. The restructuring strategy of forming subcontracting networks is applied most often by companies in Ireland and the Tampere region.

Table 4.1: Organisational restructuring measures by region

Type of organisational change	Flanders	Lazio	Nieder- österreich	Portugal	Ireland	Stuttgart	Tampere	London
Group work or teamwork	40%	42%	27%	39%	39%	34%	60%	34%
Profit or costs centres	32%	42%	18%	39%	37%	26%	45%	34%
Downsizing and splitting of company	31%	22%	27%	76%	28%	36%	25%	27%
Subcontr. and geographical relocation	34%	20%	37%	25%	39%	51%	44%	46%
Flatter hierarchies	19%	16%	26%	23%	32%	34%	46%	25%
Strategic alliances	20%	37%	35%	40%	34%	41%	40%	42%
Subcontracting networks	24%	11%	12%	24%	38%	22%	38%	21%

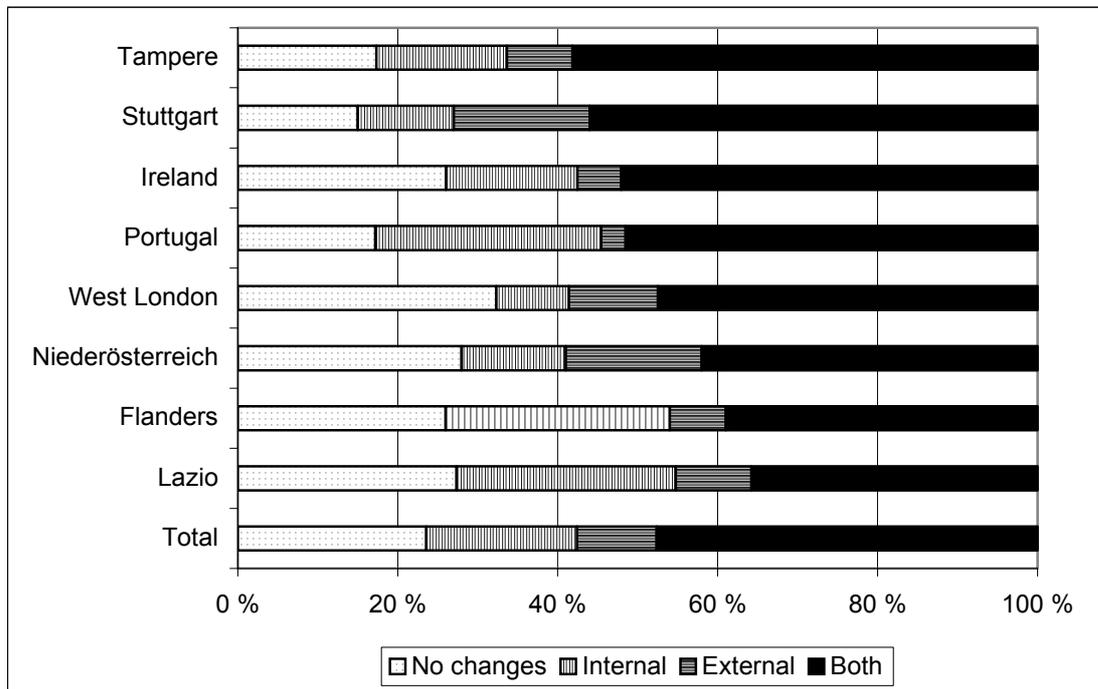
Looking at size and sector we can identify a common pattern concerning most organisational dimensions; small manufacturing companies seem to be less active in restructuring their business organisation forms than other companies.²⁰ What is interesting is that small service companies participate particularly often in the formation of strategic alliances. Not surprisingly, bigger companies more often than smaller ones mention the introduction of modern ICTs as an important factor that causes or at least facilitates organisational restructuring processes.

Generally companies focus more on internal than external change measures.²¹ Companies in the Stuttgart area and in Niederösterreich seem to represent an exception to this general trend, because they are slightly more inclined toward external restructuring processes. Modern ICTs seem to be as important for the restructuring of the internal organisation as for changes in forms of co-operation with external organisations. However, the most common pattern of organisational change is the concurrent restructuring of the internal organisation and forms of external co-operation. Close to 60% of all companies in the Stuttgart area and in the Tampere region had changed internally and externally concurrently. In contrast, in Lazio only about 35% of all companies have been engaged in both internal and external restructuring processes.

²⁰ We have to take into account, however, that some organisation features are natural elements of small companies, such as flat hierarchies, for example. Therefore, small companies may report fewer organisational changes.

²¹ Group work or teamwork, cost centres, splitting the company and flatter hierarchies are subsumed under internal changes, while external changes include subcontracting or geographical re-location, strategic alliances and subcontracting networks.

Figure 4.2: Type of change by region



When analysing the type of change, sector and size matter to some extent. While about 30% of all small manufacturing companies had not introduced any change, this share is only 16% among large manufacturing companies and about 20% among service companies independent of size. And more than 50% of all service companies as well as of all large manufacturing companies had introduced both external and internal changes.

4.1.2 Holistic organisation models

Companies' organisation models can be distinguished according to the degree of vertical and of horizontal integration. Vertical integration refers to the aspect of centralisation of decision-making and exercise of control. In highly centralised companies decision-making power is concentrated at the top, orders are given and also controlled centrally. Because top management delegates its decision rights to some extent to lower levels of the hierarchy, formal rules of co-ordination and control are installed. A strictly vertical information flow along hierarchical lines is typical of centralised organisation forms. In decentralised organisations, on the other hand, the execution of tasks is not separated from decision-making; both take place on the same organisational level. Centralised hierarchical control based on formal rules hardly exists; instead, various types of self-control are installed. The model implies intensive horizontal information exchange. We have used the introduction of flat hierarchies as the main indicator for vertical de-integration.

Horizontal integration refers to the aspect of specialisation and autonomy of action. In the case of high specialisation, organisation units are not self-sufficient because they are not able to produce whole products or major parts themselves. On the other hand, complex and less specialised organisation units are in general highly independent, because they are quite self-sufficient in fulfilling their tasks and do not depend on contributions from other units. In organisations with highly specialised units the demand for horizontal co-ordination is much higher than in companies with more fundamentally integrated units. We have used the introduction of group work and

teamwork as the main indicator for horizontal integration. On the basis of what has been said so far, we can distinguish between the following four organisation forms: machine bureaucracy (strong hierarchies, high division of labour), professional bureaucracy (flat hierarchies, high division of labour), J-model (strong hierarchies, group work and teamwork) and network organisation (flat hierarchies, group work and teamwork) (Mintzberg 1979, Nonaka and Takeuchi 1995, Lam 2000)²².

We can associate these organisation forms with different types of information and with the way it is diffused. Concerning the type of information, we can differentiate between codified knowledge and abstract information, on the one hand, and uncoded knowledge and concrete information on the other (Polanyi 1957). Information diffusion can either be limited or information can be widely diffused. These relationships between organisation forms and different types of information are presented in Table 4.2.

Table 4.2: Organisation form, type of information and form of information diffusion²³

Organisation form	Type of information and form of diffusion
Machine bureaucracy	information is codified and abstract information diffusion is limited and under central control
J-model	horizontal information flows are uncoded and concrete, vertical information flows are codified and abstract horizontal information diffusion is partly limited by the lack of codification and abstraction vertical information diffusion is limited and under central control
Professional bureaucracy	information flows within sub-units are mainly codified and abstract, information flows between functionally specialised sub-units are mainly un-codified and concrete information diffusion between sub-units is limited due to lack of codification and abstraction, diffusion within sub-units is partly limited by central control
Network organisation	information is uncoded and concrete information is diffused but limited to face-to-face relationships

In our company survey only a minority of companies applied the holistic restructuring approach of a network organisation. Only 20% of all companies transformed their organisation structure into a network of functionally integrated work groups no longer controlled by a hierarchical authority structure. On the other hand, 38% of all companies had not undertaken any major restructuring steps. Partial restructuring had taken place in 42% of all companies; the majority of them focused on hierarchical de-integration having introduced flat hierarchies 28%, while a minority introduced group work or teamwork 14%.

In Niederösterreich, the West London area and Flanders the majority of companies are still organised according to the machine bureaucracy model. In contrast, less than one third of all companies in the Tampere region belong to the machine bureaucracy type. The professional bureaucracy model can be found most often in the Stuttgart area. In Flanders and Lazio every fourth company had applied the J-model; the network organisation was most common in companies in the Tampere region. Concerning size and sector, the most striking result is that about two out of three

²² A slightly different typology is presented by Boisot (1998). He distinguishes between bureaucracies, fiefs, clans and market-based organisations (M-model).

²³ Partly adopted from Boisot (1998), 125 ff.

small manufacturing companies belong to the machine bureaucracy model, whereas among all large companies less than 50% had not undertaken any major structuring measures. In the following we enrich the quantitative analysis with some empirical material from our case studies.

4.2 Single restructuring measures and the use of ICT

4.2.1 ICT and (de)centralisation

It is often argued that ICT supports decentralisation by way of making communication, co-ordination and control easier and less costly. By decentralising decision-making in combination with dispersing supporting activities, ICT is expected to support organisational change in the direction of concepts referred to as 'production concepts' (Kern & Schumann, 1984). The company survey mentions 'achieving greater decentralisation in the organisation' as one of the possible aims of introducing and using ICT. However, only a minority of the companies is actively thinking about decentralisation whilst introducing modern ICT. Actually decentralisation of responsibility and decision-making represents a long-standing managerial approach, which is not necessarily linked to the use of modern ICT.

Nevertheless, due to ICTs, it has become very easy to share more information all over the company and to bring more information to lower organisational levels. Indeed, an increasing number of employees have access to technologies like e-mail, the Internet/Intranet, common databases, production planning systems, etc. More information and communication channels on lower levels in the organisation make it possible to stimulate horizontal co-ordination and decentralised decision-making, based on the provision of de-centralised information. In this way ICT can easily result in further decentralisation, but of course not necessarily in all cases. Despite the potential of increasing decentralisation, the empirical results sometimes reveal increasing centralisation (Piori 1994).

Centralisation of decision-making sometimes occurs more latently. A centralised information system as part of an ERP package, for example, is opening the door for more central control and steering possibilities. This is often the major goal of introducing such packages: to be able to gather as soon as possible very detailed (performance) figures from different units, departments or establishments within the company or group. Unit-specific information can no longer be masked and is reaching the top of the company very quickly, often on-line. Introducing a centralised information system can be a forerunner to more central decision-making.

The argumentation points to the increasing control possibilities associated with ICTs. Below we outline a concrete and more visible example of increasing centralisation. Whereas a lot of IT activities had been decentralised to different business units in the past, they have been increasingly subjected to movement in the opposite direction in recent years. This is a tendency that has been observed in many large companies under study.

Since the 1997-98 restructuring (FLA 2), all informatics-related activities have been centralised as much as possible in one professional IT Group. This group is actively working on obtaining more uniformity in the field of IT, both in ICT infrastructure and applications. Centralisation in the field of IT can reduce the independence of operational units. As their activities become increasingly ICT-dependent, the people staffing the operational units depend very much on the centralised IT unit.

In conclusion, ICT can but does not necessarily have to result in more decentralisation. There seems to be a significant degree of organisational choice in using ICTs, bearing the seed of both centralisation and decentralisation. Company culture, general orientation and tradition probably determine the degree of (de)centralisation much more than whichever ICTs are chosen. There appears to be a link between organisational change processes and ICT, but we can certainly not

interpret this link in terms of causality. At most, ICTs can be seen as a kind of facilitator of organisational change.

4.2.2 Cost and profit centres and flattening hierarchies

Restructuring practices have become influenced more by the market logic than by the production logic. Growing market competition forces companies to accelerate production processes by horizontally integrating various tasks and functions. Companies organise their production process around customer-oriented processes rather than functions, as in traditional organisation models. Such restructuring is made possible by modern ICTs, as they facilitate the sharing and co-ordinating of information among different organisation members and units. Organising companies on the basis of integrated, ICT-supported production processes tears down boundaries between functionally specialised units as well as between hierarchical levels.

The establishment of 'cost and profit centres' is an important element in current restructuring processes. Boundaries resulting from hierarchical integration as well as functional de-integration become blurred. More autonomy is given to companies' divisions which become fully responsible for costs and profits at the same time. The tasks and responsibilities of the headquarters, on the other hand, are reduced quite significantly. According to Hedlund and Rolander, in companies referred to as 'heterarchically' organised companies, responsibility for product groups, functions and specific territories can be decentralised in such a way that many units have a say in the company's decision-making process (1990). Loose coupling and direct negotiation among sub-units, particularly concerning transfer prices, is typical of a 'profit centre organisation'. However, cost and profit centres are not introduced as a result of the use of ICTs, but they do enable the achievement of the various targets to be more regularly and thoroughly monitored. Due to the fact that various data allowing tied control are available through modern ICT headquarters can allow autonomy on the establishment level to some degree. These data easily uncover areas of inefficiency and poor performance.

The introduction of cost or profit centres reduces the need for middle management, as organisation levels between headquarters and cost centres become obsolete, therefore allowing the flattening of hierarchies. But the reduction of organisational levels of bureaucracy continues further down the hierarchical ladder as companies become more aware of the disadvantages of large bureaucracies: slow information exchange and even loss of information, lengthy decision-making processes and particularly a non-innovative business culture. All these consequences of large bureaucracies can become serious problems in an economy in which business success depends greatly on companies' capability to be first on the market with new products. The following example shows that introducing flat hierarchies is not a straightforward task.

The food manufacturer (LON 2) had delayered, relayered and was about to delayer again. When the current managers took over, the company had too many layers of supervisors, many of whom for historical reasons were not really needed. The whole structure had been shaken up and people got rid of. The most skilled and capable employees had been put in team leader roles, one of each shift in each department. However, this was beginning to get out of control again. Being a team leader was seen as inferring status and people were starting to call themselves team leaders and take on assistant team leader roles. This was creating communication problems – information had to be passed through too many people before reaching the shop floor, sometimes being distorted on the way. The factory manager was about to introduce self-managing teams, which could remove virtually all hierarchical layers. This was aimed at improving the flow of communication and at encouraging more people to take responsibility.

The stripping of layers is justified in terms of the capacity of modern ICTs to render much managerial work redundant (Murray and Willmott 1995: 168). Through providing information and new means of communication ICTs support delayering processes within companies. But just as the other organisational changes, profit centres, downsizing and reducing hierarchical levels are rarely

caused by the introduction of modern ICTs. They are introduced as part of the search for efficient means of operating and to remove excess labour.

4.2.3 Work groups and cross-functional design teams

Hierarchy flattening, as we have demonstrated above, often goes together with the introduction of semi-independent work groups linked laterally rather than vertically (Lipsey 1999). Traditionally work is divided into many different tasks and workers are specialised and located in separate departments. In a process-oriented structure, teams perform activities which are traditionally spread all over the organisation: order taking, production and dealing with customers. By reaching out to customers, suppliers and others, they thereby also change the relationships between organisations. Such direct contact with groups and organisations outside the company implies that many unproductive activities such as control and waiting for decisions taken higher up the ladder are made redundant.

ICTs rarely play a direct role in establishing group work or teamwork. It is a structure that suits companies, regardless of whether they are frequent users of ICTs or not. Nevertheless modern ICT can technically support decentralised co-operation of work groups within different organisations and can intensify and accelerate information and knowledge exchange. Therefore ICTs often impact on the form of group work and teamwork; teams become smaller and members have less distinctive roles. In addition, modern ICTs enable decentralised co-operation with suppliers and customers.

Work groups become responsible for self-contained production processes without fixed division of work among their members. They have to organise themselves and are expected to continuously optimise the way in which they organise their work. But at the same time, by monitoring each other, work groups should also continuously improve co-operation and information exchange. Learning by doing and by interacting is an important aspect of group work.

In working groups jobs are less described by restrictive regulations. Each individual is no longer responsible only for his/her own tasks, but also for the end product. The barriers between different qualifications in small groups become blurred. Everyone should become better acquainted with different steps of the production process. In this way, delimited responsibility, which goes hand in hand with a specified job that fits nicely within the ladder of hierarchy, fades. Smaller teams of workers process increasingly complex data flows in and among organisations. The new communication technology enables these small groups to get easy and fast access to the needed information. But new forms of work organisation such as group work or the formation of temporary project teams do not function very well on a purely 'virtual basis'. These organisation forms depend upon the participants' social skills alongside the needed professional abilities.

FLA2 was – and actually still is - a pioneer in the field of teamwork in Flanders. Quite recently, the company invested a lot of money in so-called team PCs along the conveyor belt. According to the interlocutors, this fits very well with the company philosophy underlying the team concept: self-management, autonomy and independence. Due to the availability of ICTs on the team level, a team does not depend anymore on others for its information supply. The teams are responsible themselves for looking up the information they need (e.g. on the Intranet, in databases), for sharing this information with the team members who need it, for communicating with who they want (e.g., via an internal mail system), etc. The team PC is also used to follow up the team budget and cost evolution, as well as to input on the floor some data related to personnel administration (e.g., absenteeism, overtime hours, leave arrangements, etc.). In this way, ICTs support the self-sufficiency and autonomy of the production teams, but ICTs were certainly not the underlying cause for introducing further elaborating teamwork (in fact, the first teams were introduced about 20 years ago). FLA2 simply tries to make optimal use of ICTs in order to support its team philosophy, as it is making optimal use of other things for the same purpose (e.g., the right organisational preconditions, selection of the right people for teamwork, training and investing in human capital, etc.).

This observation also applies to the gradual de-concentration of supporting activities to the production teams. Quality control, for example, has already been de-concentrated to a large extent several years ago. In principle, each team is responsible itself for the quality of its work and products. ICTs can support autonomy in the field of quality control since the team PC is actively used for the input of quality observations, for making calculations and analyses, for comparing the team results with other teams, for storing quality problems of the past, for making improvement proposals and for communicating with the quality control department on more specialised quality issues. In line with the latter, we can also point to better co-ordination between the production department and the supporting services.

Such re-allocation of tasks affects the position of middle management. Traditionally its task has been to filter and spread information coming from above. But as workers become directly responsible for whole work processes and for co-ordinating co-operation in the whole production chain, they themselves need to have all the necessary information at their immediate disposal. The increased opportunity to directly control work processes through modern ICTs further erodes the position of middle management.

Nowadays the strategy of process integration is also applied as a solution for the exploration/exploitation dilemma. The establishment of 'trans-functional design teams' creates a new style of innovation management, which reintegrates research and development with engineering design, procurement, production and marketing even in the largest companies (Freeman 1987: 44). The team concept stresses the importance of cognitive diversity, as it tries to integrate the competencies of various expert groups right from the beginning.

The development of new products, market assessment, price calculation, design, and the organisation of new work processes – all these activities are performed in cross-functional teams consisting of members from various departments, and sometimes even members from supplier and customer companies are involved. All products are designed with manufacturing in mind, which reduces expensive processes of redesign and also speeds up the marketing of new products. Companies can 'tool up' long before the actual manufacturing stage has been reached.

The development of new products within cross-functional design teams requires intensive synchronisation as well as exchange of information and knowledge among the members of the team. Self-reflexivity is an important aspect of cross-functional teams, as workers have to be able to understand and integrate the views and perspectives of other team members into their considerations and decision-making processes.

Our case studies demonstrate that group and teamwork can be organised in different ways. Work can be more or less structured, work roles can be more or less fixed and membership can be long-term or variable. Companies are to some extent experimenting with the form of group work

and teamwork which best suits their workload, the type of work they and their clients do. But there is a limit for using electronic data interchange in trans-organisational design teams. The reason is that technical integration requires highly standardised business processes to be cost-efficient.

4.2.4 Outsourcing and geographical relocation

A wide variety of ICT-related external restructuring was found in the case studies. The advanced infrastructure for telecommunications, the connection of company computer networks with the Internet and the increasingly common use of electronic mail have considerably extended the opportunities for the spatial dispersal of company functions and activities. The most familiar forms of outsourcing and relocation of work are the following:

- relocation of production to neighbouring countries, while planning and management functions remain at the company headquarters in the home country;
- software developments for customers abroad with long-distance work taking place on the customer's computer system;
- cross-boarder co-operation in development teams using central databanks and electronic communication;
- use of computer-centre capacity in remote locations and the outsourcing of the maintenance of the company's own ICT infrastructure;
- use of call centres abroad and the operation of dispersed call centres; and
- Intranet applications among other things for central information storage and decentralised access to information.

Together with the strategy of concentrating on core businesses, outsourcing has become an important organisation measure to make companies more efficient. Particularly large companies increasingly reduce their size and become leaner in order to get the same entrepreneurial dynamism, innovativeness and informality as small companies often have, in order to be able to react as quickly and flexibly as the latter do. Nowadays as companies reflect on their core activities and concentrate on them, an increasing number of functions become the subject of 'make-or-buy' decisions. Functions and processes that do not belong to the core of the business can be subcontracted to other companies specialising in these activities. However, in the studied companies, modern ICT has not played the decisive role in making decisions about outsourcing. Actually in most cases outsourcing had a long history, it had started already before technological modernisation began. But because electronic networks reduce the costs of co-ordination and transaction, they become an important factor supporting processes of specialisation and outsourcing. Modern ICTs can also open up choices of location for organisationally divisible services.

Although outsourcing is practised by a greater number of companies, few of them have made significant use of outsourcing. In general, important parts of the core processes were not subject to outsourcing. The idea that in the end there might be a company that subcontracts all production and is only concerned with product design, marketing and management, while all other activities in the chain are performed by other companies seems to be not very realistic. Companies have realised that far-reaching outsourcing, which not only includes peripheral functions but also core business processes, implies a risk of losing core knowledge and important assets. Becoming aware of the problems associated with outsourcing, some companies have actually reversed the trend to push out

activities and processes; for example, they now see knowledge-intensive services more and more as part of their core competencies.

Outsourcing results in smaller organisations with simpler structures that are supplied more frequently in smaller batches and therefore become more dependent on other companies. However, formal organisational relationships do not automatically turn into market relationships; instead, many outsourced parts are still linked with the core company and controlled very closely by it. And often they are also economically dependent as subcontractors to the core company, on the basis of long-term exchange agreements.

A logistics company in Niederösterreich (A1) does not have any international transport function, i.e., trucks and drivers; this is outsourced to subcontractors. Therefore, most of the contracts with the company's customers (pick-up and delivery consignments) are through the drivers employed by the subcontractors. Outsourcing such a sensitive function is made easier by the monitoring opportunities offered by new ICT. Due to the comprehensive recording of all transport relevant data, the company's quality-control department can check all drivers at all times on the basis of these data. Possible weaknesses can be rapidly recognised owing to the comprehensive records. Time loss and defaults are analysed on a daily basis using the data resulting from the real-time representation of the business process in the information system.

An increasing number of companies are hiring IT subcontractors, freelancers, and external consultants being detached on a project basis. In the company survey more than 50% of all companies have outsourced ICT functions, one half on a short-term contract basis, the other half on a long-term basis. However, outsourcing of the entire ICT activities occurs very seldom. It seems as if the companies fear a too extensive dependency on external ICT suppliers.

The airline IT department (LON 1) used a high proportion of freelance contractors, some software and maintenance work has also been outsourced, both to UK companies and companies abroad. During the 1990s much of this was to India, but by 1997 the company was actively investigating in new locations, including elsewhere in Asia and in Eastern Europe. Although subcontracting a significant amount of work, there remained a core workforce of direct employees within the IT department.

For more established companies, ICT outsourcing implies a true change in comparison with the former situation, in which as much as possible in the field of IT was done in-house. With respect to young companies never having carried out the activities in question themselves, we cannot speak of real outsourcing, at most of subcontracting.

It is also important to mention that due to technical innovations customer self-service is increasing. This rather new form of outsourcing particular processes will have long-term consequences also for the organisation of many business processes.

Outsourcing of activities using the Internet is particularly recognisable in an Austrian logistics company in Niederösterreich (A 1). Customers of this company have, since very recently, increasingly been offered tools over the homepage giving them the ability to carry out particular stages of despatch preparation themselves and thus to speed up the actual processing. Thus, order data can be entered through the Internet and the despatch documents or labels can be printed out by the customers themselves using software available for downloading. For the customer this leads to a quicker hand-over of despatched documents, and less work for the service provider. This also reduces the complaints in the billing department, as the customer is responsible for placing the correct orders.

Global competition drives companies to search for economic advantages worldwide, which often leads to the breakdown of production processes into discrete functions and single processes and their geographic relocation. This strategy to vertically de-integrate, although not caused by modern ICTs, is nevertheless supported by these technologies, as they enable long-distance communication. Central databases from which official versions of technical drawings or specifications can be retrieved are equally important. Amongst the companies in our company survey, however, there was more evidence of staying put than moving away, but a minority has geographically relocated business functions. If companies did so, these were mainly standardised

and less knowledge-intensive functions and processes, particularly when geographic relocation involved foreign countries. The main aim was to reduce costs.

Call centres are frequently mentioned as an example of having free choice regarding the location for organisationally divisible services. The reason lies in the new technical possibilities made available by telecommunications.

The above mentioned logistics company (A 1) in the courier, express and parcels service in Niederösterreich provides a good example to illustrate the role played by the relocation of call centres in the framework of company strategies. The company studied is the Austrian subsidiary of a worldwide group, which was linked from the beginning into an integrated multinational organisation structure. The despatch of documents or parcels was carried out by a highly standardised process with clearly defined distribution of tasks and interfaces. The customers place their transportation orders mainly by telephone to a call centre. This is located in Ireland for the whole Western Europe. The necessary customer data is recorded and the relevant transport data is then faxed to the most conveniently situated regional site.

The following example also demonstrates the possibility of location independence of work. At the same time, the rationalisation of tasks through the utilisation of new technologies, in this case the Internet, is taking place. It should be emphasised that the standardised nature of the order process allows these tendencies in the first place. ICT thus facilitates new forms of organisation in particular in the area of co-operation among companies and between companies and consumers, but its application is conditional on the existence of a standardised change process.

An industrial catering restaurant chain (A 3) is increasingly using the Internet in order to present itself to customers better and to offer part of its range of products. Customers can order meals over the Internet through the home delivery service. The technical processing takes place via an external logistics company. All customer-relevant data are either transferred over the Internet by the customers themselves, or put into the information system through phone calls. The acceptance of customer orders takes place in a company's location about 300 km away from the head office. The delivery of the goods, too, is carried out by external transport companies, which spread over the whole sales area and only employed as the occasion demands.

There are of course also limits of 'location-independent work' using ICT. Co-operation can very often not rely on technical media alone and communication cannot be primarily electronic. In most working contexts, the tasks are not even sufficiently standardised and informal communication is still important for ICT-supported outsourcing. Particularly to interpret things in the same way and to develop a common understanding and create a jointly held meaning, there is a need for a lot of direct communication. This can be illustrated by the following example of international co-operation in product development.

In the new and continuing product development of the general machine-tool company (A 5) studied, there is close co-operation between the companies' development centres in various European countries as well as overseas. The international co-operation in a common project relies on central data banks for the 'official' versions of the plans and on communication by phone and e-mail. Despite this well-developed technological support, business trips are necessary up to twice a month for the project leaders in particular in order to get together with the other developers for co-ordination and fine-tuning. This experience shows that the use of communication technology cannot replace meetings involving travel. If, for example, product specifications are only circulated and discussed via e-mail, misunderstandings may occur because the information is understood differently. Only face-to-face communication in a group meeting is seen as effective in developing a common understanding and the same meaning.

There is no doubt that a trend towards outsourcing of tasks, and long-distance co-operation has been strengthened by ICT. The new technological possibilities make the realisation of particular organisational options easier. It is not only the function of technology as a communication medium that plays an important role. In many contexts the use as an organisation technology and as a monitoring device is even more important. The fact that modern ICT helps monitoring the performance of those companies to which activities are outsourced has probably played a role in facilitating such restructuring strategy.

Furthermore, it is not the technological potential that determines the new organisational patterns. On the contrary, technological networking to a great extent takes place on the basis of organisational conditions: only high standardisation of business processes allows ICT-based integration of processes beyond company boundaries and at a geographical distance. In addition, strategic business decisions play an important role in this context. Also the limits of outsourcing, relocation and electronic co-operation should be mentioned. Highly complex tasks and dynamic development of products and of consumer relations are disadvantageous to the possibilities for close technical linkages. Standardisation of business processes is very often a precondition for the actual use of technological networking possibilities.

4.2.5 Restructuring of the supplier chain and virtual organisations

Together with the application of modern ICT, companies increasingly change from an inward to an outward orientation of restructuring (OECD 2000b). One aspect is the restructuring of the supplier chain. Large companies completely restructure their supplier chain by reducing drastically the number of suppliers. At the same time, they intensively collaborate with system suppliers and subcontractors around issues such as R&D, product quality or Just-in-Time delivery. A new division of tasks emerges; suppliers have to produce complete systems which can be assembled directly without any contribution from the core companies. Furthermore, supplier companies have to take over additional tasks, particularly research and development; then the innovation process becomes more like a joint undertaking of networked companies. In addition, customer companies can take part in the co-construction of new products, in order to avoid marketing problems.

Different levels of interdependence between partners in an innovation and production chain can be distinguished until finally the reciprocal influence by the actors of the network is so intensive that the separate organisational context fades and the network itself emerges as the new organisation. Then one is not far away from the theoretical concept of 'virtual organisation', a form of company organisation in which constellations of various companies combine to work on a particular project no longer bounded by distance (Malone and Laubacher 1998). Individuals or groups of people from these various companies work out of physically dispersed workplaces, or even work from mobile devices not tied to any particular workplace. They often form a temporary small group to solve particular problems. As soon as a solution for the problem has been found, the group dissolves and its members start to work in another group, often with different partners. In general, people work in several groups at the same time. Through this we can see the development of a network of overlapping group structures. However, these virtual organisations have hardly developed yet. And again, their development is not caused by the introduction of modern ICTs, but the new technology can be supportive.

4.2.6 Strategic alliances

A new phenomenon linked to the outward orientation of companies is the increasing number of strategic alliances. According to Hage and Alter (1997), we can distinguish between older, more traditional types of inter-organisational co-operation among producers and suppliers and new types such as joint ventures or inter-organisational alliances. The company survey revealed that quite a few companies had formed strategic alliances with other companies. These new forms differ from the traditional ones in various aspects.

While traditionally co-operation between companies was reduced to simpler tasks like co-ordinating prices, pooling financial resources, or marketing, for example, it now involves more complex tasks, including joint research and production of products or services (Alter and Hage 1993; Gomes-Casseres 1994). By building broader and deeper joint ventures than before, companies

try to promote their strength and to eliminate their weaknesses (Powell 1990). Furthermore, the span of networks has broadened, crossing industrial sectors rather than being contained within them. In addition, the same company may now be involved in a number of networks, including joint ventures in order to develop new products and strategic alliances in order to set national standards. These networks are often competing with other joint ventures and alliances (Gomes-Casseres 1994). Also the membership of networks has become more diverse; a third party is frequently involved to ensure the enforcement of agreements (Hage and Alter 1997: 95).

Co-operation within strategic alliances is particularly important for promoting innovations. We have some empirical evidence that collaboration within joint ventures and strategic alliances is an important factor in the discovery, application and diffusion of new technologies. Strategic alliances are not based on the assumption of a zero-sum game; instead, the underlying idea is that the partners can gain from sharing knowledge by jointly optimising benefits and reducing risks.

More concretely, we can enumerate several reasons for companies to engage in R&D co-operative arrangements with other companies, not only with those in their home country but also and in particular abroad. Due to rapidly growing R&D costs caused by increasingly complex innovation concepts and the dramatic reduction of product cycles in some industries, companies find it more and more attractive to form strategic alliances around their R&D activities. Because of the complex web of communication and mutual commitment developing within collaboration arrangements, options for further innovations are kept open insofar as they bring together various perspectives and new combinations of knowledge.

Furthermore, companies increasingly face a shortage of highly skilled researchers, which may encourage them to share scarce human resources. At the same time, radical innovations based on merging technology fields make it necessary for companies to find new partners and form strategic alliances to quickly get access to the needed knowledge. In addition, co-operation in strategic alliances may also improve research efficiency, as it reduces duplication. As with all other external restructuring measures modern ICT is a strong enabler of the formation of strategic alliances.

The following table gives an overview of the most important features of restructuring and it demonstrates how they contribute to process integration and vertical de-integration, which are the main features of the network form of organisation.

Table 4.3: Elements of the new organisation logic and aspects of process integration and vertical de-integration

Organisation form	Process integration	Vertical de-integration
Group work	Integration of single tasks	Break-up of hierarchical positions of specialists and foremen
Cross-functional teams	Integration of various functions such as R&D, production and marketing	Independence from line structures
Profit centres	Integration of all activities necessary to produce complex parts of a product	Decentralised costs and profit responsibility
Supplier and customer relationships	Trans-organisational integration of whole production chains (collaborative production)	Partnership between core companies and system suppliers based on long-term agreements
Virtual organisations	Temporary co-operation of experts	Project team with alternating leadership
Outsourcing	Focus on core processes and competencies	Smaller and less bureaucratic units
Strategic alliances	Knowledge sharing in specific areas	Independent inter-organisational units

4.3 Co-ordination forms and business culture

4.3.1 Discursive co-ordination as new governance forms

In the following we discuss intra-organisational and inter-organisational governance aspects, focusing particularly on new developments related to the new network model. Due to the vanishing of formal organisational norms and the establishment of network structures, co-operation and information exchange becomes more complex; at the same time, it is more difficult to get a clear picture of the company as a whole (Jäger 1999: 87). Decentralisation and responsible autonomy, elements of the new organisation logic, always carry the risk that co-operation will turn into competition. Therefore, although management can no longer rely on traditional command and control mechanisms, it still has to co-ordinate the diverse components and processes of a company. Here we can identify a change from traditional bureaucratic co-ordination to new forms of governance characterised as discursive co-ordination (Schienstock 1997). The new governance form has three key elements: systemic discourse, performance agreements and benchmarking via automatic generation of performance standards.

Systemic discourse is the key element of the new co-ordination form. One aspect of systemic discourse is to reach an agreement on the general strategic orientation concerning markets, output, human resources, and planned budgets. We can talk about the setting of framework conditions. Discursive co-ordination also means that units are no longer centrally controlled; instead, co-ordination of activities takes place through mutual adjustment or continuous discourse on a decentralised basis. Discursive co-ordination is not intended primarily to create consensus among the participants; it rather aims at initiating learning processes.

The second element of the new co-ordination form is a performance agreement. The traditional bureaucratic control relationships between headquarters and profit or cost centres are transformed into contractual ones. Between headquarters and these centres agreements are signed that specify output norms, the demanded product quality and the time of delivery. The rationale behind this is that when organisational units are involved in the fixing of performance standards, they themselves are also committed to them and feel obligated to achieve the agreed performance norms. Thus we can speak of a normative integration of members of the centres, in contrast to an alienated or calculated involvement characteristic of the traditional bureaucratic control system. The consequence of these agreements is that centres become responsible for adherence to the agreement, but they are free to choose how to organise production or service processes in order to achieve the stated requirements.

IT-based management information systems and the application of user-centred and performance-centred design in computer applications have also become an important part of the new governance form. "Technology becomes less a means of dictating control (by machine pacing) than a means by which management is able to set and encourage worker commitment to achieve performance standards. This is made possible by automatic generation of performance data ... and analysis" (Frenkel *et al.* 1993: 787). One example would be the number and duration of service transactions, another the number of customers served or the turnover within a department store; sometimes customer-based matrices are obtained from surveys.

Performance data are often not used to control the outcome in the first place but to stimulate competition among work groups (Flecker and Schienstock 1994). Within companies they become the basis for an intra-organisational benchmarking between work groups (Schienstock 1997: 177). Objective data then become the basis for future performance agreements; they are better accepted by workers than abstract performance norms prescribed by management. "Communicating performance to employees in the form of graphs and summary data, for example by presentation on workplace bulletin boards or through electronic mail, tends to legitimise performance standards" (Frenkel *et al.*

1993: 787). The discursive form of co-ordination can be applied to various levels of the companies as well as to the interaction between organisations. Systemic discourse can be viewed as a platform to jointly create and exchange information among organisation units.

4.3.2 Changing organisational culture

4.3.2.1 Turning distrust into a trust-based organisation culture

The belief that ICT applications and organisation forms stimulate intensive communication and knowledge exchange seldom produces the expected results. Modern technological infrastructure supported by organisational rules allows anyone to post information and gives access to all available information, insofar it is a prerequisite for extensive information and knowledge exchange. But the values and norms that make up the company's culture are the principle determinants which influence communication patterns. Techno-organisational structures alone cannot create an environment which fosters continuous exchange of information and knowledge, they must be based on a supportive business culture.

On the other hand, the design of technical systems and organisational norms always express a specific organisational culture. Hierarchical control, characteristic of the traditional Fordist model, for example, signals distrust among organisation members and particularly between management and workers. It is likely that a rigid corporate culture co-evolves, which can become a decisive obstacle to establishing more flexible organisation forms and trust-based communication and knowledge exchange. The use of modern ICT as a surveillance device aggravates the problem of bureaucratisation and rigidity.

When companies establish new organisation forms, supported by the use of modern ICT to stimulate and accelerate information and knowledge flows, they can no longer rely on a weak, distrust-based corporate culture characteristic of Fordist production practices. Instead a strong, trust-based culture is needed for decentralised and highly flexible companies to function effectively. A trust-based company culture creates an environment in which the promise of reciprocity is high and in which employees feel obliged to share their information and knowledge with other organisation members. When we talk about strong trust relationships, we mean identification-based trust resulting in moral involvement, which can be distinguished from calculus-based trust (Lewicki & Bunker 1996).

Our case studies revealed that some companies tried hard to establish trust-based relationships; they understood programmes of cultural strength as an important part of companies' renewal strategies. "Such programmes", as Murray and Wilmott argue, "drew together and energised often fragmented and conflicting organisational forces around core values that would guide the work of all organisation members from Chief Executive to clerical staff" (1995: 171).

Cultural change programmes are part of strategic management that companies establish to render employees more capable of responding effectively to the challenges posed by global innovation competition. They reflect a rethinking of how to tap the creativity and adaptability of human beings and link the management of employee skills, competencies and careers more directly to the pursuit of business strategies.

The creation of a company vision can be seen as an attempt of management to support the development of a strong corporate culture; it allows communication among organisation units even if they have different interests and preferences (Willke 1989: 99f). Organisation units can better understand the various interests of other organisation members, groups and departments and the conditions under which they are acting and they are more likely prepared to take these into account in their own strategies and actions. They may then be willing to co-operate with others and give up departmental egoism, aiming at creating advantages for the whole company.

The rise and increasing spread of total quality management is also a very visible sign of increasing attention being given to a more holistic approach to management, including the establishment of a strong organisation culture. Total quality management views the enterprise as a totality of interrelated processes and activities, aiming at continuous incremental improvement. "Its emphasis is on managing internal as well as external customer relations where various measures of quality can be improved inter alia by eliminating bottlenecks and costs associated with a failure to 'get it right first time'" (Murray and Willmott 1995: 171).

4.3.2.2 Virtual company culture

There are some doubts, however, whether ICT-based organisation networks can function efficiently in a strong trust-based business culture. In the case of organisational networks, we have to abandon the traditional concept of organisation culture (Castells 1997: 199; see also Schienstock 1993: 38f). We can no longer stick to a concept of a unifying organisationwide corporate culture. An intra- and particularly inter-organisational network consists of a multiplicity of different actors, which contradicts the idea of a unifying 'network culture'. The traditional distrust-based organisation culture is dysfunctional and must be replaced by a new organisation culture; not by a new culture in the traditional sense of a system of values which glues the organisation network together, however.

There is, as Castells argues, indeed a common cultural code in the diverse workings of the network enterprise. But "it is made of many cultures, many values, many projects that cross through the minds and inform the strategies of the various participants in the networks, changing at the same pace as the network's members, and following the organisational and cultural transformation of the units of the networks. We can speak of a multifaceted, virtual culture. Although being virtual, a corporate culture is still powerful in enforcing organisational decisions and co-operation in the network. "But", as Castells argues, "it does not stay; the 'spirit of informationalism' is the culture of creative destruction" (1997: 199). Corporate culture can then be viewed more as a toolbox, the content of which is used strategically in processes of organisational renewal and it is continuously changed and reinterpreted (Swidler 1986).

A new understanding interprets organisation culture as a continuous process of negotiation, reproduction and adaptation (Schienstock 1993). Such negotiations are very important for processes of ICT application, since creating a consistent model of reality which is shared by all organisation members, is a precondition for technically supported communication processes to function effectively (Coombs *et al.* 1992). Furthermore, we have argued earlier that multi-functionality is the main characteristic of modern ICTs. This implies that organisation members have to develop a common view on how to make the use of modern ICTs most effective. They have to collectively choose the functions for which modern ICT is applied in companies. Therefore, the development of an information system and its concrete use is always accompanied by processes of negotiation to come to an agreement on how reality within companies should be viewed and interpreted and how modern ICT can be embedded into this reality.

In our case studies we came across companies which did not try to establish a strong trust-based organisation culture by setting up programmes of cultural strength; instead, they created opportunities for employees to meet informally and to talk and listen to each other. They have established spaces to make informal information and knowledge exchange among their employees more robust. This practice is based on the assumption that these meeting points can create an atmosphere in which trust can develop and this can stimulate the exchange of even tacit and ambiguous knowledge. At the same time, this allows the development of a more diversified and fluid organisation culture which supports the flexibility of network organisations.

Physical spaces are sometimes supported by virtual spaces, but are not replaced by them. The Internet, the Intranet discussion groups and groupware discussion databases have the advantage of

convenience and choice as they allow access to a vast variety of different knowledge sources. But their downside is that they do not allow for personal contacts, which, as Davenport and Prusak argue, reduces trust and commitment (2000: 47). Physical places reduce access to available information as they allow only a limited number of contacts. Therefore a combination of physical and virtual places may provide the best solution for stimulating information and knowledge exchange aimed at accelerating innovation processes.

4.4 Organisational changes on the workplace level

Modern ICT has a significant impact on the character of work. This is partly due to the technology itself and partly due to complementary organisational changes, as we have already described above. There is no doubt that the changes taking place on the workplace level depend heavily upon changes on the previous levels of analysis. The degree of centralisation, for example, will influence the possibilities for engaging in job enlargement or enrichment.

When we talk about the changing nature of work in the information economy, two aspects are of particular relevance here: the growing importance of information work and the increasing reflexivity of work. For the first aspect, the fact that a new info-sphere is emerging alongside the techno-sphere is important (Toffler 1980: 165). 'Self-reflexivity' means that subjective participation in work operations on the part of the employees is increasing. We will also investigate the impact of ICTs on workload and stress, and discuss whether modern ICT will support autonomy or control. This exploration and investigation will especially draw upon the rich qualitative information from our case studies. Towards the end of the paragraph, some quantitative information from the survey will be integrated.

4.4.1 The changing character of work

4.4.1.1 The increasing importance of information work

There is widespread agreement that the structure of labour is increasingly determined by activities like information acquisition, information processing, and information-based decision-making. The more efficiently the production processes can be regulated on the informational level, the more information work will gain in importance at the cost of work on the material-energetic level of the production process (Baukowitz/Boes 1996). It is argued that various kinds of information workers whose work is confined to objects and 'material' which exist only on the level of information will replace those working on the material level.

'Interface workers', who influence the material level of the production process by way of the informational level and 'guarantee workers', who as 'guardians' and 'controllers' keep the production process running smoothly will, according to some scholars (Castells 2000), become particularly important. Both groups concentrate their work – in contrast to information work in the strict sense – on the material level of the production process. This is the actual object and quality criterion of their work. But they manipulate their 'work object' indirectly, via the informational level or within the technical-mechanical system, and therefore they have to regulate and control their operations on the basis of the effects which the informational level produces on the material level.

The result of this process is that labour in the 'information economy' – due to the continued spread of ICT-based systems - is equipped with a new level of intervention, which inserts itself between human labour and the material and energetic level in production. Labour manipulates the material-energetic components in the process of production increasingly by means of this intermediate informational level, and changes its status within production as well as its own nature. It becomes – in essence – information work, or information-mediated interface work.

In the course of this process of informatisation, the level of abstraction applied in handling the objects of the work rises. Manipulation and perception become ever further removed from the

material-energetic level of production – to be precise, in varying degrees, whether as information or as interface work. The connection between the informational and the material-energetic levels is becoming more fragile, due to the increasing 'universality' of the informational sphere.

A consequence of this 'abstractification' of work could be described as 'de-materialisation' or 'de-sensorisation'. In contrast to manufacturing operations, information work has still another characteristic feature: in manufacturing the product has a material existence with material properties. The quality of such an object can therefore be determined 'objectively'. In the case of information work, the quality of the product can be judged only within the context of a certain interpretation, which results from an – assumed – model of reality, itself a socially constructed fact. The product of work in this case is a symbol in the network of social relationships, the object of analogous social interpretation, without being unequivocally determined.

The difference seems to be twofold: On the one hand, the objects with which information work is occupied are artificially created. They are artefacts whose existence is determined primarily by certain model assumptions about reality. On the other hand, the product of these operations is not objectively defined; the evaluation of its success is the result of a social process of interpretation. The work process itself becomes part of a formalised information process, which orients itself on the production targets. As a result – it is feared – working capacity will become negotiable and accessible to increasing control and to further phases of rationalisation.

However, the fact that ICTs increasingly penetrate into the lowest company levels is still saying nothing about the actual number of PC users and the real importance of the PC for the functions in question. There is no doubt that increasing number of production functions involve intensive PC work, meaning that the above-described changes in the character of work can be observed. In companies active in the core sector of software development, for example, more or less all members are in daily contact with ICT, which represents the main working tool. In the final assembly of the automobile companies, on the other hand, the percentage of people actually working with ICTs is still pretty low. And even if blue-collar workers have to work with ICTs, it is only for a small part of total working hours. Although automation and informatisation are making an entrance, final assembly is still very labour-intensive: the majority of work to be done remains purely manual along the conveyor belt. In fact up to now, ICTs have not changed the task packages of the majority of core workers much. On the basis of the automobile case studies, we certainly cannot speak of a trend towards 'servicisation' of production work.

To this we want to add a second nuance. Switching to PC work does not necessarily have to imply a radical break from the former situation, as is often the case in the chemical industry. The introduction of today's ICT-intensive operating system does not work in a chemical plant: physical switches on a control board have become virtual switches on a PC screen, but the logic of the system has remained completely the same, although work has certainly become more abstract. Increased levels of abstraction of work have also been observed in other cases under study. The examples mentioned so far predominantly deal with blue-collar jobs in the core processes of the more established case companies. In some of these jobs, the contact with ICTs gradually increases, thereby making the work more abstract or mediated.

4.4.1.2 Reflexive work

It is also argued that under increasing systemic integration labour becomes more self-reflective (Lash 1994). This development increases the importance of subjective participation in work operations on the part of the employees. Quality control and, within certain limits, the control of productivity as well are shifted into work-operations. Therefore, in addition to the turnout of goods, labour has to check, improve and regulate itself to guarantee quality and efficiency. The borders

between the process of routine work and that of innovation have become blurred: an increasing share of work consists of self-innovation. Furthermore, in systematically organised co-operation, labour must consistently and comprehensively monitor the behaviour of not only others, but also of itself to be able to fit its own operations into the intended total operating performance of a work group and, if needed, to correct its own performance.

Lash also stresses the importance of 'structural reflexivity' as a new characteristic of work. According to Lash, work "entails self-reflexivity in that heteronomous monitoring of workers by rules is displaced by self-monitoring. It involves (and entails) 'structural reflexivity' in that the rules and resources (the latter including the means of production) of the shop floor, no longer controlling workers, become the object of reflection of agency. That is, agents can reformulate and use such rules and resources in a variety of combinations in order chronically to innovate" (1994: 119).

Schimank takes up the aspect of 'structural reflexivity' by stressing the increasing subjectivity of work (1986). Contradicting Braverman's traditional thesis, according to which the introduction of a technical system leads to an increase in control of the production process and to marginalisation of subjectivity, he argues that "subjectivity is just as necessary in the production facilities at present and in the future as it ever was in the past – possibly even more so" (ibid.: 72). The reason for this basic need for subjectivity is formulated as follows: "The – in principle insurmountable – inability of mechanised systems to insure the environmental conditions of its own operability is the source of the need for subjectivity in mechanised production facilities. Mechanical systems have to be linked with personnel systems. The vision of the fully automated factory is a technocratic illusion. Only subjectivity can re-integrate, when necessary, the horizons of reference which had been banned by techniques, to determine which environmental conditions were not anticipated by the assessment of mechanical operations and to convert them into conditions which can be mastered by the machinery." (ibid.: 82).

Wersig and Tacke add to this argument. While well-ordered relationships of co-operation are typical of Taylorist work-contexts with correspondingly standardised communication, organised in the manner of an interface between employees, in systemically organised contexts, the relationships of the systemic integrated work to its surroundings and to other subsystems are, in principle, not capable of standardisation. Co-operation and communication are therefore not sequential and they cannot be organised as regular interface-relationships, but only reciprocal, with permanent and irregular communicative relationships (Wehrsig/Tacke 1992). They demand permanent self-reflection from the employees, which is only realisable by means of the subject-relationship on the part of the individual workers in regard to the conditions of their operations. The fundamental contingency of this situation in principle precludes acting strictly according to rules (ibid.).

4.4.2 Autonomy versus control?

We have argued above that to some extent subjectivity and self-reflexivity are necessary in dealing with changing requirements for work caused by environmental changes. The need for self-reflexivity implies, as Lash argues, structural reflexivity realised through organisational changes, increased autonomy and reduced control. On the workplace level these organisational changes open up opportunities for introducing job enrichment and increasing levels of job autonomy.

The nature of work was changing in the hotel (LON 4), partly due to pressures from customers, which are becoming increasingly demanding, partly due to pressures to increase productivity and efficiency. ICTs were also playing some role, through enabling people to work differently and through providing more information and enabling managers to analyse how things could be done better. These factors were all leading to broader job roles and greater autonomy. However, there has long been a culture in this hotel chain of people taking responsibility for their own jobs and having autonomy to do things in the most appropriate way.

In some industrial companies blue-collar workers have been given access to the production planning system after the installation of networked PCs on the shop floor. The workers can now use the information system to check the availability of materials. On the basis of this information, they can make some decisions about the sequence of the work - decisions that used to be made on higher hierarchical levels and imposed on the workers in question. This is only one example of employees getting more responsibilities and decision-making power thanks to ICTs.

In general our case study results show that the technical potential of modern ICT is widely used to support decentralised organisation with a large proportion of self-organisation and direct horizontal co-operation. However, ICT not only bears the potential for increasing decentralisation and autonomy. We have also mentioned that ICT can stimulate organisational change in the direction of increasing centralisation. On the workplace level, this can result in a strengthening of control/surveillance by the central authority. The case studies reveal that in fact ICT is used to control business processes and for surveillance of (individual) employees and their work quite often.

To these case study observations we would like to add some findings from the survey. For companies, 'giving workers more autonomy' is a less important aim of introducing and using ICTs than 'controlling workers' output'. However, the fact that ICTs are not in the first place introduced for this reason does not yet mean that more job autonomy cannot be a positive side effect of their introduction. We have some support for this argument. Overall, approximately two thirds of the respondents agree with the following statement 'Due to ICTs, employees get more responsibilities'.

In conclusion, the empirical results show that the technical potential of ICT is often used to support decentralisation with a significant proportion of autonomy, but at the same time, ICT offers opportunities to enforce control. In fact, the further decentralisation is driven, the more important the opportunities for the accompanying control of business processes and individual performance become. In the application of modern ICT, the facilitation of decentralisation, horizontal co-operation and self-organisation represents only one side of the coin. The other side of the coin is the ongoing potential for control and surveillance, which continues to be provided by ICT.

We now try to integrate these findings in Friedman's dichotomy on the different ways of steering employee behaviour (1977). Friedman distinguished between 'direct control' and 'responsible autonomy'. In the first option, management tries to destroy employee autonomy as much as possible and enforce the required performance by means of direct control. For some categories of employees, Friedman detected a completely different management strategy based on the maximal protection of employee autonomy. Instead of direct control, indirect regulation mechanisms such as offering promotion possibilities, extra-legal advantages, etc., are in use here. The point we are trying to make here relates to the multi-functional potential of ICT to stimulate simultaneously both ends of the dichotomy, that is, employee autonomy and employer's control. In other words, it looks as if ICT allows for a third option that could be labelled 'controlled autonomy'.

4.4.3 Workload and stress

On average, the case study companies confirm the idea of a trend towards increasing workload and stress. Many factors contribute to this observation, including rationalisation operations, understaffing because of labour market shortages, pressure coming from increased competition, more direct contact with customers, and uncertainty over the employment situation. In comparison with the above 'stress factors', ICTs are only of minor importance. However, ICT can increase the workload and create extra stress. As opposed to regular mail, for example, e-mail reaches the addressee much faster. In most cases, a more rapid answer is expected as well. Having to go through hundreds of e-mail messages after a few days off is very time-consuming. It is especially frustrating to sort out the mailbox and find the few important messages among countless irrelevant ones. The technology itself does not offer reliable tools to solve all problems it creates.

In addition, e-mail has proved to be an effective medium only for largely standardised, clear information. It has its limits when more intensive communication is necessary. It was often mentioned in the case studies that the markedly different style of electronic communication in comparison to ordinary letters can lead to upsets, irritations and even conflicts. The reason could be its brevity and message formulations that imitate verbal communication but which lack the non-verbal communication component necessary for interpretation of the explicit message. Recipients often ask themselves how something is supposed to be meant. In a number of case studies interlocutors point out that efficient and conflict-free use of electronic communication cannot be taken for granted; instead, it is often the source of conflict and stress.

What was felt to be an equally severe problem was the need of people to adopt new ways of managing information. Many people continue to manage electronic information in the same way as when everything was on paper. Everything is printed out and stored, whether this is necessary or not. While people are trained to use new and updated software they are rarely informed about file and information management.

This kind of ICT-generated stress is in line with the stress model of Karasek and Theorell (1990). ICT is often increasing the number of job demands (e.g., more information to deal with, sorting incoming e-mail messages, the need for more rapid answers, etc.) without proportionally increasing the degree of job control to cope with the new demands (e.g., the recipient has no control over the number of incoming e-mail messages, the technology does not help the recipient in dealing with the problem of sorting, prioritising, etc.). Furthermore, technical problems beyond the users' control can be very frustrating and eventually result in work stress.

Most ICT-related stress is probably felt by those people who have difficulties in coping with the new technologies and resulting requirements. Not being able to use the new technologies properly, or being transferred to a secondary job because of a lack of digital skills, can be very frustrating. In general, however, we came across few examples of people having serious 'coping problems' in the field of ICTs. ICTs can also reduce work stress. Indeed, as better ICTs facilitate working more efficiently, they can also decrease stress at work.

The ERP package (Axapta) applied in FLA 8 is reducing the time needed for data input and looking up information. Also the creation of standard reports and overviews (e.g., periodic sales figures) can be automated to a great extent. The relative gain in time was considered to be a welcome reduction of the workload and stress for the administrative work forces in question. In general, the efficiency and productivity of research work continually increases together with improvements in modern technology. According to TV, this evolution is positive for the quality of labour among the persons involved. Working more efficiently and productively thanks to better ICTs reduces the workload and stress rather than increases it. Deadlines are not changing, and if something can be looked up faster, things can be less hectic. Stress especially arises when ICTs refuse to work optimally. For example, if the computer refuses to work, the whole montage process is at a standstill, at the risk of not meeting the programme deadlines.

ICT dependency equally increases along with the degree of intensity of ICT use. In fact, the lack of power to solve emerging IT problems and the resulting dependency upon IT professionals is often a much greater stress factor than the increasing use of ICTs itself.

Stress becomes particularly severe when new ICT systems are introduced, as the following case study shows.

The hotel (LON 3) had experienced three new systems in two years. This had caused a range of problems, especially for staff at the reception. One system had not been fully appropriate to the job it was supposed to do and a new one was developed. It was the point of changeover between systems which was the most troublesome. Although staff were trained in advance, using an unfamiliar package in a quiet training room is very different from doing so with a queue of customers all waiting to be quickly booked in or out. This company had provided as much support to staff at each changeover as possible. They had also provided massages and other bonuses and rewards to help staff relax and deal with these pressures.

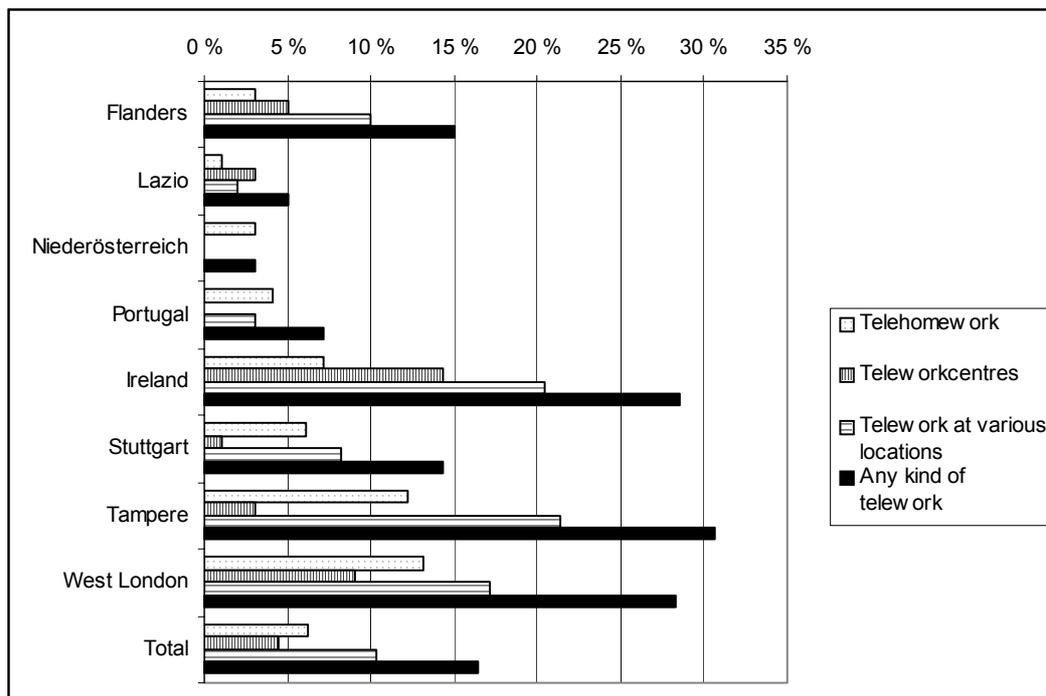
Many employees, we can conclude, suffer from increasing stress levels. However, in comparison with other stress factors, the use of ICTs only seems to play a minor role. In some instances, better ICTs can even relieve work stress. On the other hand, ICT dependency and the lack of power to solve emerging IT problems can create stress and frustration.

4.4 Telework

It is not for the first time that a revolution in new forms of work is expected as a result of new technology. The new ICT seems to make work completely independent of time and place. The spatial relocation of activities, made possible by the use of ICTs, is taken up in the literature under the heading of teleworking. For more than a decade already the number of teleworkers has been expected to increase dramatically. In the following we investigate whether or not this evolution has really been taking place.

A distinction has been made between three types of telework. Telehomework has been defined as 'information processing work done at home for at least 20% of the time and provided with the necessary ICT infrastructure to communicate with the employer and or customers'. Telework centres are hired workplaces at telework offices or regional office buildings connected with an ICT infrastructure to the headquarters. Telework at various locations finally refers to employees working at variable locations (at customer companies, in travel) and provided with the necessary ICT infrastructure to communicate with the employer.

Figure 4.3: Types of telework by region



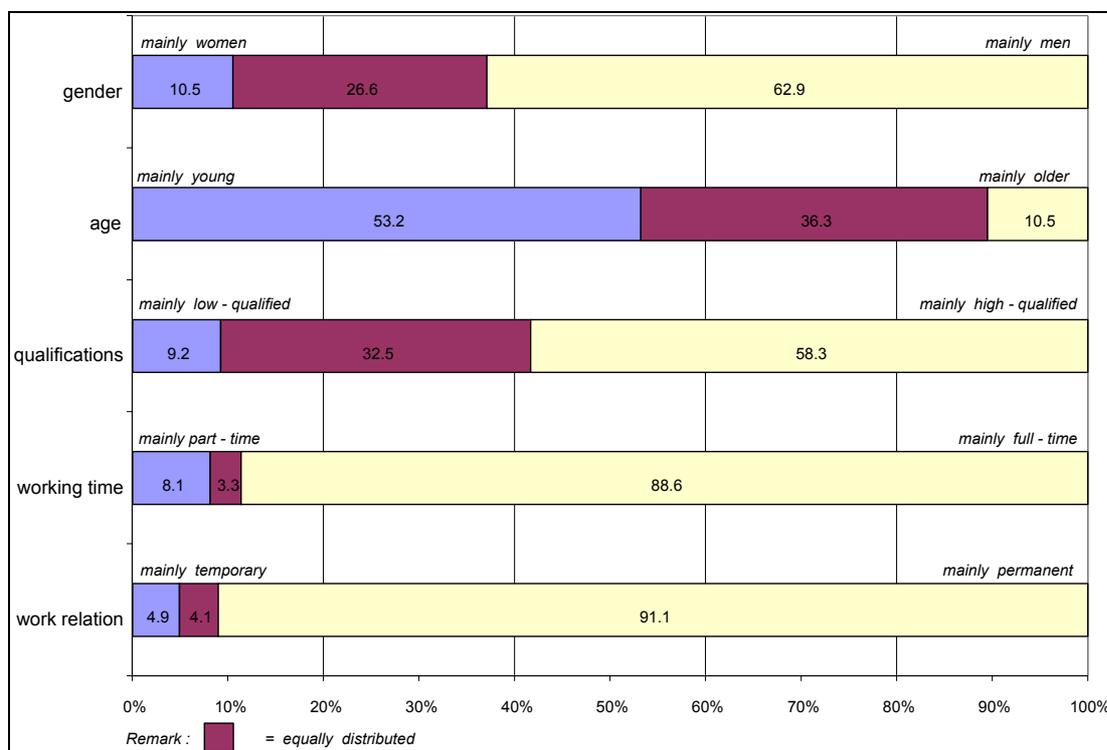
Telework done at home or in specialised telecentres are the least widespread types of telework. Telework at various locations (or 'mobile work') has only been observed twice as frequently. In general, however, we have to conclude that the working form in which space is no longer a hindering factor is still a far from common practice. The number of companies using

telework in one way or another is limited to only 16%. In fact, we can say that the quantitative importance of telework is still very small; it bears no relationship at all to the attention it receives in the literature.

The above definitions clearly indicate the link between telework and ICTs. ICTs are simply a '*conditio sine qua non*' for telework no matter in what form. They form a necessary, but certainly not a sufficient, precondition. Although information technology is an important enabler of working at home, it is only one factor among many in ensuring its success.

The control aspect is often mentioned as a significant barrier for engaging in telehomework, even more important than the technical aspect (although ICT often plays a crucial role in the control possibilities of telehomework). This suggests that only perfectly assessable and controllable - on-line or afterwards – work can be performed at home.

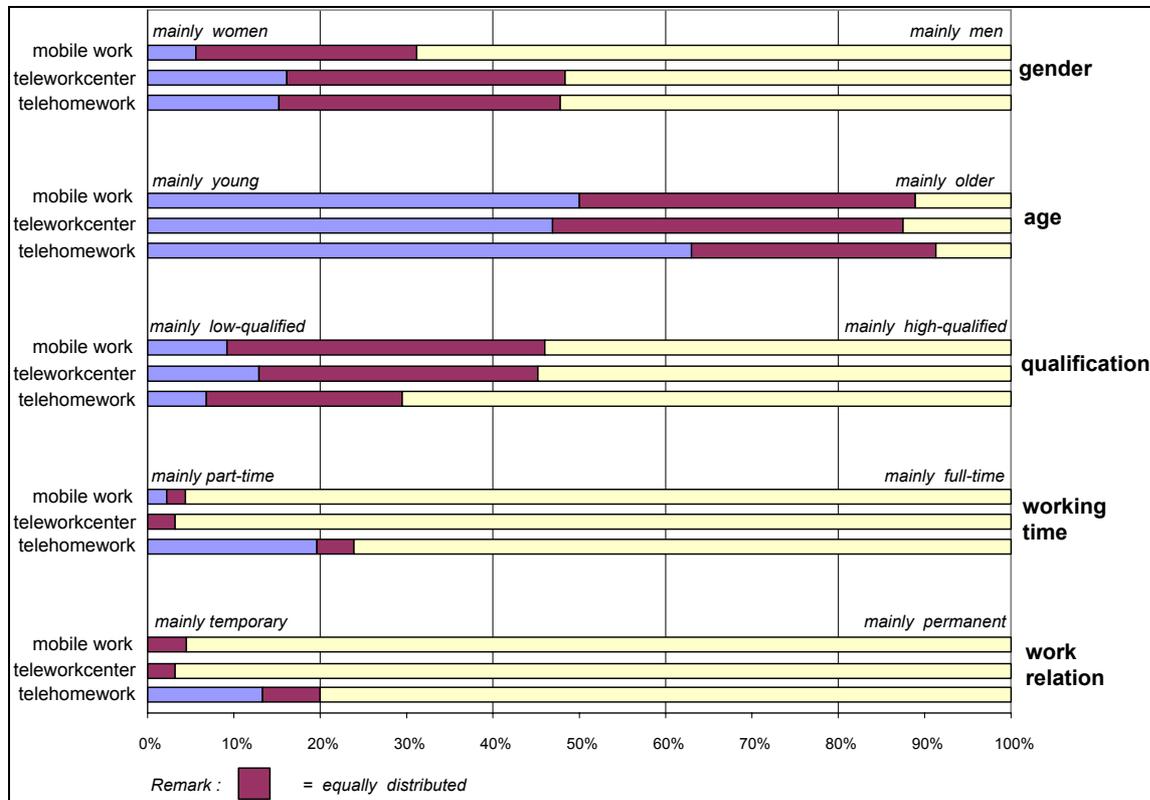
Figure 4.4: Workforce profile of (any kind of) teleworkers



The above figure illustrates the distribution of teleworkers by gender, age, qualifications, working time, and work relationship. In general, telework cannot be considered to be very 'precarious work': in approximately 90% of the companies telework is associated with permanent work relations and full-time work. Furthermore, teleworkers are predominantly men, highly qualified and young. It seems that professional and office-based tasks are done at home more often than simple support functions. Most support staff is expected to be on site to support the frontline employees.

We have re-analysed the survey results on the basis of the type of telework. As Figure 4.5 shows, telehomeworkers are indeed more often working on a temporary and part-time basis. Compared to the other teleworkers, they tend to be younger, more often female, but also - and this is a bit counterintuitive – more highly qualified.

Figure 4.5. Workforce profile of different kinds of teleworkers



4.6 Conclusion

We have argued earlier that business restructuring in the emerging information economy implies more than changes on the shop-floor level; instead, it needs to take the whole organisation model into account. Our research indicates that changing the organisation model or at least parts of it is a common practice within companies. However, there is no specific organisation measure that dominates restructuring processes. This indicates that companies have different views on what the most efficient organisation forms are. On the other hand, restructuring is becoming an increasingly cumulative process. Those companies that get involved in restructuring processes introduce a variety of new organisation measures concurrently. Still only about 20% of all companies can be characterised as network organisations having introduced both strategies of vertical de-integration (flat hierarchies) and horizontal integration (group work and teamwork).

Organisational restructuring does not mean simply taking an existing organisational model out of a toolbox and implementing it through a top-down strategy. As many companies do not apply a holistic approach of restructuring right from the beginning, we may characterise organisational change processes more as experimenting with various models than as rational decision-making processes.

We have discussed discursive co-ordination as a key element of the network organisation model. It is quite clear that the companies can no longer rely on bureaucratic organisation forms but the new co-ordination form can only function if companies' sub-units have become fully

autonomous. Initiatives aiming at stimulating information and knowledge flows as a precondition for innovation can hardly produce the expected results, if they only rely on the establishment of new organisational forms. As long as the new structures are based on a distrust culture, companies will hardly achieve their aim. However, it is also very debatable whether companies can stimulate and accelerate innovation processes through establishing programmes of cultural strength.

While these programs may stimulate mutual trust and thereby support the exchange of even tacit and ambiguous information exchange, we can have some doubts about whether a unifying organisationwide corporate culture will achieve the aim of increasing innovation activities. Suppressing organisational sub-cultures may actually lead to the exclusion of sources of innovation. Practices to create spaces for the exchange of information and knowledge may be more successful, as they create an environment in which trust can develop without destroying the sources of diversified knowledge creation. These spaces should allow for frequent face-to-face discussions but they can also be supported by network technology.

Although single workplaces and isolated work processes are no longer the main target of restructuring activities, we can still identify major changes on this organisational level as well. We have emphasised that the character of work is changing. The increasing importance of information work, the reflexive character of work and increasing subjectivity of work have been discussed as the main dimensions of the transformation of work. We have also mentioned that work in the information economy is becoming more stressful and that workload is increasing, although in general it is the organisational aspects and not the ICT itself that is the key stress factor. In addition, we have argued that neither responsible autonomy nor direct control characterise work in the information economy properly. Instead, due to the multi-functionality of modern ICT, a third option of combining autonomy and control is developing. This option could be labelled 'controlled autonomy'.

Our findings concerning telework contradict the traditional image of this form of organising work. In general, the form of working in which space is no longer a hindering factor is still far from common practice. Furthermore, according to our company survey, professional and office-based tasks are more done from home than simple support functions; and in addition, teleworkers are predominantly men, highly qualified and young.

5. SKILLS AND COMPETENCIES IN THE INFORMATION ECONOMY

The change in qualification requirements as a result of technological change is at the centre of the discussion on the information economy. There is no doubt that the speed of change in modern ICT places great demands on the adaptability of working people, companies and also educational establishments. Still it is highly disputed whether the widespread use will lead to re-skilling, as some scholars argue. In addition, there is an intensive debate on what kind of skills and competencies are needed most. While it is often assumed that the widespread use of ICT will increase the need for information or digital skills, companies often mention a great demand for social skills. A further research question concerns the forms of learning. While increasing demand for ICT specialists seems to indicate the importance of formal learning, some scholars strongly emphasise that informal learning-on-the-job, including 'learning-by-doing', 'learning-by-using' and 'learning-by-interacting' is gaining importance.

In the following we will first turn our attention to the de-skilling vs. re-skilling debate and will provide some empirical material. The debate on skills and competencies needed in the emerging information society, however, is too much occupied with this somehow old-fashioned debate. We therefore pay more attention to the concrete qualifications needed for working in a changing environment. While the literature focuses mainly on the need for digital skills, we will here apply a broader view. Taking into account that companies can only gain from the introduction of modern ICTs if they introduce complementary organisational changes, we will deal with a wider range of skills, competencies, knowledge and work orientations. Finally we will discuss training aspects, focusing particularly on the aspect of learning-on-the-job.

5.1 The de-skilling versus re-skilling debate

The discussion about the demand for skills and competencies in the information economy is highly controversial. It was dominated for a long time by the de-skilling versus re-skilling debate. Both trends were directly related to the widespread use of modern ICT. The de-skilling thesis was based on the control potential of modern ICT. It was argued that computer technology would support and extend the Taylorisation of production processes and, by eliminating skilled work, management could gain control over the work process (Shaiken 1984, Braverman 1974, see also Robins and Webster 1997). Some researchers, having a more differentiated view, argued that the application of new technologies, particularly in offices, is leading to the re-skilling of lower-level occupations. But this process is accompanied by the redundancy of routine workers on the lowest levels, while professionals and middle management are the main victims of de-skilling (Baran 1989: 697).

In other publications, contrary to what has been stated so far, a tendency towards re-skilling is assumed (Strassman 1985). This is partly because unskilled jobs are about to disappear due to automation processes. On the other hand, the lack of skilled labour is seen as a limiting factor in relation to innovation (Stahl *et al.* 1993: 26), a competition criterion, which becomes increasingly important in the information economy. It is argued that in the information economy, human capital becomes the most important capital, while the importance of raw material, machines, energy, and financial capital is diminishing. Human capital thus constitutes an intangible asset with the capability to enhance or support productivity, innovation and learning (OECD 1998: 9). The German Enquete Kommission argues in a similar way: "Generally we can anticipate that together with the wider diffusion of modern ICTs as well as information and knowledge work the average level of qualification demand will increase" (1998: 115). And Kumar states that new technologies add rather than subtract from the skills of workers (1997: 23).

Our company survey confirms the great relevance of skills and competencies in the emerging information society. Although 'lack of employees' qualifications' was not the most important reason

stated by companies when they were asked about the factors hindering the introduction of modern ICT, it was nevertheless mentioned quite often. About 25% of all companies considered the lack of qualified workforce as important hindering factor. In addition, more than 90% of those asked agreed with the statement that 'information and communication technology increases the need for employees constantly to be learning something new'. We also asked whether modern ICTs would mainly create routine work for workers with low qualifications. About 65% of managers asked rejected this statement; on the basis of their experience in the companies, a significant minority of about 35% of the managers nevertheless agreed to the statement, which can be seen as supporting the de-skilling thesis.

The re-skilling argument, however, is based on shaky grounds. ICT-based activities include a wide spectrum of work processes. And low-skilled jobs are still existing besides automation and relocation to low-wage countries. Examples of this are the input of customer orders in the company information system. Of course, direct transfer of data caused by increasing networking (business-to-business applications) will reduce the demand for low-skilled 'data workers'. But as our case studies show, there is still a need for employees carrying out plausibility checks and dealing with customer queries. We can also find routine work in call centres, in particular if it concerns simple information and data recording tasks.

Second, it is important to differentiate between the education level people have acquired and the qualifications they possess, on the one hand, and the concrete skills and competencies actually needed in the work process on the other. Quite many of the case companies declared that they were 'asking more' from newcomers currently than a couple of years ago, both in terms of educational and other requirements. Jobs that were previously occupied by people who had been in commercial schools are now being applied for by business college graduates or even university graduates. And retiring employees are very often replaced by people with a higher educational background. This means that people with high qualifications are often selected, not because of increased skills required for the jobs, but because they are available and are assumed to have social competencies and personality.

It is also important to mention that specific skills can increase only for a very limited number of employees, while the skill requirements of the other workforce are not subject to significant change. For example, whereas the importance of digital skills has clearly grown in automobile companies, the percentage of people actually being confronted with ICTs - and thus needing digital skills - is still comparatively low. In contrast to the re-skilling thesis, semi- or even unskilled workers still dominate the production processes in many manufacturing companies. But this is also true for service industries as the following example shows.

In a restaurant (A 1) the use of ICT has increased significantly during the last years. However, various groups of employees are affected very differently by the technicalisation strategy. Work processes in the administration department have been computerised throughout; knowledge of task-specific programmes and computer-communications media and filing systems became absolutely necessary. For the work processes in the restaurant and in the café, on the other hand, the use of modern ICT remained marginal, additional information skills were not required.

The fact that qualification requirements differ significantly between different groups of employees also goes for international skills, organisational competencies, initiative-taking, and others. It is often forgotten in the literature that the way in which labour is organised in companies is very essential in the discussion on required qualifications. Only if one takes the opportunity provided by ICTs to broaden and enrich jobs are new qualifications and abilities needed in these renewed jobs. However, in many (blue-collar) jobs the condition of enriched jobs or increased job autonomy is not satisfied.

The argument of higher qualification is often based on the obviously growing demand for specialist skills, enabling ICT systems to be effectively implemented and exploited in different companies. Our case studies reveal that companies have more problems with the availability of ICT experts than regarding user skills. But these specialists require more than technical skills only. These are obviously very important, but ICT does not operate in a vacuum. It can only be effective if introduced in a form that meets particular business needs. IT specialists therefore require a wide range of other skills. In particular, they need to be able to understand and analyse business needs, translate these into IT solutions, and communicate effectively with other specialists and non-specialists (Dench 1998). These specialists also play an important role in identifying new developments in ICT which are relevant to a business, in driving an organisation forward and generally in 'bringing technology to the business'. There is no doubt that the demand for highly skilled ICT specialists is increasing, however, their employment might actually reduce skill demands for many other ICT users.

5.2 Conceptual aspects

The 'skill-biased technical change argument' (Berndt, Morrison and Rosenblum 1992; Berman, Bound and Griliches 1984) states that it is due to the dynamic technological change that many skills and competencies become obsolete and new qualifications are required. The concept has been criticised, however, for not being able to fully reflect the nature of this technical change. One cannot relate shifts in skill demand to the use of modern ICT only; instead, we have to take into account the co-evolution of ICT and organisation forms. One has to highlight the central role of ICT-enabled organisational change in a cluster of complementary and mutually reinforcing innovations to understand the shifts in skill demands (Bresnahan *et al.* 1999: 1–2).

Furthermore, when talking about a shift in skill demands and the need to invest in human capital, we have to go beyond the argument of a general trend towards higher qualification or re-skilling (Kern and Schumann 1984; Piore and Sabel 1984). We have to point to particular forms of knowledge, skills, competencies as well as work orientations, attitudes and work virtues that have to be promoted to develop and fully exploit the productivity, innovation and learning potential of new organisation forms and ICT applications (Garnham 2000). As company restructuring cannot be interpreted as a single act adapting the enterprise to a changing environment, but it must be understood as a continuous process of organisational learning: strategies to engage workers in a process of lifelong learning are justified and necessary (European Commission s.a.).

No generally accepted definition of human capital and skills exists. In the OECD Report on 'Human Capital Investment', the following meaning of human capital has been adopted: it comprises "the knowledge, skills, competencies and other attributes, embodied in individuals which are relevant to economic activities" (1998: 9). This definition indicates that human capital is a multidimensional concept. Here we will mainly follow the definition of human capital proposed by the OECD, differentiating between knowledge and skills or competencies. But instead of talking about other attributes, we will speak more concretely about work orientations, attitudes and work virtues (see also Hillage and Pollard, 1998).

Although knowledge is a contested concept, some important categories have been established. In this respect, we can differentiate between theoretical or abstract, knowledge, content knowledge, technical knowledge, and practical or tacit knowledge. Within the second aspect of qualification we can differentiate between cognitive, social, management, international and professional skills. The concept of skills, however, is gradually shifting towards the broader concept of competence which stresses particularly the ability to handle complex and unclear situations. Concerning the aspect of orientation and work virtues, awareness of quality and reliability, on the one hand, and creativity,

innovativeness and entrepreneurial spirit on the other are seen as important qualifications which have to be cultivated to really gain the advantage of new ICT-based organisation forms.²⁴

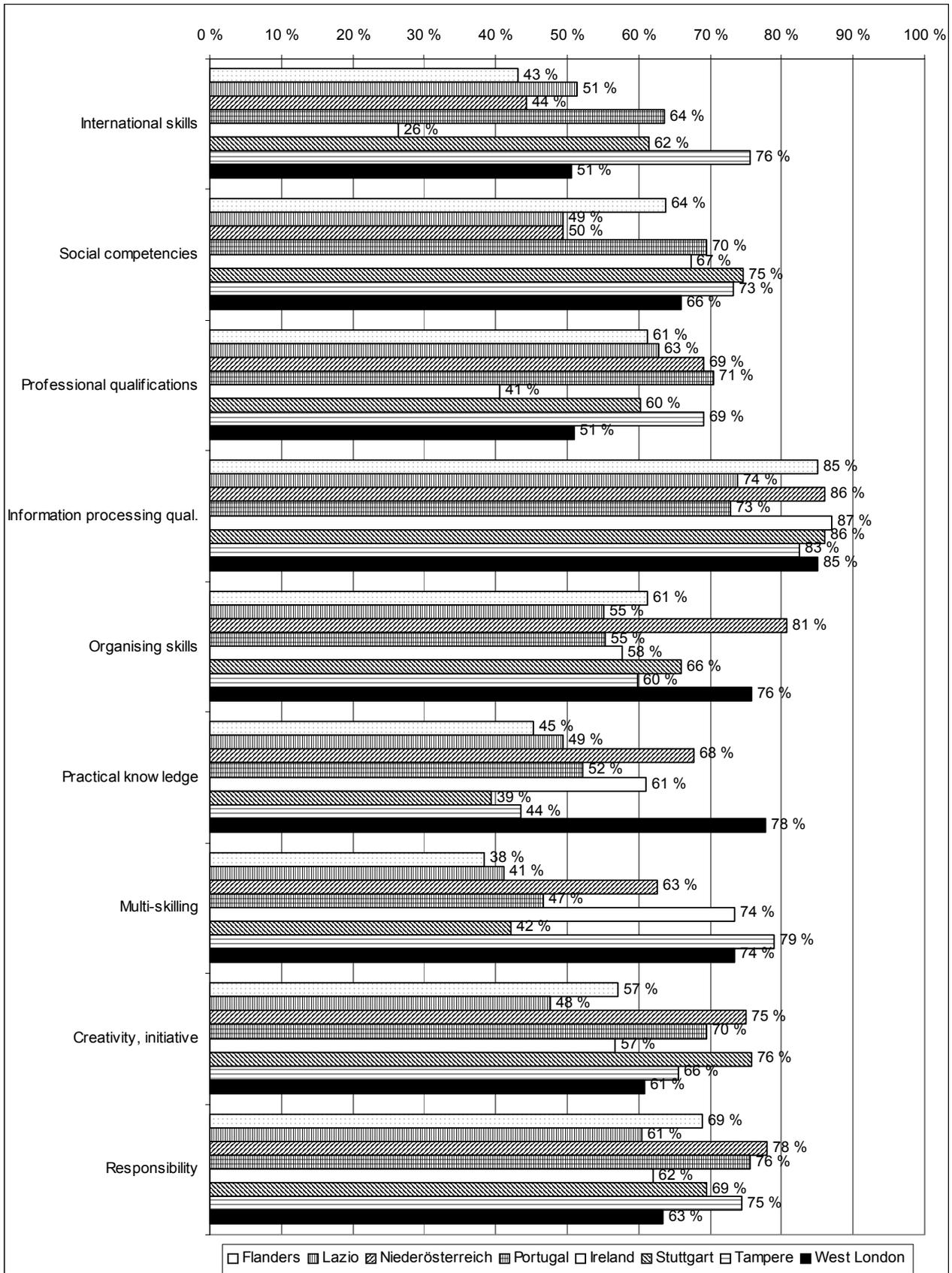
5.3 Skill demands in information economy

Our company survey reveals that companies have a great need for many different types of knowledge, skills, competencies, and work orientations. These are not always linked to the introduction and intensive use of modern ICTs but they are often related to the development of new ICT-based organisation forms. Concerning all categories of knowledge, skills, competencies, attitudes and work values mentioned in the questionnaire, more than 50% of all companies that participated in the company survey identified an increasing demand.²⁵ By far the greatest share of companies mentions an increasing demand for information processing competencies (82%). There is, however, also a demand for creativity and entrepreneurship. Furthermore, it is quite obvious that soft skills (social skills and organisational skills) are becoming as important as professional skills. Figure 5.1 shows that the demand for specific skills differs significantly from region to region.

²⁴ The use of the three dimensions is not always clearcut.

²⁵ We have to take into account, however, that while companies mention demand for specific skills or competencies, which may actually become important for a small minority of employees only.

Figure 5.1: Demand for skills, knowledge and work orientations by regions.



Based on a factor analysis, we have reduced the number of skill dimensions to the following three: work-process-related skills, organisational and management skills, and information skills including both technical and social aspects. Again regional differences are significant.

Table 5.1: Demand for specific skills and competencies by region

	Work skills		Organisation and management skills		Communication skills	
	low	high	low	high	low	high
Flanders	42%	29%	37%	34%	35%	29%
Lazio	46%	28%	48%	26%	47%	25%
Niederösterreich	19%	50%	26%	36%	36%	30%
Portugal	36%	47%	25%	39%	28%	41%
Ireland	23%	40%	36%	37%	40%	18%
Stuttgart	49%	23%	27%	40%	15%	47%
Tampere	40%	33%	26%	54%	23%	55%
London	16%	44%	44%	33%	40%	29%

The above table shows that the demand for work skills is comparatively low particularly in the Stuttgart area. This may be explained by the fact that work skills in this region are very high due to the dual vocational training system and that there is little need for additional training. However, in Niederösterreich, where there is the same kind of vocational training system, demand for additional work skills is very high. Companies in Portugal, Ireland and London also mention a high demand for work skills, which may be explained by the low level of vocational training. Demand for organisational, management as well as communication skills is comparatively high in the Tampere region, in the Stuttgart area, and in Portugal. These results may be explained by the fact that the number of companies in these regions having introduced organisational changes is particularly large.

We can also identify some differences when looking at size and sector. Only about 25% of all small service companies do not mention a need for working process skills, while this share rises to about 40% among large service companies. The need for organisation and management skills is mentioned less often by large service companies, while small service companies seem to be more in need for these skills. And comparatively few companies among the large service companies did not mention the need for communication skills, while among the small manufacturing companies the need for these skills seems to be less urgent.

5.4 Restructuring and new skills and competencies

As the research conducted in the project cover a wide range of work processes, functions and tasks, the qualification requirements vary significantly. Here our aim is not to identify broader trends in the development of skills, competencies, knowledge and work orientations but to aim at identifying new developments independent of whether or not they represent a widespread phenomenon. This means that the qualifications identified are not necessarily needed by all employees, or even by a majority of them.

Companies, as the survey data show, value information skills as highly important. There are two aspects that have to be taken into account. First, information skills are needed to work with specific technologies and software programmes. Our case studies show that in an environment of computerised work, human information processing skills are becoming more valuable (see also Bresnahan *et al.* 1999). More and more companies are becoming aware of the need for deeper analysis of collected information. While computers can produce, store and recall huge amounts of data, these features are only valuable in combination with the human knowledge of how to sort out relevant information and how to analyse, interpret and judge it. Computers, for example, may collect a variety of different data about customers and be able to quickly produce customer profiles, but final decisions concerning the extension of credit limits, for example, depend on the judgement of the responsible employee. If companies want to take advantage of the informing function of modern ICT, they need to have a workforce that has a high enough cognitive skill level to make these judgements.

Connectivity is the other aspect that has to be mentioned here. As has been stressed earlier, modern ICT makes the exchange of information and knowledge between different actors much easier, as it bridges both time and space. In the present stage, where e-commerce and customer relations are becoming key issues, employees dealing with customers as well as other field workers require additional ICT qualifications. In manufacturing, in logistics and in service companies they have to offer ICT applications for electronic communication to their co-operation partners and clients. Even if IT specialists are available for support or ultimately to install the software at the customer's premises, customer-relation staff have to know the way in which the respective programmes function and are used, and the possible applications in the customer's information system.

Electronic communication is also intensively used for co-ordination and co-operation in international project teams. This means that electronic communications media and the companywide Intranet as a source of information have to be added to CAD applications. In addition, with an easier access to technological databases, this vastly expanded connectivity within companies will probably speed up innovation processes significantly. But this will only happen if the responsible people have the competencies to use the increased connectivity and information sources effectively.

The need to innovate more rapidly and to take the needs of customers into account more carefully are two of the driving forces behind the transformation of work into a problem-solving process. This means that employees are increasingly confronted with new and unfamiliar tasks for which solutions are not yet available. In such situations, employees can draw only to a limited extent on their content knowledge: they need more theoretical or abstract knowledge. To find solutions to new problems, the workers must have the ability to ask the right questions, to find the information needed, and to select the most suitable aids and tools. They must be able to conceptualise new problems in such a way that they can search for solutions by proceeding in the appropriate systemic and methodological way (European Union CCAM Contract # 76246).

An increased need for information skills does not necessarily result in reduced requirements for professional skills. Precise knowledge of ICT systems and complete command of electronic communications media are preconditions for coping with the demands of complex and highly networked jobs, but they do not replace vocational knowledge. On the contrary, the more people are working within dispersed groups, the greater the need for multiple or interlocking skills. Multi-skilling can be defined as the possession of skills which exceed the boundaries of a specific profession. Workers must be capable of seeing their own work from the perspective of preceding and following activities. Because of this new trend of restructuring, a broader spectrum of skills in the sense of multi-skilling is becoming increasingly important. Workers need to have skills from different professions in order to perform their jobs in the new form of a networked organisation. Yet there is not always the need to have skills as profound as those acquired for a specific profession.

If one wishes to participate in the dynamic process of developing group work, it is not enough to have skills in only one specific profession. The extensive group process integrates various core functions with indirect functions, such as quality control, repair work or programming, to mention a few, and also with some disposition functions. When work is primarily structured around a small number of business processes or work flows linking the activities of the employees with the needs and capabilities of the customers, the canon of professional skills the workers must have expands. Therefore, the ability to learn and to keep learning is often reported to be important.

As regards the knowledge aspect, we can identify another trend. In order to be able to handle complex ICT systems, not only technical, but also practical knowledge is crucially important. The increased use of technology and a trend towards organisational integration of single functions and activities are both causing the role of human work to change. Manufacturing no longer consists of direct involvement in the production process; instead, the principal responsibilities of workers include monitoring, controlling and regulating technical processes and systems. The use of modern technology leads to uncertainties and problems that are difficult to plan or predict. In concrete situations these uncertainties cannot be solved on the basis of theoretical knowledge and a systematic way of thinking only; a kind of knowledge is needed which enables people to react immediately to new and uncertain situations. But experiential knowledge is not needed only when technological problems occur, as the following example shows.

In a machine tool company (A 7) production planning is made through PPS. However, it often happens that the managing clerk gets information from other departments that large orders are expected but not yet registered in the PPS. It needs a lot of experiences and practical knowledge to be able to include this information into the optimisation of order quantities.

Practical knowledge can be characterised in many different ways: Some people have a right feeling for a material or an ability to detect pitch changes in the sound of technical systems. Or they have the ability to make decisions without reflection or to quickly find solutions to less structured problems using their intuition and improvising skills. Furthermore, it is often important that workers are able to detect early signs of problems and in this way prevent process shutdown. In the event of an accident workers must be able to minimise the damage without time-consuming analyses of all the relevant data, and to make the right decisions. We often refer to practical knowledge as 'tacit knowledge', as this knowledge cannot be codified; instead, it must be accumulated by processes of 'learning-by-doing' or 'learning-by-using'. Personal factors, such as feeling, the capacity for anticipating and intuition, are becoming important, as people need to be able to function in uncertain and unstable situations.

Having practical knowledge also means that the workers should be able to use their competence to deal with problems in unknown situations. It does not, however, here refer to the ability of people to transfer technical knowledge they have acquired in the past directly to new situations. Instead, practical knowledge means that people have learned how to deal with the unexpected, to cope with critical situations on the basis of fragmentary information only, and to make decisions immediately. In a way, they must have learnt how to learn. Learning how to learn is the usual expression for the quality enabling individuals to transcend their current capabilities and to solve unknown problems (European Union CCAM Contract #76246).

Social skills or competencies, as our case studies show, are often seen as more important than information skills. Given the mutual dependence of workers within a work process, social skills will be increasingly required in order for them to co-operate and communicate with each other. Due to the trend towards decentralisation, workers also have to keep direct contact with members of other work groups. Trans-functional design teams also put great demands on their members. Communication between different professionals means that each group has to be able to present its needs or ideas in a form that can be understood by the others. Social competence, therefore, is often

related to the ability to take part in teamwork in such a way that all participants are satisfied and that the outcome of the group work will be seen as a collective achievement.

Another reason why social competencies or skills become important is that, together with higher levels of autonomy and the decentralisation of decision-making, workers will more often be speaking directly to suppliers and customers (Bresnahan *et al.* 1999: 16). For example, in hotels and retail stores it is very important for employees to be able to relate to customers and to deal with difficult and demanding people. Social skills include the following characteristics: flexibility in attitudes towards new tasks, autonomy in decision-making and willingness to shoulder responsibility, self-confidence in defending one's own ideas within the working group, ability to express one's own views and thoughts, tolerance of the argumentation of others, and willingness to co-operate and to support the others if necessary, as well as a willingness to search jointly for a compromise in conflict situations. This is reflected in the following two cases:

In most organisations managers emphasised the importance of employees' ability to get on with other people, and provide a quality service. Teamworking is very important in many organisations, and employees need to be able to work with colleagues on different levels and in different roles across their company. The hotel and the retail store (A 5) both stressed the importance of employees' ability to relate to customers, to deal with difficult or demanding people. Personality and social skills were valued most in the recruitment of new personal. In call centres, those on the front line also need good social skills. The market research organisation relies on professional researchers and data specialists who are not only good technically but who can also relate well to clients. It is frequently the quality of these social relationships, which lead to repeat and long-term business.

FLA10's re-conversion programme gives further insight into (evolution in) skill requirements, as it departed from a job description and list of required competencies for every vacant or newly created function. The people of the Job Centre had to compare this list to the available skills and fields of interest of the people in re-conversion. Quite logically, the concrete requirements vary from function to function. In general, though, the people from the Job Centre stressed the increased importance of social and commercial skills. As the amount of PC work has significantly increased in recent years, digital or ICT-related skills also grew in importance. However, the presence of these latter skills has never been as decisive as social skills. That is because the re-conversion has been accompanied by huge investments in whichever training was needed for the new function, also in the field of informatics. If necessary, PC training started from absolute zero. Things like ambition, motivation, willingness and potential to learn were by far more important than digital knowledge *per se*. In fact, the Job Centre selected people to be converted on the basis of 'trainability'. They did not have to be able to start in the new function immediately, but in the training sessions aimed at achieving this goal.

The capability to control oneself and to manage and cope with one's own emotions is viewed as an important part of social competencies, as organisation members have to co-operate and communicate increasingly with a variety of different people inside and outside the company. The process of informatisation, as Wouters argues, "entails an increasing demand to manage emotions in more flexible and different ways, to be able to negotiate in all kinds of situations, with all sorts of people, and to proceed through mutual consent" (1992: 241). Employees working in call centres are particularly confronted with the demand to manage emotions in more flexible and different ways, as they have to communicate with very different people of different social backgrounds, knowledge and temperaments.

Due to the flattening of hierarchies, the power to make decisions has been increasingly decentralised and more responsibility has been handed down to various levels of personnel, down to the operational level. Workers must be able to plan, organise and to some extent also control their work autonomously or together with their colleagues. They have to establish, sustain and renegotiate exchange relationships with co-operation partners both within the firm and from the outside. Furthermore, workers are becoming responsible for the quality of their work, for achieving the

agreed cost limits and for delivering their products at the agreed time. All these are tasks were earlier performed by management - planning, organising, negotiating, control and decision-making are seen as typical management functions, which means that the new forms of organisation can only function if the workers acquire the necessary managerial or executive competencies.

To this we can add the need for being able to manage information flows, which has two aspects. On the one hand, employees, in particular managers, professionals and secretarial staff, need to adopt new ways of managing and storing information at their own workplace. As modern ICTs create and provide a huge amount of data, employees need a different mindset and approach to handle information. They have to be able to differentiate between more and less relevant information. Another important management skill is to understand the role of ICT in organisations and how these can be most effectively utilised. The following example shows the increasing importance of organisational and management skills.

In a telecommunications company (FIN 2) a restructuring project was started aiming at supporting planning and creating transparency. Significant changes in the content of work and organisation are involved in the project, which basically has the core objective of realising a customer-friendly one-step/one-shop solution. It can be anticipated that besides knowledge of various processes organisational abilities, management competencies and the ability for being able to manage information flows are becoming more important.

The process of organising a business globally will call for a range of new skills, which can be classified as international skills (Dertouzos *et al.* 1994). They are not reduced to the ability to speak foreign languages only. In these international relationships, co-operation is much easier if one knows about the culture, tastes, customs, legal systems and institutions of the partner's country. Today this does not only involve the large companies: for medium-sized and sometimes even small "high-tech" companies, dealing with foreign clients or suppliers is just normal business as the globalisation of markets and international integration accelerate.

The more such aspects as quality and time gain importance as criteria in global competition, the more the success of a company depends on specific work orientations and virtues such as quality consciousness, precision and reliability. New skills required and partly lacking are not always primarily ICT-related know-how, but mainly extra-functional skills and work orientations such as accuracy, quickness, mental flexibility, etc. Another factor is immediacy: people are expected to reply directly to e-mail and fax documents. This not only creates new pressures on workers but also diminishes the time available to consult with colleagues or supervisors about the right way to respond: the knowledge must be immediately at hand.

More than the mentioned work virtues, creativity, determination and entrepreneurial spirit are becoming crucially important qualifications.²⁶ The transformation of such abstract concepts as continuous improvement or constant learning into reality very much depends on a creative workforce. Being creative means inferring a course of action from a synthesis of diverse pieces of information (Frenkel *et al.* 1993). Entrepreneurship can be characterised as the willingness to try new things and to take the risk of failure as long as high gains may be anticipated. In addition, in companies that want to take advantage of the invention potential of new ICT, new cognitive skills are called for on a standing basis. Table 5.3 gives an overview of techno-organisational restructuring measures and the related qualification needs.

²⁶ Innovativeness and creativity are sometimes viewed as very different skills.

Table 5.2: Techno-organisational restructuring and qualification needs

Qualifications	Restructuring aspect
Knowledge theoretical methodological knowledge technical (digital) knowledge practical, tacit knowledge	solving complex problems use of modern ICTs dealing with unexpected events, continuous improvement
Skills cognitive skills multi-skilling international skills social skills management skills (information management)	selecting, analysing, judging and interpreting an increasing amount of data integration of tasks, group work globalisation of markets and production direct interaction within and between work groups, customisation, direct interaction with suppliers flat hierarchies, decentralisation, increased information exchange
Work orientations and work virtues quality consciousness, reliability creativity, entrepreneurship new work virtues	quality and time as key aspects of global competition innovativeness commitment, trust

5.5 Training aspects

It is quite obvious that a great number of the above qualifications are not acquired in a formal education process separated from the production process. Instead, they have to be developed continuously in learning processes taking place within day-to-day business. By performing their tasks, workers will gain specific knowledge and skills and take on new work virtues. Social skills and competencies, tacit knowledge, quality consciousness and entrepreneurship are some examples of those qualifications that workers acquire mainly while going about their day-to-day business and co-operating with other people. These skills and qualifications are most effectively learned within the framework they are applied. Certain other qualifications, such as theoretical or abstract knowledge, technical knowledge or international skills can at least partly be taught in formal training in specialised organisations.

In the following we will analyse the training aspect by focusing on the acquisition of information skills and ICT-related training. Although often very limited, in one way or another, most companies provide some training for or assistance in working with ICTs. The concrete modelling of ICT-related training or information exchange, however, varies considerably. In many cases the instructions are given by an internal training centre, in other instances, external instructors are hired in from outside to give a training session. Employees can also be sent out to follow a specific course, organised by the ICT supplier, for example.

Formal training is offered mainly when major changes, such as the introduction of a new ICT system or of new software which affect the work of a greater number of employees, occur. In such cases formal training generally takes place before the new system is introduced to avoid serious interruptions of the production process. If individuals get formal training, they often become responsible for identifying the specific skill deficits and the training they need to overcome the

deficits. The tendency to make workers responsible for the needed know-how themselves is due to the fact that the dynamic technological change and rapidly changing market conditions make it ever more difficult for companies, particularly in the IT branch, but also for ICT users, to estimate future qualifications requirements for different groups of employees.

There are, however, also companies that assess the training needs of their staff on a more regular basis. Employees are invited to discuss with their superior about their skill needs as part of their long-term career planning. In addition, more and more employees expect to be trained and will leave if they feel that necessary and relevant training is not provided. There is some evidence that access to training is at least in partly related to the attitudes and desires of individual employees. Those employees prepared to push hardest and ask most are likely to gain most or broader training. This is of course easier for employees in a strong labour market position, that is, in professional and skilled jobs.

Besides off-the-job training sessions, most learning is actually taking place on the job. Minor changes in the ICT system or software are usually accompanied by only a brief instruction or information session. To be able to use the changed system effectively, workers have to practice on their own and to get support from more experienced colleagues. This means that compared to classroom training, on-the-job learning through using things is becoming more important. And, in particular, ICT-users rely on social networks of mutual support to cope with technological change, stressing the importance of learning by monitoring others and learning by interacting.

There are often some unofficial specialists for ICT or for particular software among the users. This is very important in the smaller companies under study, because they rarely have at their disposal well-elaborated official channels for solving IT - related problems. But it is more generally the official and unofficial 'key users' or 'user specialists' that play an important role. Social and spatial proximities seem to be important prerequisites for effective support, but also the telephone is used to get help. In the larger companies users can often rely upon an IT helpdesk or helpline in case of emerging problems. However, also here unofficial help from proximate colleagues or friends is tried out first.

FLA2 also provides training in the field of ICTs. This training is organised per target group, starting from specific needs. Certainly for white-collar employees, there has been a significant number of training sessions (e.g., courses on E-mail, Office, Windows or more technical packages such as Lotus Notes, Robcat...), but FLA2 feels the need to bring more PC knowledge to the work floor as well. At the time the interviews were conducted, ICT courses were organised for all team leaders. Also team members can be given ICT training, but this does not happen on a structured basis, mainly because not all team members have to be able to work on a PC. In every team there are some workers who know how to handle a PC, and these persons can take care of the team activities for which PC knowledge is required. Furthermore, the team members learn very much from each other: the team leader and the 'PC freaks' of the team are supposed to share their knowledge with the others. FLA2 prefers this 'learning in a team' rather than obliging everybody to follow certain training sessions.

ICT also impacts on the delivery of training. Many employers utilise ICT to deliver training, through the provision of open learning centres/resource centres or computer packages, for example, which personnel can work through in their own free time. There has also been a growth in distance learning and experimentation, with the delivery of learning resources to people who are unable to attend classes regularly, or who want to learn in their own free time.

Quite recently FLA3 installed an open learning centre (OLC), in which employees can take self-directing courses and learn interactively on a PC (e.g., a language course). The OLC is accessible for everybody (also blue-collar workers), but not during working hours. Although still in its infancy, the OLC allows employees to invest in themselves, thereby increasing their employability. FLA5 is also exploring the possibility of using ICTs for giving other training courses, training sessions on CD-Rom or the Intranet, for example. The company foresees most benefits in the call centre activities. Since the flow of calls into the system fluctuates, operators could use a free period to train themselves further on a PC, without having to leave the workplace.

From what has been said so far we can conclude that it has become useful to replace the concept of further training with the concept of continuous learning. This has several implications:

- (1) Using the concept of continuous learning means that the process of acquiring new qualifications is seen as an ongoing, lifelong process.
- (2) This also means that acquiring new skills and knowledge is not seen as something very exceptional, but as something very natural, taking place everywhere and all the time instead.
- (3) The concept of continuous learning points to the impossibility of 'completing' the qualification process. Social skills or entrepreneurship, for example, cannot be acquired once and for all; they have to be updated and improved continuously through the learning of new things.
- (4) Last but not least, the learning concept points to the importance of the production process for improving human capital. Only if the production process is designed in such a way that it allows learning can the workers improve skills, knowledge and competencies and acquire new work virtues and orientations.

5.6 Conclusion

The emerging information economy seems to support a trend towards up-skilling to some extent. However, this cannot be related only to the introduction of modern ICTs. One also has to highlight the central role of IT-enabled organisational change in a cluster of complementary and mutually reinforcing innovations in order to understand shifts in skill demands. Still the increasing use of modern ICT also allows the creation of more simple tasks and jobs, for which low-skilled employees can be hired. But we cannot only point to the various trends towards up- or down-skilling; we also have to analyse what new kinds of skills, competencies, knowledge, and work virtues become important in the emerging information economy.

While it is obvious that demand for information skills is increasing due to the widespread use of modern ICT, it does not seem to be the most urgent demand. It is not the technology in the first place that causes new skills and competencies to emerge, but organisational restructuring, which influences skill demands. In this respect, the fact that new network forms of organising work become more important must be seen as the driving force behind new skill demands. Therefore, companies primarily stress increasing demand for social skills.

Changing skill needs also impact on the training aspect. The company is becoming an important place for promoting human capital and acquiring new skills, knowledge, competencies, work attitudes and work virtues. But the need for new impulses coming from formal training in specialised institutions still exists. What is needed is a diversity of learning places with different focal points. In addition, the process of acquiring new qualifications must be seen as an ongoing, lifelong process.

6. SOCIAL EXCLUSION RISKS IN THE INFORMATION ECONOMY

There is increasing concern over the negative employment impact and increasing social exclusion risks caused by the information society (Soete 1996, Schienstock 2001). In the following we discuss the risks of becoming socially excluded in relation to techno-organisational changes in the work environment. Our argument is that not only the risks of social exclusion originate to a great extent within companies, but also opportunities for social inclusion.

We want to emphasise again the very restricted character of the concept of social exclusion/inclusion in the project. The analysis is strictly limited to the sphere of work, thereby focusing on the first stages of the social exclusion process - or last stages of the social inclusion process - only. Consequently we cannot say anything about social exclusion/inclusion as such, but only about the starting points for possible processes of social exclusion and about social inclusion opportunities created by the emerging new technological practices within companies.

In the following we first discuss whether particular groups, among them older people who have difficulties in coping with modern ICTs, are at risk of becoming excluded. We then deal with the argument that modern ICT by supporting employment flexibility will cause exclusion risks. Next we discuss organisational restructuring measures as possible risk factors. Finally we focus on the employment aspects of information society. Particular attention is given to long-term unemployment.

6.1. Skill deficits and social exclusion risks

The 'skill-biased technical change' concept argues that the dynamic technological change will lead to rapid outdated of existing qualifications. Although this is not only a technological phenomenon, but also a problem related to ICT-based organisational restructuring, it might cause increasing problems for those groups of employees whose qualifications are becoming outdated and who have difficulties in ICT-related training sessions and in coping with ICTs. These employees might be at risk of becoming excluded from work and the labour market. Rapid technical progress and associated organisational changes often requires of workers preparedness to become involved in continuous learning processes. There is always a period of adaptation as every change in the software brings along new changes in the way of working. Many workers are confronted with new tasks and problems and they have to develop new skills and competencies more frequently than before. As companies have shorter time horizons and old knowledge and experience is becoming less valuable, learning new skills and, even more, learning how to learn, is becoming more critical (Thurow 1999: 145). It is assumed that slow learners, and among them the unskilled, handicapped and elderly in particular, will have difficulties in preparing themselves all the time for new tasks and problems; continuous learning may be beyond their capacity. Being under pressure to innovate more often, companies may select only rapid learners while dismissing slow learners (Lundvall and Borrás 1997).

On the basis of our case studies we can draw the conclusion that there are differences particularly between younger and older workers in their capacities to work with ICTs and to cope with new technologies and related organisational changes. Older people have significantly more problems with the PC than younger people. They ask for help more frequently than others, and also limit themselves to the less advanced ICT applications. As older people have never worked with PCs at school or elsewhere, they lack the natural basis younger people have and it is not evident at all that older people can catch up. On the other hand, the observation that older people and also women returners have more difficulties than their younger colleagues should certainly not be exaggerated or dramatised. Often the people in question just need some more information and guiding and eventually an extra training session, as in many cases there is only a need for basic

digital skills; in the end, most of the older people manage working with ICTs fairly well. In addition, senior staff have long-term work experiences and this is often more important than digital skills.

Of course, age is not the only parameter determining the ability to cope with modern ICTs. Willingness to be trained, motivation and a general mentality towards new technologies are at least as important. These aspects can easily compensate for a higher age; motivated older people with the right mentality and necessary learning potential stand a fair chance of coping well enough with ICTs. The overall consensus is that given the right attitudes, older people and women returning to work can easily be trained in the necessary technical skills.

Employees learning potential and their general capacity to cope with new ICTs will quite logically be influenced by the educational background of the people in question. In many cases, the oldest people were simultaneously the least educated ones. Older people with low educational backgrounds and lacking a strong motivation and general interest in ICTs are least likely to master the new technologies well. The question is then whether these people really need advanced digital skills in order to carry out their functions properly. Furthermore, what do companies tend to do with people lacking the required ICT-related skills: are they still given a place in the company or are they at risk of becoming excluded?

The exclusion of older people appears to be a real risk, as more than 40% of the survey respondents agreed with the statement: 'ICTs threaten the jobs of older workers'. On the other hand, direct exclusion because of a lack of ICT-related skills seems to take place rather seldom. If companies dispose of people really not being able to cope with ICTs, they are often given work involving no contact with ICTs.

Our case studies reveal that if employment security is affected by a lack of skills, the situation usually relates to other factors than ICT. The case studies also show that people lacking digital skills can sometimes be deprived of the most interesting jobs in their units. Although the introduction of ICTs rarely results in direct social exclusion, it can bring along or enhance a kind of social polarisation or differentiation in the workforce, that is, between the employees having digital skills and those lacking these skills. The introduction of ICTs and related organisational change, we can conclude, have made older and/or less educated workers more exposed to greater occupational vulnerability.

Freeman and Soete (1994) reject the notion of skill-biased technological change as being too simple. Modern ICTs, the authors argue, have much more contradictory consequences. According to them, the substantial growth and employment potential of networking is typical of the most recent set of ICTs. "At the same time not being linked up to information networks necessarily implies being locked out of the efficiency gains associated with the use of ICTs. Moreover, it implies being prevented from participating in the learning activities associated with new and more efficient uses of IT" (Freeman and Soete 1994). Lash argues in a similar way, speaking about 'reflexivity winners' and 'reflexivity losers'. "Life chances in reflexive modernity are a question of access not to productive capital or production structures but instead of access to and place in the new information and communication structures" (Lash 1994).

In general our empirical findings support this argument. Those people not involved in information networks do not have the opportunity to acquire any new digital skills or practice their existing ones. But even more important is that they do not have access to knowledge-based information that is needed to participate in innovation processes and thereby to improve their own knowledge and competencies. On the other hand, being linked up to information networks does not always provide major learning opportunities, as this is very much dependent on the position and function people hold within companies' information networks.

6.2 Flexible work and social exclusion risks

Another phenomenon often associated with the emerging information economy is a fundamental transformation of work regulations: the individualisation of work in the labour process. The traditional form of work based on full-time employment, a career pattern over the life cycle, clearly defined work tasks, standardised working hours, a collectively agreed wage and a fixed workplace is shrinking. Instead, new forms of flexible work are becoming more and more common. The most important dimensions of flexible work are (Castells 2000):

- working hours: deviations from the standard full-time job are no longer exceptional cases;
- working tasks: work is no longer limited to a specific number of predefined tasks; instead, work is increasingly very generally predescribed, allowing a very broad deployment;
- location: workers do not have a fixed workplace; in project work, for example, they increasingly change workplaces; and
- job stability: work is increasingly organised in projects, which does not include a commitment to further employment.

Flexibilisation of working hours and job insecurity have become a widespread phenomenon which is indicated by the fact that the fastest-growing categories of work are temporary labour and part-time work. For example, school leavers starting their working life have increasing difficulties in getting a full-time job. Also, self-employment is becoming a substantial component of the labour force.

Our future society is often described as being highly segmented because various groups of workers are affected differently by the individualisation and flexibilisation of work (Atkinson 1984). We can expect, it is argued, that only a small group of core workers will have a secure work status and contracts of indefinite duration. Core workers are those whose skills are most essential to the main activities of the company but who have to accept 'functional flexibility'.

There is also another form of flexibility, often known as 'numerical flexibility' (OECD 1998). It takes the form of varying the size of the workforce in response to changing requirements, whether these involve seasonal fluctuations, responses to changes in customer demand, or market changes. Making use of numerical flexibility depends upon the existence of workers referred to as 'periphery workers'. They conduct those activities that which are less critical to the company's core activities and are hired on employment contracts (part-time, temporary contracts); we can speak of temporal flexibility. Many of these forms of flexible working involve the employment of women (Huws *et al.* 1989).

The third group comprises external workers distanced from the enterprise; they are generally service suppliers, subcontractors or self-employed workers. These workers are no longer employed by a company anymore, but their employment contract is substituted by a commercial contract. External workers do not have conventional career prospects or employment security. It is also likely that their employment status will change very often, besides working as an independent entrepreneur on a commercial contract in an advisory post, they may be employed on the basis of a short-term conventional labour contract, or they may become unemployed for some time. When companies work with external workers, we can speak of contractual flexibility.

In many companies that participated in our companies survey the degree of using labour flexibilisation strategies - either temporal, contractual or functional - increased in the last five years. In the mainstream literature these increasing levels are often associated with the broad diffusion of modern ICTs. Our case studies provide some support to the hypothesis that there is a direct relationship between ICTs, on the one hand, and companies' use of flexibilisation strategies on the

other. This is in line with the fact that 60% of all respondents in the company survey agreed with the statement that ICTs increase the need for flexible working practices and labour contracts.

In general small companies rely more often on contractual flexibility by using external labour. Larger companies, on the other hand, are more frequently looking for internal solutions to satisfy their flexibility needs by introducing functional and temporal flexibility. Some companies rely on temporal flexibility because they do not know whether the growth of turnover is going to be temporal or structural. Other companies have become more prudent in handing out contracts of unlimited duration after having experienced a downsizing operation. Because of an employment security policy companies are careful not to expend their core workforce.

The empirical material of the project does not provide so much support to the 'independence from place and time' thesis. Spatial flexibility can be found rather seldom. On the contrary, the majority of jobs are firmly anchored to a given spot. This is not only the case for production activities, that is, the handling of material commodities. But the overwhelming majority of information processing activities is also still taking place at the office and during fixed hours. In discussions on introducing telework which are taking place in some of the case companies, many barriers have come to the surface.

The thesis of a rapidly shrinking group of core workers is not supported by our research either. However, elderly managers and specialists who have been employed for a long time in 'normal', that is to say, non-precarious, conditions are now faced with increasing job insecurity and may also be at risk of being made redundant (Yépez del Castillo 1994: 619-620). This is because the introduction of new organisational forms is often associated with the destabilisation of bureaucratic career structures enjoyed by a large proportion of managerial and professional staff. And together with limited company-defined careers, extensive further training is often reduced (Thurow 1999: 143). Consequently fewer of those in managerial and professional occupations can now be guaranteed lifelong employment and continuous career advancement. With the demise of the bureaucratic business structure, these worker groups have to accept flexible careers (Brown and Scase 1994); an inevitable feature of 'flexible career' patterns is that they are inherently insecure (Brown 1995: 36).

There is also some evidence of greater flexibility in the hours worked by core workers as the following example shows.

Flexitime has increased quite substantially in the events-managing company (LON 7) as the company promotes a flexible working culture. This goes hand in hand with a culture of trust; employees are trusted that they will put in the necessary hours to complete the work. There is also an element of give and take. Employees are expected to work extremely long hours, often well into the night, if a certain project requires it. It is then perfectly acceptable to take time off *in lieu*. Employers and employees obviously agreed to become more aware of the need for a balance between work and other areas of life.

Furthermore, core workers are required to accept 'functional flexibility' (Beatson 1995), which concerns the employer's ability to vary the allocation of work within the organisation so that changes in their jobs can easily be made when required. Functional flexibility is mainly associated with the introduction of group work. It can be stimulated by means of ICTs: shared information systems, commonly accessible disk drives and standardised software packages, for example, can make task demarcations less strict and boundaries between functions more fluid. This can allow using labour for a wider variety of different tasks. In a way, ICT can stimulate an evolution towards multi-skilling, which is a necessary precondition for making strategic use of functional flexibility. But it is not clear from the company survey whether or not ICTs play a role in the debate about multi-skilling and functional flexibility. Besides, functional flexibility is not directly linked to social exclusion risks. We can argue, however, that functional flexibility can reduce labour demand and may therefore reduce inclusion opportunities.

It may not always be the case that companies extend temporal flexibility. There is some evidence that under specific circumstances companies are moving away from the use of temporal

flexibility, as they become aware of the fact that a more stable, permanent workforce would improve efficiency and innovativeness.

The food manufacturer (LON 5) used to make considerable use of temporary labour, usually through agencies, to cover peaks in workloads and to support permanent staff. This was declining – temps often do not have the necessary skills/knowledge, they slow down production and make mistakes. This was not considered to be a particular problem when the company was ahead of the competition. However, as other companies have entered this niche market and their market share has declined, attention has been paid to making the operation more productive. The use of temps has been reduced through better planning of shift working and more training (so that permanent employees are more flexible and effective).

The literature often links the ICT revolution to ongoing labour casualisation strategies. It is argued that teleworkers are often hired on a commercial contract for a limited time for specific tasks and that they tend to face a rather insecure job and income situation (Huws *et al.* 1996). ICTs clearly impact co-ordination and facilitate communication with external contractors, called upon when necessary. However, ICTs rarely play a more determining role than that. And according to our company survey, as mentioned earlier, telehomeworkers are mainly male, young, highly qualified, permanently employed by a company and working full-time; not a group that one would call weak in the labour market or threatened by the risk of social exclusion. The same goes for IT professionals increasingly delivering their services on a freelance basis. We can conclude that companies, contrary to what is assumed in the literature, seldom pursue a massive labour casualisation strategy when they start using modern ICT intensively.

Based on our empirical findings, we have to be careful not to automatically associate flexible work with growing exclusion risks. Whether flexible workers are actually exposed to significant labour market problems and exclusion risks cannot easily be determined. For example, workers often choose part-time work themselves and seldom face major labour market problems, because this work form is accepted and increasingly considered to be normal and is therefore no longer seen as an exceptional employment contract.

Those working on a commercial contract not covered by collective agreements may experience more serious social disadvantages. They may well find themselves outside the remit of social protection regulations, precarious, poorly paid and socially marginalised. As they do not have their own clients, they are very dependent on the work given by the company they are working for.

However, our traditional view of the market position of core, peripheral and outside workers does not seem to hold true any longer. Obviously, the new vulnerability of labour under conditions of increased flexibility does not concern only less skilled or unskilled workers. We can see some new risk groups developing, such as parts of middle management, foremen or some specialist groups which were for a long time seen as core workers sheltered by ‘internal labour markets’. Evidently for some groups of employees, formerly conceived of as core workers, these internal labour markets are slowly disappearing. Castells points to the fact that nowadays the working life period in which professionals are recruited to the core of the enterprise is shrinking. The jobs of the employees over 50 years of age are the first in line for any potential downsizing (1997: 276f). Based on the case studies, we can conclude, that in many companies the great majority of core workers are still sheltered by internal labour markets.

On the other hand, we can no longer equate peripheral or external workers with those who are in a weak market position. Among them we can identify at least two groups: low-skilled workers performing routine jobs (data processing) with very flexible employment contracts and highly qualified part-time and self-employed specialists. Many self-employed experts actually are in a very strong position, drawing on their extensive networks and renewed knowledge to ensure effectiveness (Robins and Webster 1997: 9). They often work in temporary groups on a project basis. As soon as a project has been completed, the group dissolves and its members start to work in another group, often with different partners (Schienstock 2001). Because they have many connections, these

'networked people' can easily mobilise all the knowledge needed to solve complex problems. Our case studies also support the argument that while a core labour force is still the norm in most companies, subcontracting and consulting are growing forms of obtaining professional work (Castells 1997).

Self-employment has no doubt some advantages, such as independence and taking more responsibility. But not all people concerned have chosen 'self-employment' voluntarily. They are often forced to accept this new form of employment as the result of companies' outsourcing strategies. That is when we can speak of the 'fictitious self-employed'. Although they have the status of independent employers, economically they are not independent because they actually work as employees dependent on decisions taken by the management of the core company. The fact that normally employed workers are replaced by the 'fictitious self-employed' may become a major problem in future, as the latter are not covered by the protection mechanisms of labour and social laws (Enquete Kommission 1998: 130). Then labour is losing institutional protection and becomes increasingly dependent on individual bargaining conditions in a constantly changing labour market. Should this process of forced self-employment continue and accelerate, we can definitely speak about new social exclusion risks.

6.3 Automation, outsourcing and downsizing as risk factors of social exclusion

Because we did not find so much evidence of ICTs directly resulting in social exclusion, we explored the relationship with intermediate factors containing some inherent risks. We first examine the impact of automation processes enabled by modern ICT on social exclusion risks. We then analyse the extent to which new organisational forms such as outsourcing and downsizing produce exclusion problems. Although the development of these new organisational forms are not caused by modern ICTs, they can nevertheless be seen as an enabling factor.

6.3.1 ICT and automation

In the case studies we came across some examples of ICTs bringing along rationalisation or automation. The most tangible examples could be found in blue-collar jobs. Automation in sectors such as automobile assembly or chemicals is of course far from new, not initiated at all by modern ICTs. These technologies that are used as an automation device seldom caused major exclusion problems, which can be explained partly by the development of new organisational strategies. For example, companies hardly employed data-input typists; other clerical workers carried out the entry, even of large amounts of data as part of their job.

However, ICTs can facilitate and accelerate the process of automation. For example, the copying and binding work can disappear, reducing the time that is needed to carry out specific tasks. However, this and other similar rationalisation effects do not pose a threat to the employment of individuals, even if they were not properly qualified. This means that significant increases in productivity do not necessarily imply major exclusion risks. In most cases the workforce remains stable, while the output often increases significantly compared to the old one. In white-collar jobs we cannot speak of a one-shot, very visible automation operation, but the ongoing penetration and improvement of ICTs can result in a more latent increase in efficiency, and often in imperceptible automation of previously human activities. In this respect, the aspect of self-servicing is interesting, as the following case demonstrates.

As part of its rationalisation strategy a call centre (A 9) reduced the number of inbound calls by offering customers Internet applications for the entry of orders. In some cases the number of calls is already going down as a result of data input by customers and of the customers tracking their consignments themselves using WWW applications. In this case increased volumes are actually being handled by the same workforce.

As to the consequences in the field of employment, we have to make a distinction between automation causing direct redundancies versus automation preventing/reducing additional job creation. Whereas the former could bring about social exclusion risks, the latter is more an example of the reduced social inclusion possibilities. Immediate rationalisation effects, in the sense that particular jobs disappear because of ICT-driven automation, have rarely been observed.

6.3.2 Externalisation and downsizing

ICTs, as our case studies demonstrate, do not play a crucial role in the decision-making process about externalisation strategies such as outsourcing or geographic relocalisation, but they do support the process, because they facilitate communication and information exchange between companies. ICTs are often a necessary, although not a sufficient, condition for companies to engage in externalisation. The automobile industry could serve as an example here. In this branch, outsourcing is going hand in hand with sequential JIT supply and this supply is extremely ICT-intensive. ICTs make further outsourcing possible, with inherent risks in the field of employment.

Companies which aim at dealing with the employment effects of externalisation do this often in a socially acceptable way, for example, by assigning the affected workers other jobs. Of course all depends on the economic situation of the particular companies. Growth in turnover obviously facilitates the internal transfer of employees, but in times of an economic crisis it is much more difficult to guarantee employment security after externalisation. In such situations companies tend to apply (early) retirement schemes or they do not prolong contracts of limited duration. In brief, although externalisation rarely results in crude dismissals in the companies under study, it has always been and remains a very delicate problem containing inherent exclusion risks. But outsourcing, as the following case shows, may actually have positive employment effects.

An electronic company in Niederösterreich moved large parts of its production to the Czech Republic, while other functions including some production were kept in Niederösterreich. It could be argued that at first sight this outsourcing has caused major exclusion problems. However, management maintained that only the competitive advantage stemming from the utilisation of low wage costs in the Czech Republic has allowed for the rapid expansion of production. As a consequence, the relocation can be said to have created jobs not only abroad, but also in Niederösterreich. It has to be noted, however, that the reduction of production in Niederösterreich reduced the number of jobs for semi-skilled female blue-collar workers, while the new jobs on the site are for skilled, mainly male engineers.

The re-absorption of displaced employees within a company depends upon the nature and location of the lost jobs. Especially when activities are relocated in some distance from the original location, the scope for the original jobholders to be re-employed is limited. Where roles are subcontracted but still needed, employees often move to the sub-contractor. This often has negative implications for the terms and conditions of their new employment. However, we also came across cases in which the outsourcing company did influence some terms and conditions of re-employment.

The most striking risks in the field of employment, and eventually in social exclusion, are likely to come from the execution of a large-scale downsizing operation. Of the companies participating in the survey, 14% reduced their overall employee numbers in 1995-1999 significantly. Furthermore, some case study companies experienced a major setback in employment in the course of the nineties. But according to the survey results, only 25% of the companies having experienced downsizing considered the application of modern ICTs to be an important influencing factor. ICTs seem to hardly impact directly on the decision to engage in downsizing. According to the survey, the general economic situation and pressure of competition are by far more important than ICTs *per se*. On the other hand, some aspects of that competition are clearly ICT-related and therefore the organisations' responses can be ICT-dependent as well.

6.4 Employment aspects of the information economy

Employment is one of the key aspects in the information society discourse. However, it is quite clear that all anticipations are based on a great amount of uncertainty. It is extremely difficult to calculate the impact of the emerging information society on employment. Difficulties in anticipating employment effects associated with the emerging information society result from the complexity of the subject. The debate on this question has raged over the last two decades and, although particularly during the 1980s many studies on different countries and industries were made, they have far from generated a clear-cut answer (Castells 1997: 252ff). Kaplinsky (1986: 153) points to the fact that the findings differ according to the level of analysis.

Here we will restrict ourselves to the problem of ICT-related job creation and job destruction within individual companies. As argued earlier, ICTs are unique insofar as they affect every function within companies. They not only contribute to the creation of new products and processes, but they also automate production processes; this means that they both create and destroy jobs (Bessant 1989: 27-30). The general argument that the use of ICTs reduces employment is too simple. Of course, the fact that ICTs contribute to automation and therefore to the replacement of employment cannot be denied. But we have to take into account that the use of ICTs can increase productivity, reduce costs and improve competitiveness. This may open up new markets and increase output. Furthermore, the use of modern ICTs may increase information and knowledge exchange and thereby improve innovativeness and the development of new products. To assess the employment effects of modern ICTs in a sophisticated way, we have to take into account both job destruction and job creation.

Notwithstanding the reservation that ICT-related employment anticipations are based on a high degree of uncertainty, we wanted to contribute to the debate. Among others, the survey respondents were asked to judge the following statement: 'ICTs create more jobs than they destroy'. The majority of respondents disagree with this statement. On the other hand, only about 40% of the managers are convinced that ICTs have a positive overall effect on employment. Although these are only managerial perceptions of reality, they warn us of a too rosy perspective on employment in the information economy.

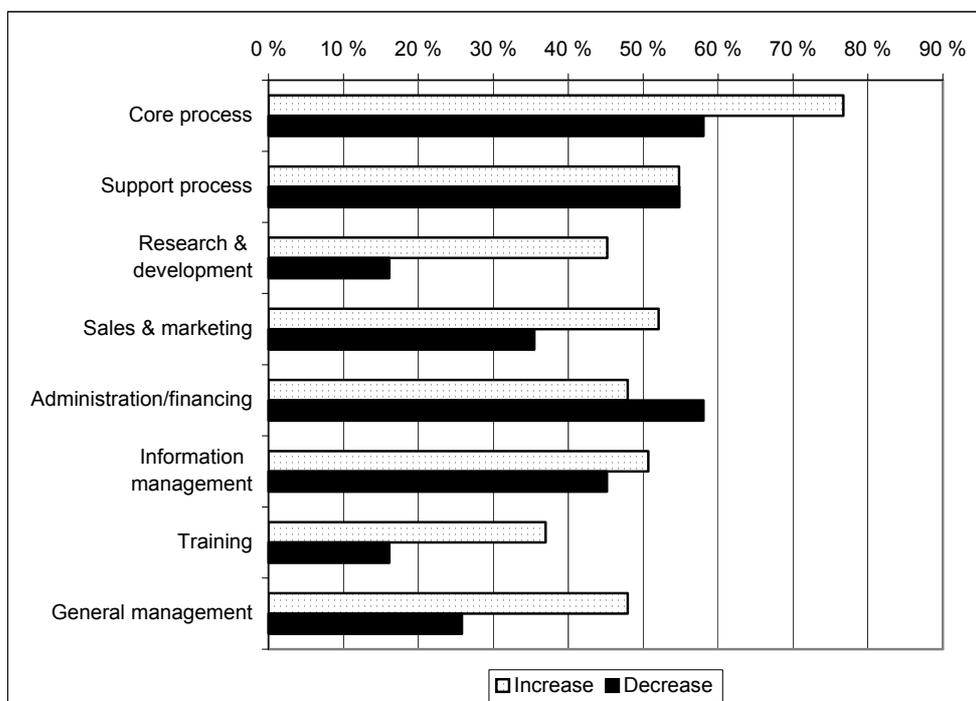
If not resulting in net positive employment effects, ICTs can still create social inclusion possibilities for specific target groups. A great majority of managers in the participating regions are convinced that ICTs increase disabled people's access to employment. Their opinion may be influenced by the fact that telehomework is becoming more common, which may give disabled people a better chance to get jobs. ICTs could also increase job opportunities for women. Working from a distance by means of ICT applications, as often argued, can facilitate the balancing of work - family relationships and this could result in higher female participation in economic life. Approximately 40% of the survey respondents agree with the statement that work is becoming more family-friendly due to ICTs and that ICTs offer more job opportunities for women. Besides in the survey, we have also been looking for ICT-related inclusion possibilities in the case studies. In general we found little evidence of ICTs contributing to the inclusion of disabled people or actively stimulating female labour market participation.

In a way serious investing in upgrading the workforce instead of hiring better-educated employees can be considered to be an example of actively preventing exposure to exclusion risks or promoting inclusion possibilities.

TELEPHONE (FLA 2) worked out an entire training scheme in which regular employees in re-conversion could be retrained to become full computer experts. The retraining took place on a full-time basis and lasted for three months. TELEPHONE took care of all costs. There were absolutely no pre-requirements in the field of educational background or PC knowledge. If necessary, the PC training started from absolute zero. However, the Job Centre did test the candidates' assimilation potential and learning capabilities. The initiative was far from successful: the retraining possibility was offered to approximately 300 employees in re-conversion. Sixty accepted the offer, but only five of them passed the selection tests. In the end, only three employees started - and also finished - the training to become a computer expert. Although this number is much smaller than initially hoped for, it shows that TELEPHONE is willing to invest a lot of money in upgrading its relatively low-educated workforce, also in the field of ICTs.

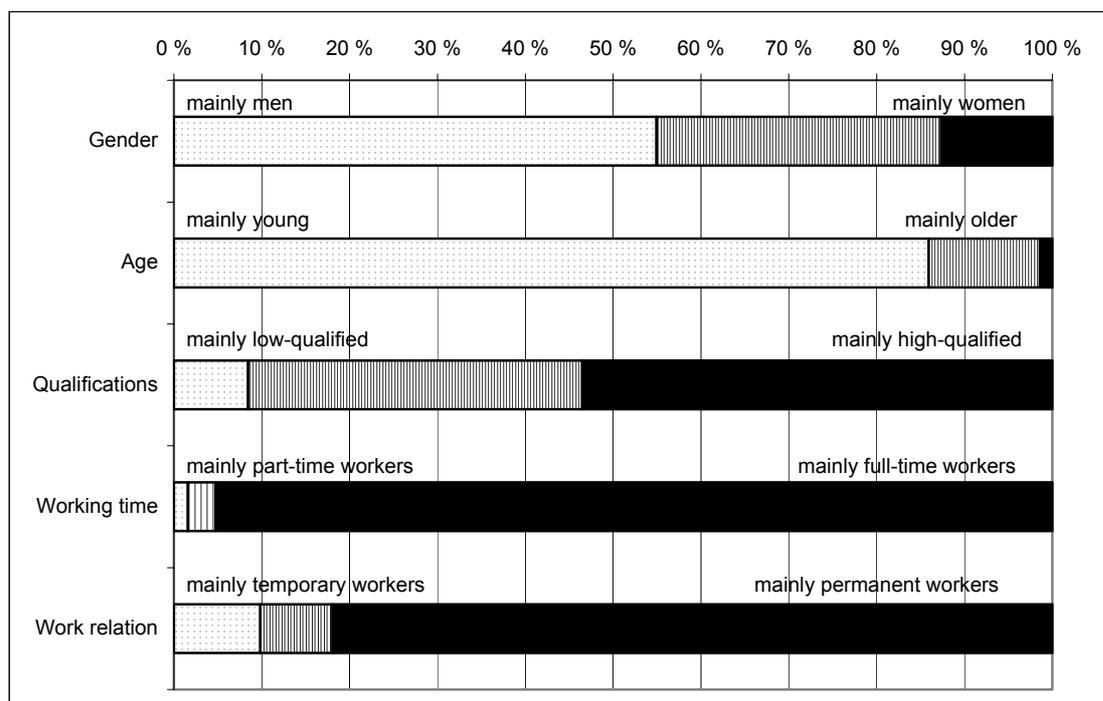
We have further analysed employment effects by asking companies about ICT-related job creation and job distribution. Companies that relate employment changes to the application of modern ICTs see their core processes particularly affected. Nearly 80% of them associate the increase in employment and about 60% associate the decrease in employment in core processes with the application of ICT. In this group, at least every second company also associates the increase in employment in support processes, in sales and marketing and in information management, and the decrease in employment in support processes and administration/finance with the use of ICT. The decrease in employment in support processes and in administration/finance is more often associated with ICTs than the increase in employment in these areas. Concerning all other functions, the use of ICTs is more often rather associated with the growth than with the decline of employment. Particularly, declining employment in training as well as research and development is hardly associated at all with the application of modern ICTs.

Figure 6.1: ICT-related employment change in different departments or functions



Then comes up the following question: which groups in the workforce are most affected by the employment changes? Among those companies relating changes in employment to the use of modern ICT, the majority sees mainly male workers as affected. This relates to both the increase and decrease in employment. Concerning age, the majority of the companies associate the increase in employment with younger workers and the decrease in employment with other workers. The number of highly qualified workers was seldom reduced in these companies and over half of the companies having increased employment had hired especially highly qualified workers. The increase and decrease in employment has more often affected permanent and full-time workers than temporary and part-time workers.

Figure 6.2: ICT-related employment growth by types of affected workers



6.5 Long-term unemployment

Although we have focused on the first stage of the social exclusion process, we can indirectly draw some conclusions concerning stages of unemployment. Restructuring strategies, caused by global competition, have contributed to the increase in unemployment that has taken place in many industrial countries in recent years. What is particularly striking is the growing structuration of unemployment. It is the increasing and long-lasting nature of the phenomenon that causes severe problems, since the share of the long-term unemployed among people without a job has been growing continuously in recent years.

The proliferation of unstable forms of employment is an important factor that causes long-term unemployment (Salais 1980). In a situation of decreasing labour demand, it becomes more and more difficult for the unemployed to find normal, non-precarious employment. Therefore, newly unemployed are often moving constantly from one insecure and unskilled job to another, while young and highly qualified people are the beneficiaries of newly created, more demanding jobs. Even a great number of the newly created jobs, however, are based on atypical work contracts.

For those who are unemployed, the risk of becoming long-term unemployed and finally totally excluded from the labour market increases exponentially with the length of unemployment – unless gaining skills in other ways, through voluntary work, for example. "This dual trend – precarious employment and recruitment of over-qualified workers – continuously pushes to the back of the queue those among the unemployed who are considered to be the least productive" (Yépez del Castillo 1994: 620). Women, unskilled workers and people over the age of 50 are the groups that are most at risk of becoming long-term unemployed.

The mirror manufacturer (LON 5) was finding it increasingly difficult to find good staff. The expansion of the company and increased automation and I, means that employees are expected to be more flexible, willing and intelligent. Those groups perceived as having problems, such as the long-term unemployed, are not even considered and would not be invited for an interview. This was felt to be 'common sense', as those that had been out of the labour market for a long time for no acceptable reason were probably bone idle.

For skilled people, inclusion is often only possible if they accept less attractive jobs. Unemployed bank employees, for example, can find a job in call centres. Members of middle management, especially older people, have difficulties in finding similar employment, but there are opportunities in less skilled work, for example, on the shop floor. Some employers argue that it is not the question of whether a person is unemployed, but the previous experiences (work and otherwise) and the attitude at the interview that are important. This applies to jobs which do not require a high level of skills and which involve minimal or straightforward use of technologies. The longer workers are out of employment - unless gaining skills in other ways, through voluntary work, for example - the harder they will find it to demonstrate or provide evidence of an ability to adapt to change and new ways of working.

6.6 Conclusion

A major part of this report has been devoted to the question whether ICTs bring along or contribute to new forms of social exclusion risks. The answer to this question is fairly unclear. On the one hand, we found very few examples of direct social exclusion risks because of the introduction and increased use of ICTs. On the other hand, ICTs can indirectly support organisational change processes containing inherent risks in the field of employment security, such as outsourcing and further rationalisation of the business process. However, the influence of ICTs on these change processes is often very limited. Economic and strategic considerations tend to play a predominant role. Furthermore, outsourcing and automation are certainly not the only factors bearing the seed of social exclusion risks. In many cases, non-ICT-related factors such as temporary hiring appear to be at least as important. The elaboration of downsizing and ICTs also underlined the impact of the pressure of competition and the general economic climate. We finally want to mention that ICTs can sometimes open up new social inclusion possibilities by employment creation in general or by targeting specific risks group in the labour market (e.g., disabled people).

Although anticipating the employment changes related to ICT applications and associated organisational restructuring practices is very difficult, we have attempted to contribute to this debate. Companies associate employment changes particularly in core production processes quite often with the introduction of ICT. Furthermore, mainly highly qualified young men with full-time employment and permanent work contracts are seen as gaining most from ICT-based employment growth.

On the basis of the empirical research we can conclude that the tendencies prevailing in the mainstream literature should be taken with a grain of salt. Organisations are not changing as rapidly as proclaimed by trendwatchers and ICTs are not always playing such a crucial role in the change process. But the fact that techno-organisational restructuring is more an emergent than a completed process is no reason at all to wave aside or postpone the debate on its social consequences.

7. TECHNOLOGICAL PRACTICES IN THE INFORMATION SOCIETY AND THE SPATIAL DIMENSION

Having discussed some major trends in the adaptation of companies' strategic goals, the application of modern ICT, organisational restructuring and cultural renewal, skill demands, and social exclusion risks separately, we now come back to the concept of technological practice. We analyse how various technical practices are linked to each other and whether particular configurations among these variables emerge. Of particular interest is whether and to what extent the emerging technological practices are influenced by the network concept.

We also discuss the question whether a common European model of the information economy is emerging or whether different territories follow different paths into information economy. Our approach is limited insofar as we concentrated on ICT-based restructuring patterns of production processes, while other scholars who analyse the information economy focus more on shifts in industrial structures. Our approach, as mentioned earlier, is based on the assumption that the emerging information economy is more associated with changes in the production model and less with new emerging industries. To give a more complex picture, we would need to combine the two aspects.

7.1 The network hypothesis

We have argued above that globalisation is about to change the rules of the competition game. The capacity to be first on the market with new products is increasingly becoming the main competition criterion. It is further assumed that together with the emerging new competition criterion and the availability of modern ICTs fundamental changes in the organisation of companies will take place. The new organisation model is characterised as the network organisation. Although we do not interpret modern ICT as the causing factor of change, we nevertheless assume that modern technology has an important role to play in the change process, mainly as an enabling and supporting factor. Our hypothesis is that the new emerging technological practices can be characterised by the application of network technology, decentralised and integrated organisation forms, innovation as the key company aim, trust-based organisation culture and increasing demand for communication skills.

Brown and Druguid (2000: 29) contradict the argument of co-evolving technical and organisational network structures. They argue that only if managers are primarily information processors, will organisations become flatter, as hierarchies can then be replaced by information-processing equipment. However, they continue, management is more than information processing, including leadership, planning and other functions. Then linear predictions about linkages between the various dimensions of production strategies are too simplistic.

Characterising the network concept as the new Leitbild of restructuring prevents us from assuming a linear process of transformation from the Fordist production model to network forms of organisation. Instead, it allows us to speak of cumulative developments and to search for diversity concerning technological practices, with various combinations of elements of the new ICT-based network model and the old Fordist restructuring paradigm. Our research actually revealed a variety of techno-organisational models applied within companies. Obviously there is no single static model of combined technology application, organisation form, companies' main goals, organisational culture and skill demands that automatically brings benefits to the company.

Our research reveals a general trend showing that intensity and modernity of ICT use, on the one hand, and the organisational change practices, on the other hand, are closely related. Among the companies that have not undertaken restructuring measures the share of low users of modern ICT is particularly large, while two out of three companies having introduced both internal and external restructuring measures are also advanced users of ICT.

Table 7.1: Use of ICT by organisational restructuring

Organisational restructuring	ICT use		
	Low use of ICT	Traditional use of ICT	Advanced use of ICT
No restructuring	45%	22%	34%
Internal restructuring	34%	21%	44%
External restructuring	29%	22%	49%
Intern. and extern. restructuring	18%	17%	65%
Total	32%	20%	48%

This is the general trend. However, based on our empirical findings, we can distinguish between the following four techno-organisational systems²⁷: low-tech Fordism, high-tech Fordism, low-tech network, and high-tech network. Low-tech Fordist companies have hardly installed modern ICT or only less advanced systems and they have not undertaken major steps of restructuring oriented by the network organisation model. High-tech Fordist companies have introduced advanced technological systems but organisational restructuring has hardly taken place. The low-tech network model is characterised by massive organisational restructuring without major technical innovations. And the high-tech network form combines advanced technical systems with at least partial organisational restructuring.

Our empirical findings show that so far the network concept has not influenced companies' restructuring strategies to a great extent. Only 26% of all companies can be characterised as high-tech network organisations and among them less than 40% have applied a holistic approach of organisational restructuring, including both the vertical and horizontal dimension.²⁸ 21% of all companies can be characterised as low-tech Fordist meaning that they have undertaken neither major technical nor organisational changes. We have identified 30% of all companies as technically oriented modernizers, which can be characterised as high-tech Fordist organisations. 23% of all companies can be characterised as organisationally oriented modernizers, which can be labelled as low-tech network organisation. External restructuring measures, including subcontracting or geographical relocation, strategic alliances, and sub-contracting networks have been introduced most often by ICT-based network organisations, followed by low-tech network organisations. Low-tech Fordist organisations, on the other hand, have introduced external restructuring measures rather seldom.

As argued earlier, it is not the 'technical nature' of modern ICTs and their technical capability but companies' practices of using ICT and the function they perform that determine both the nature and extent of benefits which can be gained from these technologies. Here we differentiate between four practices of making use of modern ICT; as automation technology, as organisation technology, as control technology and as communication technology. Table 7.2 shows how techno-organisational models and use practices of modern ICTs are linked. For low-tech Fordist companies the use of modern ICT as control technology, including the surveillance of workers is most important, while the other functions are less relevant. Companies characterised as high-tech Fordist are using modern ICT particularly as automation technology. For both forms of the network organisation the communication as well as the organisation function are more important than for the two Fordist types of organisation.

²⁷ The typology is based on a cluster analysis which includes the following variables: information technology use, internal communication technology use, external communication technology use, functional integration of tasks and hierarchical de-integration.

²⁸ 60% of the companies characterised as high-tech network organisations have only partially restructured, either focusing on the vertical or on the horizontal dimension.

Table 7.2: Techno-organisational systems and functions of modern ICTs

Techno-organisational practices	Functions of modern ICTs							
	automation		organisation		control		communication	
	low	high	low	high	low	high	low	high
Low-tech Fordist	55%	12%	54%	15%	41%	40%	47%	25%
High-tech Fordist	30%	39%	36%	28%	37%	33%	32%	30%
Low-tech network	33%	37%	26%	37%	21%	34%	28%	43%
High-tech network	26%	38%	22%	51%	33%	28%	27%	40%

Differences between the four techno-organisational structures concerning barriers to introducing modern ICTs are less significant. For all techno-organisational models compatibility with the existing ICT system is a major problem. Except for the low-tech network organisation, the problem of controlling ICT-related costs is also a key hampering factor. And network companies, independent of their size, seem to have serious problems with data security and protection legislation. Fordist companies seem to have fewer problems with the required qualifications to handle ICT, obviously because they have less demand for skilled people. It is also interesting that high-tech network companies have more problems with resistance from workers and union representatives than other companies, although this is not one of the most important hampering factors. This may be explained by the fact that restructuring processes are more complex than is the case in other companies.

The concept of technological practices includes not only a technical and an organisational dimension, but additional dimensions such as companies' dominant goal, the organisation culture and skills and competencies are part of technological practices. Concerning companies' overall aim, we have argued that due to the globalising economy companies are more and more confronted with innovation competition. Our survey shows, however, that quality is the most important aim for the great majority of all companies. More than 50% of them mention quality as their most important aim, whereas less than 25% of all companies are innovation-oriented (8%) or mention flexible adaptation (17%)²⁹ as their main overall aim. And about 20% of all companies are more cost-oriented, mentioning either productivity (12%) or delivery time (8%) as their primary aim.

There are differences between the four types of technological practices, however: about twice as many companies of the high-tech network type (31%) compared to the low-tech Fordist type aim at innovation and flexibility. On the other hand, close to 30% of the low-tech Fordist companies are productivity- and time-oriented, while these goals are less relevant for high-tech network companies (16%). This can partly be explained by the fact that high-tech network firms are more exposed to global competition than low-tech Fordist companies, which often concentrate on regional markets.

We have taken a high involvement of users in the process of implementing and developing ICT as indicator for a trust-based organisation culture, as participation indicates trust relationships. Overall about 65% of all companies practice such user involvement. Among the low-tech Fordist companies the participation rate is comparatively low (51%), whereas among the ICT-based network firms user-involvement is particularly high. We can conclude that among the low-tech Fordist companies a low-trust culture is rather widespread, while the great majority of all other companies have developed a high-trust culture.

²⁹ In the following we will subsume the two dimensions under innovation-oriented.

Skills and competencies represent the last dimension of technological practices. Here we have differentiated between demand for work-related skills, organisation and management skills and communication skills including both technical knowledge and social competencies³⁰. Differences concerning work-related skills as well as organisational and management skills among the four types of technological practices are less significant. It is also worth mentioning that work-related skills are slightly more important for the low-tech firms in both categories than for firms with a high-tech basis. But differences among companies become more significant, as far as communication skills are concerned. Among high-tech Fordist (41%) and high-tech network companies (39%) the demand for communication skills and competencies is particularly high, while less than 20% of the low-tech Fordist companies mention having demand for these skills.

We have also analysed whether the four techno-organisational practices are associated with particular changes of employment taking place in companies, which indicate possible exclusion risks as well as inclusion opportunities. Table 7.3 shows that the share of companies that have not changed employment is highest among low-tech Fordist organisations, whereas two out of three companies belonging to the low-tech network type have either reduced or mainly increased their workforce. The share of companies that relates employment changes and particularly a growing workforce to the introduction and use of modern ICT is largest among ICT-based network organisations, whereas low-tech Fordist companies do not believe in such technological determinism.

Table 7.3: Technological practices and employment effects

Type of employment change	Low-tech Fordism	ICT-based Fordism	Low-tech network org.	ICT-based network org.
ICT-related increases in employment	3%	11%	11%	19%
Other employment increases	24%	24%	37%	23%
No employment changes	61%	54%	34%	41%
Other employment decreases	9%	6%	15%	11%
ICT-related decreases in employment	3%	5%	3%	7%

³⁰ This differentiation is based on a factor analysis

Table 7.4 summarises the above discussion on our empirical findings and characterises the four types of technological practices that we have identified in more detail.

Table 7.4: Dimensions of technological practices

Dimension	Low-tech Fordist	High-tech Fordist	Low-tech network	High-tech network
Use of ICT	low or traditional use of ICT	advanced use of ICT	low or traditional use of ICT	advanced use of ICT
Function of ICT	control	automation	communication, organisation	communication, organisation
Hampering factors	adequate software, compatibility, lack of qualifications	controlling costs, compatibility, adequate software	adequate software, compatibility, data security, lack of qualifications	controlling costs, compatibility, adequate software, data security, (resistance from workers and unions)
Internal organisation model	machine bureaucracy (little org. restructuring)	machine bureaucracy (little org. restructuring)	J-model (group work)	J-model, network organisation (group work and flat hierarchies)
External restructuring	less intensive	less intensive	intensive	intensive
Main goals	quality, productivity, delivery time	quality	quality, innovation	quality, innovation
Market position	regional company	major intern. player	national company	national company, major intern. player
culture	distrust (low rate of user involvement)	trust (high rate of user involvement)	trust (high rate of user involvement)	trust (very high rate of user involvement).
Skill demands	slightly more work skills	communication skills		communication skills
Employment change	no change in employment	no change in employment	not ICT-related increase in employment	ICT-related employment increase

How can we interpret these findings? There is obviously great uncertainty about the future production model. The various dimensions we have identified cannot easily be integrated into clear-cut production models. From our research it becomes quite clear that the idea of a fundamental and rapid change in the way in which production is organised suggested by some representatives of the network economy is not supported by the current restructuring practices of companies. Instead, we can speak of a cumulative development, in which elements of the old and the new production paradigm co-exist. We were still able to identify emerging restructuring approaches. Whether these develop into more stable paths of techno-organisational restructuring remains to be seen.

7.2 Why is the ICT-based network organisation not widespread?

The central argument in the literature is that the basic criteria in achieving competitiveness in the global information economy – innovativeness and customer orientation – can only be achieved through fundamental ICT-based organisational restructuring. Or to put it slightly differently: customised innovation is the number one factor to achieve global competitiveness. This underlying assumption behind the need for techno-organisational change can be broken down in three parts:

innovation, customisation and globalisation. We discuss the three aspects more closely based on our research results.

Our empirical findings seem to disprove the argument that companies are forced to embody a philosophy of continuous improvement and innovation. Innovativeness is actually considered being the last, instead of the most important, overall aim by companies. Most companies consider quality to be their key achieving criterion and also productivity, flexibility and delivery time are obviously more important as core overall aims than innovativeness.

The second argument assumes that customers who no longer accept standardised mass products or services but ask for individual solutions are exerting a need on companies to fundamentally renounce from the traditional approach for which standardisation is undeniably one of the key underlying concepts. But according to our company survey, only half of all companies declared to be producing or providing products or services specified by their customers. Standardisation is still applicable to the other half of the companies, either in the form of complementary standard products or services or in the form of products or services with standardised variants. Obviously standardisation is not disappearing in the emerging information economy and may actually explain the relative organisational stability.

It has become almost axiomatic that business success depends upon expanding the global reach of the organisation and that this evolution is accelerated by innovations in the field of ICT. "There is, " as Boudrau *et al.* argue, "little doubt that the competitive landscape has changed dramatically over the past dozen years. [...] Organisations have extended their activities around the world" (1998: 120). According to our company survey, 42% of the participating companies are active outside the EU. This means that more than half of the participating companies are not active globally. And even more important, among the small companies that represent the great majority of the entire population of companies, only 31% are acting globally. 42% of all companies that participated in the survey and more than 50% of all small ones are only acting on the national or even on the regional level.

On the basis of our empirical findings we can conclude that the need for customised innovation in order to survive in a globalising economy is only felt by a comparatively small group of companies. If the assumptions on which the fundamental transformation argument is based have to be taken with a pinch of salt, so will the consequences be drawn from them. Indeed, as customised innovation in a globalising economy is seen as the driving force behind companies' fundamental restructuring attempts, the low degree of observations might at least to some extent explain the fact that the ICT-based network organisation is not very widespread yet. It is important to put our findings into perspective. They represent a snapshot in an ongoing transformation process. At the current stage companies are experimenting with new techno-organisational solutions in order to find the most adequate production model to cope with the new logic of the emerging form of global competition. We therefore understand the four techno-organisational models that we have identified in our research as emerging ways to the information economy. Whether they will sustain or whether in the end a new 'one best way model will emerge remains to be seen.

7.3 The regional perspective of the information economy

The empirical data gathered in the project, especially through the company survey, reveal a considerable degree of regional diversity. This seems to disprove the argument of convergence that assumes that global competition forces companies in all countries and regions to rapidly introduce modern ICTs and to restructure their organisation forms according to the 'one best way model' of the network organisation to the same extent. Diversity includes both: different ICT applications and use practices as well as different organisation structures and other complementary assets. But here we are interested in more than just demonstrating that there is a trend towards diversity. Our aim is to identify different but somehow coherent paths into the information economy based on companies' restructuring practices. After having presented our empirical findings, we will make some critical remarks concerning the idea of specific national pathways into information-based production formed by the existing institutional settings.

7.3.1 Regional diversity

The fact that our empirical findings reveal considerable diversity and therefore seem to support the argumentation of neo-institutionalism is not surprising. Actually Vickery has presented similar findings (OECD 1998) by starting from the assumption that there is a trend towards the establishment of high-performance workplaces, a loosely defined model with 'high skills' and 'high trust' as main components. Increased job complexity, greater interdependence and communication within and between organisations, flat hierarchies, and a shift of responsibility to operators or autonomous work teams are seen as major features of the new work organisation. However, there are many ways of organising work within these boundaries and no simple 'one-size-fits-all' prescription of organisational attributes can be made, specific regional variations of the 'high-performance workplace model' can be identified (OECD 1998: 272).

Vickery distinguishes among a consensual or a relation-based approach, a firm-based consensual approach, a market-driven approach and more heterogeneous approaches in 'intermediary' or 'catching-up' countries. The consensual approach is characterised by the integration of tasks into broader work roles (functional flexibility) based on a deep skill base. Workers in general have a long-term work contract. Extensive negotiation processes between various stakeholders aimed at reaching consensual solutions for different problems are typical. Niederösterreich, Flanders, the Stuttgart area and the Tampere region belong to the group of regions of which the consensual or relations-based approach is typical.

In the market-driven approach, strategies adopting numerical flexibility are typical. Work contracts are less stable, companies hire workers with the required skills and dismiss those whose skills and qualifications are no longer needed. Flexibility is also achieved through external restructuring strategies, including takeover and outsourcing. In the West London area and in Ireland, the market-driven approach is typical. Companies in catch-up countries are less technologically advanced and fewer have adopted new models of organisational structures. Workers are often poorly educated and companies' training effort is small. Portugal and Lazio represent the 'catching-up' approach.

The above typology³¹ does not cover most of the dimensions analysed in this research project. But we were able to demonstrate that there is no single static model of techno-organisational restructuring that is followed by all companies independent of their regional environment. Our approach differs insofar as we do not assume a pervasive new restructuring trend but suppose that,

³¹ Here we will not discuss the firm-based consensual approach, as this is typical of Japan.

although a new paradigm of techno-organisational restructuring has developed, various development paths into information economy represent a combination of old and new restructuring approaches.

Among the regions having participated in the project, Flanders, Lazio and Niederösterreich seem to form one cluster of similar techno-organisational restructuring approaches. The number of companies characterised as low-tech Fordist is significantly bigger in the three regions than on average. On the other hand, only about every tenth company in each of the three regions can be characterised as an ICT-based network organisation. This corresponds to the fact that the use of network technology (LAN systems) is comparatively low in the three regions. Telematic systems with only internal connectivity are rather widespread. In addition, the use of advanced ICT characterised by high automation of communication processes is low in Niederösterreich and Flanders. Concerning the reach of office automation, the three regions do not differ from the average, but in Niederösterreich the share of workers affected by office automation is also rather small. Automation of production processes has progressed less compared to the other regions.

It seems that companies in the three regions have not developed more focused strategies of using ICT. However, they generally make less use of ICT as communication technology. Companies in Niederösterreich seem to focus on the automation and surveillance function, whereas companies in Lazio use ICT more often as organisation technology.

Additional findings support the argument that Fordist structures are still dominating in the three regions, where the number of companies that have undertaken organisational changes is comparatively small and in most cases organisational changes are less fundamental. This means that the machine bureaucracy model is still the dominating organisation model. The three regions differ insofar as in Flanders and Lazio a greater number of companies have introduced the J-model, while in Niederösterreich the professional bureaucracy model is more widespread.

Companies in the three regions do not differ very much concerning their main overall aim. As in all other regions, quality is companies' dominant strategic goal. But besides quality, productivity and time are more important as dominant achieving criteria than innovation and flexibility. Concerning the skill dimension of technological practices, no major differences can be identified among the three regions, with the exception that for companies in Niederösterreich demand for work-related skills is comparatively high. Also worth mentioning is the fact that user involvement in processes of ICT implementation and development is rather high in Niederösterreich, but this culture of participation and trust obviously had no influence on companies techno-organisational restructuring practices.

Besides the differences we have mentioned, it seems to be possible to subsume the restructuring approach applied by many companies in the three regions under the heading of low-tech Fordism. This does not mean that there cannot be found any modernised companies in the three regions. For example, the share of low-tech network companies focusing particularly on organisational restructuring is comparatively small in each of the three regions. On the other hand, the ICT-based network economy is not very visible yet.

Ireland, the Stuttgart area and West London seem to form a second cluster, in which a specific development path into the information economy is emerging. In all three regions the share of companies applying a high-tech Fordist approach of restructuring is about 30%, which is significantly above average. Compared to the two other regions, in the Stuttgart area also the low-tech Fordist model is rather widespread. With respect to the ICT-based network organisation form, these three regions do not differ significantly from the average. Our findings indicate that companies in the three regions focus more on technical modernisation than on organisational restructuring.

Still the technicalisation strategies in the three regions differ significantly. Certainly with respect to the computer infrastructure, the use of network technology (LAN systems) in all three regions is very widespread. However, software support of administrative functions has progressed most in Ireland, whereas companies in West London seem to be less advanced in this respect.

Concerning the automation of production processes, the three regions do not differ significantly from the average.

The use of telecommunication systems based on e-mail is more widespread among companies in the London area, whereas the use of telematic systems including EDI is most extensive among companies in the Stuttgart area. Summing up, we can conclude that particularly in the London area the share of companies using ICT in a more traditional way is comparatively big, while in the Stuttgart area and particularly in Ireland the share of companies using ICT in a more modern way is by far outstripping the number of traditional ICT users. With respect to specific ICT functions, the fact that companies in Ireland and in the London area are using modern ICT more often as surveillance device is worth mentioning.

Concerning organisational restructuring practices, companies in the three regions also differ to some extent. In the Stuttgart area the number of companies having undertaken some organisational changes is rather big; actually this share is the largest in the German region among all regions; however, organisational changes in general are less radical and multi-dimensional than those in the other two regions. And companies in the Stuttgart area focus more on external than on internal restructuring strategies, which might be associated with the fact that they have introduced automated data exchange with other organisations quite often. The establishment of subcontracting networks is very widespread in this area. In Ireland and in West London we can identify a trend towards polarisation, with a great number of companies having hardly introduced organisational changes and others having applied a more holistic approach as they introduced a variety of different organisational restructuring measures. This is why in the two latter regions the machine bureaucracy model is still dominating, while this is not the case in the Stuttgart area. Here the professional bureaucracy model is quite often applied. Worth mentioning is the great dissemination of telework in the London area, which to some extent explains the intensive use of e-mail.

Also concerning the overall business goal, companies in the three regions differ to some extent. Quite a significant number of companies in the Stuttgart area consider innovation and adaptability to be their main aim (37%), while in Ireland a major share of companies aims at high productivity and a short delivery time (28%). Concerning the cultural dimension, major differences between the three regions can be identified. While in the Stuttgart area the share of companies practising user involvement is close to 90%, only one out of three companies in West London and one out of two companies in Ireland have developed a trust-based participation culture.

Also with respect to the skill dimension, companies in the three regions differ significantly. Companies in the Stuttgart area stress the importance of communication skills and competencies; companies in the London area mention more often the need for work-related skills. Besides all the listed differences, we are inclined to characterise the dominant restructuring approach in all three regions as high-tech Fordism. But while in the Stuttgart area a more flexible Fordist model is widespread, we can find traditional, more rigid Fordism in the London area and in Ireland. But in the latter two regions restructuring practices are more polarised, as we can also find a larger share of companies that have applied more fundamental multidimensional restructuring practices oriented by the network concept.

Placing Portugal and the Tampere region in a third cluster is motivated by the fact that in both countries more than 50% of all companies apply a network-based restructuring strategy.³² In addition, they are also ahead in applying the technology-based network approach (about 30%). LAN systems are widely diffused among companies in the Tampere region; there is hardly any company in this region that does not apply this network technology. Concerning the support of administrative and production functions through software, neither of the regions belongs to the spearhead of technical modernisation. But they are intensive users of advanced communication technology.

³² The Portuguese sample is biased towards large companies, however.

Among the Portuguese companies about every second company can be characterised as an advanced user of ICT, which outstrips the same share of companies in the Finnish region by about ten percent. On the other hand, in Portugal we can also find a significant number of companies that have an ICT infrastructure with no connection to the external environment. It is worth mentioning is that a great majority of companies in both regions uses ICT in the function of communication technology.

The fact that more than 50% of all companies in both regions have applied one or the other network approach implies that the share of companies having undertaken quite far-reaching organisational restructuring measures is comparatively big, including also external restructuring processes. We can, however, identify certain priority of restructuring in both regions. While in Portuguese companies downsizing plays an important role, companies in the Tampere region focus on the introduction of group work and profit centres.

Concerning the core overall business goal, companies in the two regions differ to some extent, as for companies in the Tampere region productivity and time are more relevant than for companies in all other regions. In addition, we can identify major differences with respect to the skill dimension of technological practices. Companies in Tampere mention demand for all types of skills (work-related skills, organisation and management skills as well as communication skills) more often than companies in Portugal.

Concerning the cultural dimension, it is worth mentioning that the companies in the Tampere region have the highest user involvement rate among all regions, while the share of companies practising user participation in the process of applying and developing ICT systems is only about average in Portugal. We can label the approach of restructuring in the two countries as network-oriented, with a stronger technical basis in a significant number of companies. But the share of companies having introduced major organisational and technological changes concurrently is too small to enable us to talk of the existence of a technology-based network economy.

7.3.2 Some critical remarks

Our research has enabled us to identify various ways to the information economy. ICT-based Fordism, a low-tech network economy and a technology-based network economy may represent different pathways into the information economy. Also a highly polarised economy with high-tech network organisations existing side by side with low-tech or high-tech Fordist organisations might be an option of adapting to the emerging information economy. Whether a production model in which most companies in a regions are staying put not undertaking major technological and organisational changes can survive in the emerging information economy remains to be seen.

On the basis of our empirical material we were able to outline the various development paths into the information economy in a very shadowy way. But can we already speak about the existence of coherent national or regional development paths with clear contours? This is definitely not the case. First, our empirical material includes too many inconsistent and contradictory findings, which is of course a general problem of typologies derived from empirical material. And second, although our typologies are derived from nationally or regionally clustered findings, we do not claim having identified specific regional development paths, which can be associated with and are formed by specific institutional settings, as neo-institutionalism suggests.

For example, Niederösterreich, the Stuttgart area and the Tampere region all have similar industrial relations systems, but they differ considerably with respect to their techno-organisational restructuring patterns. This means that in this case we cannot speak about the shaping of techno-organisational development paths through specific institutional factors. Furthermore, we have assigned West-London, the Stuttgart area and Ireland to the same high-tech Fordist development paths, but the economy of the three regions is based on very different labour market structures and

education systems. These two factors are often mentioned as key institutional factors that shape ICT applications and organisation forms.

The development path which emerges in Portugal and in the Tampere region may be classified, as we have argued, as a (high-tech) network economy, but it is very difficult to identify common institutional factors that shape ICT applications and use practices, as well as organisational restructuring. For example, the Finnish government has quite early pursued a very concise policy to support the development the information society in this country, while this was not the case in Portugal. Based on these examples, we have to conclude that at the current stage of development it is very difficult to associate possible pathways into the information economy with a specific institutional setting.

It is probably too early to talk about different regional or national paths into information economy for two reasons. First, because companies are still in a phase of experiencing with different technical and organisational options and changes are taking place very rapidly, it is not possible to identify clear national development paths into the information economy. And second, the problem with neo-institutionalism is that it assumes relatively stable interactions between clearly defined elements (Glimstedt 1988: 108). In the current situation of economic transformation, however, in which governments are gradually adjusting their economic policy and institutional frameworks of political economy in responding to the new challenges, this assumption might not be justified.

Particularly the institutional setting is coming under intensive pressure from those companies that start to introduce modern ICTs and new organisation forms to adjust to the changing environment and the new competition game. The societal effects, we can conclude, are themselves not unchanging, the result therefore is institutional fragility (*ibid.*). In times of institutional fragility, however, we cannot expect to be able to clearly identify the way in which national, regional or local factors and institutional structures are shaping the technological practices in various regions.

Our research suggests a change in the research perspective from path dependence associated with neo-institutionalism to path creation. The strength of the path dependency concept is that it assumes some kind of continuity in the process of techno-organisational change, which is guaranteed by a stable institutional setting. But in the current situation of high uncertainty in which the network concept has developed as a new restructuring paradigm and in which we can no longer assume that the institutional setting remains stable but becomes more and more fragile, we have to pay attention to the process of mutual influencing, reciprocal creation and interactive learning among companies and organisations hosted by the institutional setting, from which the development path into information economy may emerge. More research is needed which focuses on the interaction between companies' restructuring practices and institutional renewal.

8. CONCLUSIONS AND POLICY IMPLICATIONS

In this last chapter we discuss some policy conclusions based on the research results we have presented in the report. Our main argument is that policy makers aiming at supporting the development of the information economy should focus more on the demand side, because the informatisation of the whole economy may create greater advantages than the strengthening of a new ICT cluster. Stimulating and promoting the informatisation of work, however, means more than encouraging companies to invest in modern ICT; it must be accomplished by a number of complementary social innovations.

Companies have to develop more intelligent use practices of modern ICTs and they have to undergo fundamental organisational changes. The development of a trust-based business culture and the establishment of new achievement criteria have to go hand in hand with techno-organisational restructuring practices. And employees have to learn new skills and develop new competencies to be able to work in a decentralised ICT-based work environment.

It is important to apply an integrated policy approach for developing the information economy, which co-ordinates various policy areas such as technology policy, labour market policy, education policy, industrial policy, science policy, and other policies. However, we also have to be aware of the fact that the emerging information economy may not only produce benefits but also bring about costs. It is therefore important to closely co-ordinate those policies that foster the development of the information economy with others that deal with labour market problems and social exclusions risks as a possible negative side of the transformation process. But as there is no 'one best way' to information society, policy-makers have to encourage the key economic actors to develop their specific pathway into the information economy.

8.1 The two pillars of the information economy

The development of the information economy is based on two pillars: on the development of a new information sector and on the diffusion of modern ICT throughout the whole economy. While there is no doubt that being a leading producer of modern ICT will have a positive effect on national and regional competitiveness, the informatisation of work and the efficient use of modern ICT within production processes may have an even greater effect on economic growth and employment.

So far policy makers who aim at supporting the development of the information economy seem to focus more on the supply side than on the demand side. They intensively support the development of a new information sector or cluster, while giving less attention to changes in the mode of production. Informatisation of work and the effective use of modern ICTs in production processes does not seem to be in the centre of policy activities that aim at developing the information economy. We do not argue here that the traditional supply-side policy should be abandoned, but there is a need to shift attention from the supply side to the demand side of the information economy in order to boost growth and employment. In addition, policy makers should give particular attention to the question how to link a policy supporting ICT production with a policy that focuses on the diffusion and use of modern ICT within companies. What is needed is an 'umbrella policy' to cover and integrate both sides of the information economy.

The need for a diffusion-oriented policy is supported by the results of our research project, as technical factors are often mentioned as barriers to investment in modern ICTs. Particularly SMEs seem to have difficulties in assessing the value of modern ICTs for their business. Policy-makers should therefore support co-operation between producers and users of modern ICT. Closer co-operation with and consultation by producers of modern ICT may particularly help SMEs to

overcome their concerns with respect to ICT investments, such as spreading costs, incompatibility with the existing technical system, software problems and others.

8.2 Technical restructuring

The concept of technological practices indicates that it is not ICT itself that can guarantee the leaps of productivity and innovation activities companies need in order to maintain their position in an increasingly competitive environment. Instead, it is a cluster of social changes, including organisational restructuring, cultural changes, changing business aims and achievement criteria as well as new skills and competencies, that contributes to the strengthening of competitiveness along with the use of modern ICT.

Modern ICT is of course, an important part of technological practices and the technology itself has an impact on companies' competitiveness. Modern ICTs have developed dramatically in the last decade. Such technical performance as storage and processing capacity, for example, has increased significantly. This indicates that modern ICT is a powerful technology already in stand-alone configurations. But the full potential benefits emerge when modern ICT is used in the form of integrated systems. For example, the standardisation of microprocessors, communication intersection, system components and user software enable the compatibility of various technical subsystems, forming a large platform that can be used for information and knowledge exchange and for collaborative production. While there is a trend towards network applications, a significant number of companies still make use of isolated computer systems only. Particularly SMEs use advanced ICT systems comparatively seldom. And the fact that companies often apply a variety of different systems, which can hardly be connected to each other, also becomes an important hindering factor that increases competitiveness significantly.

Policy makers should support particularly SMEs in modernising their technical equipment to be able to gain the benefits from network applications. We have argued, however, that it is the use practice of modern ICTs in the first place that determines both the nature and extent of benefits being gained from this technology. There is no single logic of using modern ICT which can be derived from the technology itself; instead, modern ICT represents a multifunctional technology which can be used for different purposes. This means that we have to change from an artefact perspective to a perspective that focuses on the functions that modern ICT can serve. In this respect, we can differentiate between an automation function, a control function as a surveillance function, a tool function, an organisational function, an informing function and a communication function.

The application of modern ICT systems and more advanced use practices focusing on the organisation, informing and communication functions become increasingly important, because the rules of the competition game have changed together with the globalisation of markets. Companies now require quality, innovation, costs, and speed to market for business success and among these factors particularly innovation will become even more critical in the future. Modern ICTs can be crucial for supporting innovation processes, because they make it easy to transfer knowledge-based information from one place to another and to disseminate information worldwide. The more companies are forced to improve their innovation capacity, the more they can profit from applying modern ICTs and making advanced use of them. Furthermore, the technical potential of modern ICT can motivate companies to reflect on their strategic aims, focusing more on innovation activities.

The use of modern ICT, as our empirical findings show, is closely linked to companies' dominant achievement criteria. The network character of modern ICT and its potential as communication technology is of particular importance in an economy dominated by innovation competition because it allows knowledge sharing and, as a consequence of this, specialisation processes within and between companies. A policy aiming at accelerating ICT use needs to underline the close relationship between innovation and ICT use. This means that the diffusion of modern ICT and its adequate use should become an important part of company-oriented innovation

policy. A policy aiming at encouraging innovation should integrate measures to support the application of modern ICT and its advanced use.

Our research shows that policy makers are faced with a huge task. On the one hand, only a small minority of companies considers innovation to be the most important achievement criterion. On the other hand, many companies have to be convinced to focus on the communication function and network potential of modern ICT. Even companies with modern ICT systems make limited use of the multi-functionality of this technology. They turn to more traditional functions such as automation and process control, while hesitating to use the full potential of ICT systems.

Elaborating our argument further, it is important to mention the Internet's key infrastructure applications, the World Wide Web and the browser, that have greatly expanded the potential of ICT. These technologies integrate the existing computer and communication systems at a relatively low cost in an open network that significantly increases their utility. The use of the Internet for electronic commerce provides a faster, more reliable and potentially more cost-effective way of connecting companies; through the application of electronic commerce technologies, existing business processes can become more efficient. When applied to business-to-business relationships, these technologies may lead to significant productivity gains. According to our company survey, nowadays almost all companies have access to the Internet, but generally they make only limited use of it. For example, business-to-business applications are still rare and also connections to paid databases can be found very seldom.

8.3 The organisational dimension

As argued above, the greatest benefits from the application of modern ICTs appear when their use is combined with other organisational assets, such as new business strategies, new organisation structures or more skilled employees. The successful integration of modern ICT into the production process in general requires major structural adjustments; modern ICT can hardly function effectively and support innovation activities when integrated in the traditional, Fordist organisation framework. Modern ICTs do not determine organisation forms; instead, they must be characterised as enabling technologies. This means that they create new organisation forms; these new organisation forms in turn provide new opportunities for technical design.

Modern ICT can affect both the vertical and horizontal dimensions of organisation forms. For example, modern ICT can facilitate the sharing of information among different organisation groups and departments by enabling the introduction of flat hierarchies. On the other hand, modern ICT facilitates a technical integration of various processes or functions supporting the introduction of group work or teamwork. Our company survey reveals that companies often introduce only isolated organisational changes. But it is not enough to introduce some minor changes on the shop floor; the successful integration of modern ICT requires a fundamental restructuring approach, changing both vertical and horizontal forms of division of work information flows and co-operation.

As our firm survey indicates, the development of an ICT-based network organisation is still an exceptional case. Companies often introduce modern ICT without adapting their organisational structures; others focus on organisational restructuring without introducing modern ICT as a backbone of new and more flexible organisation forms. And still quite a few companies have undertaken neither major technological nor organisational restructuring measures; they stick to the low-tech Fordist production model.

While modern ICT has an important role to play with respect to internal organisational restructuring, the availability of a network technology, such as the Internet, results in an increasingly outward orientation of restructuring practices. Modern ICTs offer the potential to restructure the entire value chain, particularly companies' interaction with supplier companies and with customers.

But external restructuring needs to be combined with internal renewal processes, as inter-firm co-operation is most effective when it is based on decentralised decision-making.

Despite the growing evidence that ICT-enabled organisational changes have a positive impact on companies' productivity and innovativeness, policies aiming at supporting these restructuring processes and diffusing company-level good practices are not widespread. One reason is that companies cannot simply copy a particular organisation structure; instead, restructuring needs to be understood as a continuous open-ended learning process, as argued before.

Regions or countries, however, often lack a broad policy approach to the new challenges confronting businesses. Innovation policy focuses more on the development of new technologies and the set-up of support institutions; it seldom integrates issues related to business restructuring and human resources development. Both education policy and labour market policy have also widely ignored the dynamic developments on the company and the industry level, challenging education and training institutions as well as the labour markets. But there is a potentially important role for policy makers in the transformation process towards the information economy. They can contribute to the transformation processes by supporting and enhancing companies' techno-organisational restructuring processes.

What SMEs in particular need is more advice, because they seldom invest in intangibles. As they do not introduce social innovations such as new business strategies and new organisation forms together with the application of modern ICT, they can hardly reap all the possible benefits from the new technologies. In addition, as the greatest restructuring potential of ICT lays in the redesign of inter-organisational relationships, policy makers should direct their attention more to networks of co-operating firms than to single companies. This means that there is a need to develop network policies of restructuring. 'Competitive benchmarking' and 'demonstration activities' initiated by policy makers can be seen as an important element of such a network policy.

8.4. Skills and competencies

There is some evidence that the emerging information economy triggers a trend towards up-skilling. This trend cannot be related to the introduction of modern ICTs only; instead, as stressed several times, one has to highlight the central role of ICT-enabled organisational change in a cluster of complementary and mutually reinforcing social innovations in order to understand the shift in skill demands. However, in order to identify trends in skills and competence development, we cannot focus on the traditional up-skilling versus down-skilling controversy. We have to analyse what new kinds of skills, competencies and capabilities become important.

While it is obvious that the demand for digital skills is increasing due to the widespread use of modern ICT, it does not always seem to be the most urgent demand. Our empirical findings suggest that it is not the technology in the first place that causes new skills and competencies to emerge. Instead, the new network forms of organising work must be seen as the key factor that triggers changing skill demands, as companies stress increasingly the need for organisational, management and social skills. Particularly the competence to co-operate and communicate with organisation members and people from outside is often mentioned as an important competence. In addition, employees' preparedness to take on responsibility and being trustworthy is also emphasised. When recruiting new employees, more emphasis is often placed on personal characteristics, such as creativity and entrepreneurship, than to formal qualifications. Also 'international skills', including the knowledge of foreign languages and openness to other cultures, are highly demanded. But probably most important is the development of learning-to-learn competencies.

The changing skill demands also impact on training aspects. The company is becoming an important place for promoting human capital and acquiring new skills, knowledge, competencies, work attitudes and work virtues. A great number of skills and competencies will not be acquired in

formal education processes separated from the work process. Instead, they have to be developed continuously in learning processes on the place.

But the need for new impulses coming from formal training in various training institutions still exists and is even growing. This means that government's role in providing certain types of education is still very important. In addition, as companies and particularly SMEs often under-invest in human capital, financial incentives are necessary to guarantee that all categories of employees are able to continuously renew their skills and competencies. What is needed is a diversity of learning places with different focal points. In addition, the process of acquiring new qualifications and competencies must be seen as a continuing lifelong learning process.

8.5 Cultural change and employers' participation

Modern technological infrastructure supported by new organisation forms opens up opportunities for intensive information exchange by giving employees access to all available information but it seldom produces the expected results. New techno-organisational structures alone cannot create an environment to foster continuous exchange of information and knowledge, they must be based on a supportive business culture. Companies increasingly introduce programmes of cultural strength as an important part of their renewal strategies.

The new techno-organisational structures cannot function on the basis of distrust among organisation members. But one can have serious doubts about whether isolated cultural change programmes will be able to stimulate closer co-operation and information exchange. It is more important to create places and an environment in which trust can develop. The important elements of 'structural trust' include giving workers more autonomy in decision-making; integrating them into digital networks; allowing them access to relevant information; providing incentives for creative and innovative behaviour; establishing places for informal meetings; and providing training for employees, enabling them to take up new tasks and functions and to use modern ICT in a productive and intelligent way. It is likely that such an environment can motivate and stimulate intensive information and knowledge as employees exchange together with continuous interaction may create social capital, which can become the basis of more trusting relationships.

The dimension of participation is an important aspect of organisation culture, since companies' techno-organisational restructuring activities have to build on delegating responsibility to individual workers or work groups. Particularly the fact that it is difficult to implement and continuously update modern ICT without support from employees forces companies to give employees more participation rights. But employee involvement in processes of organisational changes is important as well, as they have the best knowledge about efficient work practices.

There are thus inherent forces that promote employee participation in company restructuring processes. Our empirical findings show that many companies have realised the importance of involving their employees in processes of introducing and developing modern ICTs. However, we found rather big regional differences. It is important that companies throughout Europe become aware of the need for and benefits of employee participation in techno-organisational restructuring processes. Policy makers can support worker participation in restructuring processes by integrating the participation aspect into their 'benchmarking' and 'demonstration activities'.

Employee participation should be seen neither as an alternative to the traditional forms of formal representation - trade unions or shop stewards - nor as a tool for gaining more power. It should be accepted as form of participation in its own right. The fact that union representatives in our case studies were only seldom involved in processes of ICT implementation may support such a view. Increasing employee participation nevertheless indicates that changes have taken place and that the traditional institutions of employee representation need to adapt themselves to the new situation. There is a need to clarify the functions of different forms of representation and

participation in techno-organisational restructuring processes, and to develop ideas of how to integrate the various participation levels.

8.6 Individualised strategies to combat social exclusion

Our research reveals that ICT-based organisational restructuring might not be a positive sum game. Besides restructuring winners, we can also find groups of workers that are threatened by social exclusion risks.

Various approaches have been developed to prevent or combat social exclusion. They are based on a concept of social justice different from the one underlying the postwar social consensus, which simply insured the population against predictable risks. We can distinguish between individualistic and general approaches. Individualistic approaches often analyse social exclusion in terms of denial - or non-realisation – of social rights.

The right to work can be seen as a key social right. The emphasis here lies on employment, not on income compensation through social welfare; integration into the work process is the aim of strategies to combat social exclusion. Therefore, the unemployed people and school leavers that have difficulties in finding a job are the main target groups. The following measures of an active labour market policy can be seen as key strategy elements: the readjustment of the unemployed to new labour market demands; the appropriation of wage subsidies for the creation of new jobs in companies; and the promotion of sheltered employment outside the official labour market.

Training to readjust the unemployed to new labour market demands cannot be reduced to only developing digital skills or some other specialised skills. Instead, it becomes more important to strengthen workers' labour market position in general, as an increasing number of workers have to cope with the perspective of flexible and uncertain careers in the future. Therefore, soft skills and competencies such as social competencies or organisational and management skills are becoming increasingly important.

However, embracing intensive training programmes for the long-term unemployed is often not sufficient. For this group, job creation programmes also have to be financed. There is, however, always the risk that wage subsidies for companies will not create new jobs or at least no stable employment. It is therefore important to combine employment strategies based on wage subsidies with a qualification element. In addition, programmes which have a high growth potential to create jobs for the unskilled in the community and personal services must be included. The promotion of employment in sheltered areas outside the labour market which can be combined with a policy to guarantee employment for the long-term unemployed dissociates work from employment. This means that people become socially integrated, although they are not occupationally integrated. Furthermore, such a policy helps people to manage 'non-employment'.

We know from various evaluation studies that employed people can acquire new skills and competencies more easily than people without employment. Therefore, protective training and competence development within companies becomes increasingly important. The realisation of the concept of lifelong learning may be helpful in avoiding precarious employment and may even support people in starting a new career in a more promising work environment. For workers in precarious employment and in the case of skills mismatch, training referred to as 'adaptive training' can be seen as a possible measure to avoid unemployment.

As for older people, acquiring knowledge through continuous learning becomes a heavy burden and other measures have to be taken as well. In their case, it is possible to protect them from being made redundant and becoming unemployed through social protection schemes on the basis of collective agreements or legal regulations. The problem here is that protective regulations for specific groups increase the risk of other groups becoming unemployed. Such regulations have in

effect proved to be an obstacle to the recruitment of job seekers or of new entrance to the labour market.

In the following we present a five-stage model of social exclusion and suggest intervention strategies. The process runs from full integration (stable employment), through forms of precarious, intermittent or seasonal employment, to unemployment and long-term unemployment and results in the total exclusion from the labour market, when people become unemployable and have to live on social welfare.

Table 8.1: The process of social exclusion and options for political intervention

<p>Stage 1: Stable and long-term employment</p> <p>Intervention options: e.g., continuous further training</p> <p>Stage 2: Precarious, fragile employment</p> <p>Intervention options: protection agreements, training to overcome mismatches between needed skills and existing qualifications</p> <p>Stage 3: Unemployment</p> <p>Intervention options: wage subsidies, adjustment training</p> <p>Stage 4: Long-term unemployment</p> <p>Intervention options: job guarantees, promotion of employment outside the labour market, further training and wage subsidies for firms to create new jobs</p> <p>Stage 5: Final exclusion from the labour market</p> <p>Intervention options: training to keep workers employable, social aid.</p>

8.7 General strategies to combat social exclusion in the information economy

Active labour market policy, including measures such as further training, wage subsidies or the creation of employment outside the labour market, is often seen as too limited for combating social exclusion. To fundamentally approach the problem of social exclusion, more acting in solidarity is needed. This is not meant in the sense of guaranteeing material security, but in the sense of re-establishing bonds between the excluded people and society.

The sharing of work is seen as the key approach towards re-establishing solidarity. But it is still highly controversial whether the general reduction of working hours can have a significant impact on employment. It is more often seen as an instrument for stabilising rather than increasing employment. Promoting part-time work is also discussed as a strategy for sharing work among a larger number of people. As part-time work is often applied to less-skilled jobs, it may help to reduce the employment problem for less-skilled people caused by the shift in skill demands. Furthermore, the establishment of more flexible transitions from employment to other social spheres, such as education, leisure, family, community and retirement, is also seen as a promising approach to dividing existing jobs among more people. The idea of such an approach is that if people have a real choice between different activities without a risk of losing their jobs, the supply of labour will be reduced and more people can be employed.

Dividing the existing working hours among more people is sometimes seen as a defensive strategy to deal with the problem of social exclusion, as low demand for labour is taken for granted. The problem is that of restoring strong economic growth conducive to massive job creation. The

need for applying an innovation-oriented growth policy is increasingly stressed in order to combat social exclusion. It is important to note, however, that the relationship between innovation and employment is extremely complex; no direct relationship between these two economic variables exists. Particularly product and process innovations may have partly contradictory employment effects. In the case of process innovations, effects on the employment level in general are much less benign than in the case of companies developing new products or services.

Can the introduction of decentralised, ICT-based production structures be seen as a measure to combat social exclusion or to promote social inclusion? According to the results of our company survey, while traditional companies without major organisational changes and low ICT use have mostly kept their workforce stable, those companies that have introduced technical and/or organisational changes have varied their workforce more often by both reducing and increasing it. It seems that particularly those companies that fundamentally restructure their production process to strengthen their innovativeness are the biggest job creators. Such companies derive competitiveness from the virtuous circle which builds more explicitly on exploiting the flexibility and creativity of their workforce. It is important that governments support those innovative companies that aim at strengthening competitiveness through restructuring processes but rely on a highly educated workforce at the same time.

8.8 Co-ordinating various policy areas

The concept of technological practices directs policy makers' attention from the supply-side to the demand-side perspective of the information economy. It also underlines that companies can benefit most when they combine advanced technology use with a bundle of social innovations, including intra- and inter-organisational restructuring, the use of skilled employees, new forms of employee participation, flexible work regulations, and the introduction of innovation as the main achievement criterion. Above we have discussed how policy makers can support the development of these productive and innovative technological practices.

The agenda suggested often cuts across departmental and ministerial responsibilities. There is a need for an integrative approach that involves various policy areas, including science policy, labour market policy, education policy, and technology and innovation policy. Here we want to stress the three elements of such an integrative approach: the development of a national or regional Leitbild which gives some overall guidelines for future socio-economic development, the formation of policy networks, and discursive co-ordination as a new form of governing the development process. A Leitbild, as argued above, includes a set of general ideas of socio-economic development, but it also has a normative dimension, as which it becomes the basis of practical restructuring processes. In some of the participating regions, the 'networked informational economy' has become some kind of Leitbild for socio-economic development.

Policy networks represent a new understanding of the role of the state in socio-economic development processes. The relationship between government, on the one hand, and economy and society, on the other hand, is no longer seen as a hierarchical one with the government as the central authority to develop and implement policy programmes. Instead, the concept of policy networks reflects a growing participation of non-government organisations and agencies, such as large companies, unions and trade associations in political decision-making. In policy networks the role of the state in technical macroeconomic management may decrease, but its role as a facilitator and orchestrator of private economic actors remains strong.

Discursive co-ordination means that co-ordination of economic activities among various decision makers takes place through continuous discourse and mutual adjustment. Systemic discourse can be viewed as a platform to jointly create and exchange information among economic

actors. Discursive co-ordination is not intended primarily to create consensus among the participants; it rather aims at initiating learning processes.

It is important to mention that an umbrella policy for developing the information society has to combine the restructuring perspective with the social exclusion perspective, as the benefits and costs related to the widespread use of modern ICT and its organisational embedding are often unequally distributed among various groups of employees. If the emerging information economy leads to increased social segmentation and social exclusion, we can expect that restructuring losers registering only the negative side of the information economy will oppose the transformation process. This is why social cohesion is crucial for the information economy. Focusing only on the diffusion of modern ICTs and related social innovations to make their use more effective may not be a sustainable strategy in the information economy.

Such an integrative approach should not deal with the two aspects separately, that is, support the techno-organisational transformation process while leaving the negative side of the emerging information economy to a labour market policy compensating for the costs among the most disadvantaged people. Instead, a comprehensive approach is needed which tackles both aspects together. This may imply a transformation of the traditional 'caring welfare state' into a 'co-operative social state'. The latter can be characterised more as an intermediary and an enabler than as a producer of benefits. The co-operative social state no longer concentrates on social aid as a compensation for resource deficits; it rather supports self-organising entities. This means that the main aim is to empower people to participate in the learning processes taking place within companies.

8.9 The increasing importance of the regional level

We have argued above that the effective use of modern ICT typically requires organisational changes and large investments in human capital. Intensive training is discussed as an important tool to combat reproduced and new forms of social exclusion. Policies to improve the application of modern ICTs and to make their use more effective as well as complementary policies are in some cases beyond the scope of national governments. While national governments can create an environment that supports ICT-based restructuring in companies and increases awareness of social exclusion risks, regional governments can take more concrete steps.

The fact that regional governments can take a more active role in the building up of an information economy has several reasons. On the regional level, policy makers have a better overview of the concrete needs of the companies. Particularly with respect to SMEs, they can design more tailor-made policy programmes. Since regions represent genuine communities of economic interest, governments can take advantage of true linkages and synergies (economies of scale and agglomeration) among economic actors. It is much easier to co-ordinate various policy areas on the regional than on the national level and to form policy networks which include the main actors in the field. Particularly the co-ordination of policies supporting companies' restructuring processes and education and labour market policy is easier to handle on the regional level. In addition, regions may be more suited to develop un-traded interdependencies and relational capital, which is important for developing joint strategies and policies promoting the information economy

8.10 Alternative paths into the information economy and policy learning

The argument that Europe has to find its own way to the information economy seems to assume that companies of all countries and regions in Europe have to apply more or less the same ICT-based restructuring strategies. Furthermore, this would imply that all regions are also confronted with similar labour-market and exclusion problems. Our research has shown, however, that although there are many similarities, the participating regions and countries are following different techno-

organisational paths.³³ Diffusion processes of modern ICTs and their social impact are to a certain extent region-specific, while sector specificity seems to be less important according to our findings.

From our research we have learned that the participating regions do not differ significantly in the intensity of applying modern ICT. Differences result more from the way in which modern ICTs are used and organisationally embedded. Here we can identify regions in which a great number of companies still stick to the traditional Fordist production model, with some flexibility made possible by the intensive use of modern ICT. On the other hand, we can find regions where companies have started to orient their restructuring strategies more on the network model as a new restructuring Leitbild, benefiting more from the transformation potential of modern ICT through accompanying organisational, cultural and training measures. However, we could not find a single region coming close to the realisation of an ICT-based network economy.

We do not understand the diversity of development paths into the information economy as a weakness, it may even be seen as a strength. By comparing various national strategies and their shaping through institutional structures, we may be able to identify good practices and new tools, which could then be 'borrowed' by other regions. For any region, the ability to adapt, diffuse and use products, processes, organisation forms, and even institutions developed abroad is a central aspect, not only for catching-up countries but for the leading ones as well. Due to such huge institutional diversity, institutional benchmarking in Europe is of particular advantage, as the cross-country and cross-regional comparisons of institutional performance are likely to strongly increase the political pressures for individual regions to address the underlying causes of poor institutional performance.

The strict application of the method of benchmarking is very difficult, however. There are serious problems related to the method of benchmarking, the most important being that one can by no means expect that a particular institutional solution as part of a specific economy may function in the same way and with the same efficiency in another economy. We probably cannot relate economic success to isolated institutional or organisational factors; they are part of a specific economic structure and it is unrealistic to assume that isolating single institutional or organisational solutions from the whole setting and implanting them into a new structure will not affect their performance.

Simple institutional borrowing and copying good practices may turn out to be very unsuccessful, as efficient functioning may depend upon the specific constellation of organisations and institutions in which the good practice is embedded. The method of benchmarking must therefore be applied very carefully. A less strict benchmarking - we may speak of intelligent instead of mechanistic benchmarking - may be helpful in better understanding the development of one's own economy, its strengths and weaknesses. It may give some further hints about how to improve the strategies of economic transformation, because we can learn from diversity. Institutional borrowing implies to a greater or lesser extent a process of institutional learning and adapting to new systems.

³³ Our research is limited to the company level. We have not studied the aggregated level (see OECD 2000).

REFERENCES

- Abernathy, W. (1997): *The Productivity Dilemma: Roadlock to Innovation in the Automobile Industry*. Baltimore, MD: John Hopkins University Press
- Akrich, M. (1992): *The De-Scriptio of Technical Objects*, in: W.E. Bijker and J. Law (eds.): *Shaping Technology/Building Society: Studies in Sociotechnical Change*. Cambridge, Mass: MIT Press 205–240.
- Alter, C. and Hage, J. (1993): *Organisations Working Together*. Sage, Newbury Park.
- Aoki, A. (1989): 'Global Competition, from Organisation and TFP. A Comparative Micro-Perspective'. Paper presented at the International Seminar of Science, Technology and Economic Growth, Paris.
- Atkinson J, (1995): *New Forms of Work*, IES, Report Number 264.
- Bangemann, Martin (1994): *Europe and the global information society. Recommendations to the European Council (The Bangemann Report)*. Brüssel: The European Commission.
- Baran, B. (1989): "Office automation and women's work: the technological transformation of the insurance industry". In Manuel Castells (ed.) *High Technology, Space and Society*, Beverly Hills, CA: Sage.
- Baukowitz, V. (1996): *Neue Produktionsmethoden mit alten EDV-Konzepten?* In: Schmiede, R. (Hrsg.): *Virtuelle Arbeitswelten: Arbeit, Produktion und Subjekt in der Informationsgesellschaft*, Berlin: Edition Sigma.
- Beatson M, (1995) *Labour Market Flexibility*, Employment Department, Research Series No 48.
- Bell, D. (1973): *The Coming of Post-industrial Society: A Venture in Social Forecasting*, New York: Basic Books.
- Berger, U. (1993): *Organisationskultur und der Mythos der kulturellen Integration*. In: Müller-Jentsch, Walther (Hrsg.): *Profitable Ethik – Effiziente Kultur. Neue Sinnstiftungen durch das Management?* München: Mehring.
- Berger, P.L. & Luckmann, T. (1967) *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*. Garden City, NY. Doubleday Books, 1967.
- Berman, E., Bound, J. and Griliches, Z. (1994): "Changes in the Demand for Skilled Labor within U.S. Manufacturing Industries," *Quarterly Journal of Economics* May, 109, 367–98.
- Berndt, E.R., Morrison, C.J. and Rosenblum, L.S. (1992): "High-Tech Capital, Economic Performance and Labor Composition in U.S. Manufacturing Industries: An Exploratory Analysis." MIT Working Paper 3414EFA.
- Bessant, J. (1989): *Microelectronics and Change at Work*, Geneva: International Labour Organisation.
- Bijker, W.E. (1995): *Of Bicycles, Bakelites and Bulbs: Towards a Theory of Socio-Technical Change*, Cambridge, Ma: MIT Press.
- Bijker, W.E. (1987): *The social construction of technological systems: new directions in the sociology and history of technology*, Cambridge, Mass. MIT Press.
- Böhme, G. & Stehr, N. (eds.) (1986): *The Knowledge Society*. Dordrecht.
- Bohn, R. E. (1994): *Measuring and Managing Technological Knowledge*, in: *Sloan Management Review* 1994.
- Boisot, M.H. (1998): *Knowledge Assets. Securing Competitive Advantage in the Information Economy*, Oxford and New York: Oxford University Press.
- Boudraou, M., Loch, K., Robey, D. and Straud, D. (1998): *Going global. Using information technology to advance the competitiveness of the virtual transnational organisation*, *The Academy of Management Executives*, 12, 4, p. 120–133.

- Brandt, G., Kündig, B., Papadimitrou, Z & Thomae, J. (1978): Computer und Arbeitsprozeß. Eine arbeitssoziologische Untersuchung der Auswirkungen des Computereinsatzes in ausgewählten Betriebs-abteilungen der Stahlindustrie und des Bankgewerbes, Frankfurt/New York.
- Braverman, H. (1974): Labour and Monopoly Capital: the Degradation of Work in the Twentieth Century, New York: Monthly Review Press.
- Bresnahan, Timothy F., Brynjolfsson, Erik & Hitt, Lorin M. (1999): Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-level Evidence. Working Paper 7136. National Bureau of Economic Research NBER Working Paper Series, May 1999.
- Brotchie, J., Hall, P. and Newton, P. (1987): 'The Transformation to an Information Society', in Brotchie, J., Hall, P. and Newton, P. (eds), *The Spatial Impact of Technological Change*, Croom Helm, London.
- Brousseau, E. & Rallet, A. (1998): Beyond Technological or Organisational Determinism: A Framework to Understanding the Link Between Information Technologies and Organisational Changes. In Macdonald, S. and Madden, G. (eds) (1998): *Telecommunications and socioeconomic development*. Elsevier Science B.V. Amsterdam.
- Brown, Phillip (1995): Cultural Capital and Social Exclusion: Some Observations on Recent Trends in Education, Employment and the Labour Market, in: *Work, Employment & Society* 1, 9.
- Brown, J.S. & Druguid P. (2000): *The social life of information*, Boston (Mass.), Harvard Business School Press.
- Brown, P. and Scase, R. (1994): *Higher Education and Corporate Realities: Class, Culture and the Decline of Graduate Careers*, London: UCL Press.
- Brunnson, N. (1985): *The Irrational Organisation. Irrationality as a Basis for Organisational Action and Change*, Chichester.
- Building the European Information Society for US All. First Reflections of the High Level Group of Experts. Interim Report, January 1996. Cited from the version available in the WWW: <http://www.ispo.cec.be/hleg/hleg-ref.html>.
- Castels, R. (1992): De l'indigence à l'exclusion: la désaffiliation, in: Donzelot (ed.): *Face à l'exclusion : Le modèle français*, Paris: Editions Esprit.
- Castells, M. (1997): *The Rise of the Network Society*, Maldon Mass./Oxford: Blackwell Publishers.
- Castells, M. (2000): *The Information Age. Economy, Society and Culture. The Rise of the Network Society*, Volume I, 2nd edition, Blackwell Publishers.
- Castels, Robert (1991): De l'indigence à l'exclusion: la désaffiliation, in: Donzelot (ed.): *Face à l'exclusion : Le modèle français*, Paris: Editions Esprit.
- Cohendet, P. & Llerena, P. (1997): Learning, Technical Change and Public Policy: How to Create and Exploit Diversity, in: Edquist, C. (ed.): *Systems of Innovation, Technologies, Institutions and Organizations*, London: Pinter.
- Commission of the European Community: White Paper on Growth, Competitiveness, and Employment – The Challenges and Ways Forward into the 21st Century. Brussels, 5 December 1993 (CEC COM (93) 700 final): Cited from the version available in the WWW: <http://www.cec.lu/en/record/white/c93700/contents.html>.
- Commission of the European Community: Europe's Way to the Information Society: an Action Plan. Brussels, 19 July 1994 (CEC COM (94) 347 final) Cited from the version available in the WWW: <http://www.sipo.cec.be/infosoc/backg/action.html>.
- Cooke Ph. and G. Schienstock (2000): Structural Competitiveness and Learning Regions, in: *Enterprise and Innovation Management Studies*, 1, 3 pp. 265–280.
- Coombs, R., Saviotti, P. and Walsh, V. (eds) (1992): *Technological Change and Company Strategies* (London: Academy Press).
- Coriat, B (1990): *L'Atelier et le robot*, Paris: Christian Bourgois Editeur.
- Crompton, R. & Sanderson, K. (1990): *Gendered jobs and social change*. London: Unwin Hyman.

- Davenport, T.H. & Prusak, L. (2000): *Working Knowledge: How Organisations Manage What They Know*. Harvard Business School Press. Boston/Massachusetts
- Davidson, W.H. & Malone, M.S. (1992): *The Virtual Corporation: Structuring and Revitalising the Corporation for the 21st Century*. Harper Business. New York.
- De Foucauld, J-B. (1992): Exclusion, inégalités et justice sociale, in: *Esprit* (Paris) 182 (june).
- Dench S (1998), *Information Skills for IT Specialists*, IES Report
- Dertouzos, M., Lester, R.K. & Solow, R.M. (1989): *Made in America. Regarding the Productive Edge*, Cambridge Mass. and London.
- Drucker, P.F. (1969): *The Age of Discontinuity. Guidelines for a Changing Society*, London.
- Earl, M. (1996): *Knowledge Strategies: Propositions From Two Contrasting Industries*. In: Earl, M. (ed): *Information Management. The Organizational Dimension*, Oxford: Oxford University Press.
- Eason, K. (1988): *Information Technology and Organisational Change*, London/New York/Philadelphia: Taylor & Francis.
- Ehn, P. (1988): *Work-oriented Design of Computer Artefacts*, Stockholm, Arbetslivscentrum.
- Enquete Kommission (1998): *Deutschlands Weg in die Informations-gesellschaft. Zukunft der Medien in Wirtschaft und Gesellschaft*. Deutscher Bundestag (ed.) Bonn: ZV Zeitungs-Verlag Service.
- Ernst, D., Lundvall, B.A. (1997): *Information Technology in the Learning Economy. Challenges for Developing Countries*, DRUID Working Paper No. 97-12.
- Esping-Andersen G. (1990): "Three Worlds of Welfare Capitalism", New York, Polity Press, 1990
- Europe and the Global Information Society: Recommendations to the European Council (Brussels, 26 May 1994): Cited from the version available in the WWW: <http://www.iaehv.nl/users/red/bangem.html>
- European Commission (1997) *Partnership for a New Organisation of Work*, Green paper, COM(1997)128 final, Luxembourg.
- European Commission (s.a): *Technology, an Instrument for Learning Organisation Development*, CCAM Contract #76246
- Flecker, J. & Schienstock, G. (1994): *Globalisierung, Konzernstrukturen und Konvergenz der Arbeitsorganisation*, in: Beckenbach, N. & van Treeck, W. (Hrsg.): *Umbrüche gesellschaftlicher Arbeit. Soziale Welt: Sonderband 9*, Göttingen, pp. 625-642.
- Freeman, Ch. (1987): *Technology policy and economic performance: Lessons from Japan*, London, Pinter Publishers.
- Freeman, Ch. & Soete, L. (1994): *Work for all or Mass Unemployment?* London: Pinter.
- Frenkel, St., Korczynski, M, Donoghue, L. & Shire, K. (1993): *Re-constituting Work: Trends towards Knowledge Work and info-normative Control*, in: *Work, Employment and Society*, Vol. 9, No 4.
- Friedman A.L. (1977), *Industry and Labour*, The MacMillan Press, London.
- Fulk, J. & De Santis, G. (1995): *Electronic Communication and Changing Organizational Forms*, in: *Organization Science*, Vol. 6, No 4.
- Gentsch, P. (1999): *Wissen managen mit innovativer Informationstechnologie. Strategien – Werkzeuge – Praxisbeispiele* (Gabler: Wiesbaden).
- Giddens, A. (1979): *Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis*, London.
- Gillespie, A. (1993): 'Telematics and its Implications for Industrial and Spatial Organization', *Regional Development Dialogue, Vol. 14*, No 2.
- Gillespie, A. and Robins, K. (1989): *Geographical inequalities: the spatial bias of the new communication technologies*, in: *Journal of Communication*, 39, 3, pp. 7-18.

- Glazer, R. (1991): Marketing in an Information-Intensive Environment: Strategic Implications of Knowledge as an Asset, in: *Journal of Marketing*, 55.
- Gomes- Casseres, B. (1994): Group vs. Group: How Allinace Networks Compete, in: *Harvard Business Review* 92, pp. 62–66.
- Goldsmith, N. (1991): Linking IT Planning to Business Strategy, in: *Long Range Planning*, 24, 6.
- Grandori, A. & Soda, G. (1995). Inter-firm networks: Antecedents, mechanisms and forms. *Organization Studies*, 16(2), pp. 183–214 .
- Greenbaum, J. (1998): The Times They are A'Changing: Dividing and Recombining Labour Through Computer Systems, in: Thompson, P. and Warhurst, Ch. (eds), *Workplace of the Future*, MacMillan: Houndsmill and London.
- Hage J. & Alter, C. (1997): Typology of Intraorganisational Relationships and Networks, in: Hollingsworth, R., & Boyer, R. (eds): *Contemporary Capitalism. The Embeddedness of Institutions*. Cambridge University Press, pp. 94–126.
- Harvey, D. (1989): *The Condition of Postmodernity*, Basil Blackwell, Oxford.
- Hedlund, G. & Rolander, D. (1990): Action in Heterarchies - New Approaches to Managing the MNC, in: Bartlett, C.A., Doz., & Hedlund, G. (eds): *Managing the Global Firm*, London/New York: Routledge.
- Heidenreich, M. (1995): *Informatisierung und Kultur: die Einführung und Nutzung von Informationssystemen in italienischen, französischen und westdeutschen Unternehmen*. Opladen: Westd.Verlag
- Hepworth, M. (1989): *Geography of the Information Economy*, Belhaven Press, London.
- High Level Group on the Information Society (1994): *Europe and the global information society. Recommendations to the European Council*, Brussels.
- Hildebrandt, E. and R. Seltz (1989): *Wandel betrieblicher Sozialverfassung durch systemische Kontrolle? Die Einführung computergestützter Produktionsplanungs- und -steuerungssysteme im Bundesdeutschen Maschinenbau*, Sigma Verlag: Berlin.
- Hillage, J. & Pollard, E. (1998): *Defining Employability*, Draft Report to DfEE.
- Huws, U., Hurstfield, J. & Holtmaat, R. (1989): *What Price Flexibility?: the Casualisation of Women's Employment*, Low Pay Unit, London.
- Huws U, Honey S, Morris S (1996): *Teleworking and Rural Development*, Rural Development Commission
- Huws, U. (1998): *Flexibility and Security: Towards a New European Balance*, Citizens Income Trust, London.
- Huys R. & Van Hootehem G. (1998), 'The Belgian literature report for Sowing', as part of G. Schienstock, G. Bechmann, J. Flecker, U. Huws, R. Huys, M. Mirabile, A. Moniz & S. O'Siochru (1998), *Information Society, Work and the Generation of New Forms of Social Exclusion (SOWING)*, Literature reports, University of Tampere, Work Research Centre, Tampere.
- Huws, U., Jagger, N. and O'Regan, S. (1999): *Teleworking and Globalisation*.
- Johannison, B. (1987): *Beyond Process and Structure: Social Exchange Networks*. *International Studies of Management and Organisation*, 17 (1).
- Jäger, W. (1999): *Reorganisation der Arbeit. Ein überblick zu aktuellen Entwicklungen*. Opladen/Wiesbaden: Westdeutscher Verlag.
- Kaplinski, R. (1986): *Microelectronics and Work Revisited: A Review*, report prepared for the International Labor Organisation, Brighton: University of Sussex Institute of Development Studies.
- Karasek, R. & Theorell, T. (1990): *Healthy work. Stress, productivity and the reconstruction of working life*, Basic Books Inc., New York, ISBN: 04-6502-896-9.

- Kavangh, D. & Arujo, L. (1997): Folding and unfolding time. *Accounting Management and Information Technology* 5/2.
- Keen, P. (1991): *Shaping the Future*. Harvard Business School Press: Boston.
- Kern, H. & Schumann, M. (1984): *Das Ende der Arbeitsteilung? Rationalisierung in der industriellen Produktion: Bestandaufnahme, Trendbestimmung*, Muenchen: Beck.
- Kern, H. and Sabel, Ch. (1994): *Verlässliche Tugenden. Zur Krise des deutschen Produktionsmodells*. In: Beckenbach, Niels/ vam treeck, Werner (Hrsg.): *Umbrüche gesellschaftlicher Arbeit*. Sonderband 9 der Sozialen Welt, S. 239–251.
- Kling, R. (1987): 'Defining the boundaries of computing across complex organisations', in R. Boland and R. Hirschheim (eds): *Critical Issues in Information Systems Research*. Wiley, New York.
- Kling, R. (1991): *Computerization and Social Transformation*, in: *Science, Technology and Social Values* 17, 3, pp. 342–367.
- Knights, D., Noble, F., and Willmott, H. (1997): 'We Should be Total Slaves to the Business': *Aligning Information Technology and Strategy-Issues and Evidence*, in: Bloomfield, B., Coombs, R., Knights, D. and Littler, D. (eds.): *Information Technology and Organisations*, Oxford University Press: Oxford, New York, pp. 13-35.
- Krämer, S. (1989): *Geistes-Technologie. Über syntaktische Maschinen und typographische Schriften*, in: Rammert, W. & Bechmann, G (Hrsg.): *Technik und Gesellschaft. Jahrbuch 5: Computer, Medien, Gesellschaft*, Frankfurt/New York.
- Kumar, K. (1997): *From Post-Industrial to Post-modern Society: New Theories of the Contemporary World*. Blackwell Publishers Ltd, UK.
- Lam, A. (2000): *Tacit Knowledge, Organisational Learning and Social institutions: An Integrative Framework*, in: *Organizational Studies*, 21, 3, 487–513.
- Latour, B. (1992): 'Where are the Missing Masses? The Sociology of a Few Mundane Artefacts', in W. Bijker, J. Law (eds) *Shaping Technology/Building Society: Studies in Sociotechnical Change*, Cambridge, MA: MIT Press.
- Lavoie, Marie and Therrien, Pierre (1999) *Employment Effects of Computerization, 1971-1991*, Applied Research Branch, Human Resources Development Canada, Ottawa
- Lewicki, R.J. & Bunker, B.B. (1996): *Developing and maintaining trust in work relationships*. In R.M. Kramer & T-R. Tyler (eds), *Trust in Organizations: Frontiers of Theory and Research*. Thousand Oaks; CA: SAGE Publications, Inc.
- Lillrank, P. with Holopainen, S., Lehtovaara, M. & Sipka, S. (1996): *The Impact of Information and Communication Technologies (ICT) on Business Performance. A Constructive Empirical Study and Philosophical Enquiry*, Otaniemi.
- Lipsey; R.G. (1999): "Sources of Continued Long-run Economic Dynamism in 21st Century" *The Future of the Global Economy*, OECD, Paris.
- Lucas, H. C. Jr. & Barondi, J. (1994): *The Role of Information Technology in Organisation Design*, in: *Journal of Management Information Systems* 10, 4.
- Luhmann, N. (1994): *Inklusion und Exklusion: Nationales Bewußtsein und kollektive Identität: Studien zur Entwicklung des kollektiven Bewußtseins in der Neuzeit 2*; hrsg. v. Helmut Berding; Frankfurt am Main: Suhrkamp.
- Lundvall, B-Å & Johnson, B (1993): *The learning economy*, in: *Journal of Industry Studies*, 1, 2.
- Lundvall, B.Å. and S. Borrás (1997), *The globalising learning economy: Implications for innovation policy*, European Commission, Targeted socio-economic research, EUR 18307.
- Lutz, B. (1987): *Wie neu sind die neuen "Produktionskonzepte"?* In: Malsch, Th. & R. Seltz (Hrsg): *Die neuen Produktionskonzepte auf dem Prüfstand. Beiträge zur Entwicklung der Industriearbeit*. Sigma Verlag: Berlin 1987.
- Lyon, D. (1988): *The Information Society. Issues and Illusions*, Cambridge, Mass.: Polity Press.

- Malone, T.W. and Laubacher, R.J. (1998): "The Dawn of the E-Lance Economy", Harvard Business Review, September-October.
- Margherio, L., Henry, D., Cooke, S., and Mones, S. (1997) The Emerging Digital Economy, US Department of Commerce Secretariat for Electronic Commerce, Washington.
- Massey, D. (1984): Introduction: geography matters, in: D Massey and J. Allen (eds): Geography matters, Cambridge University Press: Cambridge pp 1-11.
- Maurice, M. (1995): 'The social foundations of technical innovation: engineers and the division of labour in France and Japan' in The new division of labour: emerging forms of work organisation in international perspectives. Wolfgang Littek and Tony Charles (eds.), 317-347. New York: Walter de Gruyter.
- Maurice M., Sellier, F. and Silvestre, J.J (1986): The social foundation of industrial power, Cambridge Mass., MIT Press.
- McCracken, G. (1988): Culture and Consumption: New Approaches to the Symbolic Character of Consumer Goods and Activities. Bloomington: Indiana University Press.
- Miles, I. & Robins, K. (1994): Making sense of information, in: Robbins, K. (ed.), Understanding Information Business, Technology and Geography, London/New York: Belhaven Press.
- Miles, I. & Kastrinos, N., with Flanagan, K., Bilderbeek & den Hertog, P. with Huntink, W. & Bouman, M. (1995): Knowledge-Intensive Business Services: Users, Carriers and Sources of Innovation, in: European Innovation Monitoring System (EIMS), EIMS Publication N° 15.
- Mintzberg, H. (1979): The Structuring of Organizations. A Synthesis of the Research. The Theory of Management Policy Series, Prentice-Hall.
- Moniz, A. B./ Kovacs, I. (Coord) (1997): Evolução das Qualificações e das Estruturas de Formação em Portugal, Instituto do Emprego e Formação Profissional - IEFP, Lisboa.
- Moniz, A.B. (1998): Políticas de emprego e sociedade da informação: para uma sociedade do conhecimento. In: Sociedade e Trabalho, MTS.
- Moss, M. (1987): 'Telecommunications and International Financial Centres' in Brotchie *et al.* (eds.) (1987) *The Spatial Impact of Technological Change*, Croom Helm, London.
- Murray, F. & Willmott, H. (1995): Putting Information Technology in Its Place: Towards Flexible Integration in the Network Age? In: Bloomfield, B. & Coombs, R., Night, P. & Littler, D. (eds.): *Information Technology and Organisations*. Oxford University Press: Oxford and New York, pp. 162-187.
- Nasse, Phillipe (1992): Exclue et exclusions. Connaitre les populations, comprendre les processus, Paris, Commissariat Général du Plan, Jan.
- Nonaka, I. and Takeuchi, H. (1995), *The Knowledge-Creating Company*, Oxford University Press, New York.
- OECD (1998): Report on Human Capital Investment. OECD Paris.
- OECD (1998): The OECD Jobs Strategy. Technology, Productivity and Job Creation. Best policy practices, Paris.
- OECD (2000b): "Promoting Innovation and Growth in Services", Science, Technology and Industrial Outlook 2000, OECD; Paris.
- Parcey, A. (1983): *The Culture of Technology*, Oxford/New York.
- Paugam, Serge (1993): *La société française et ses pauvres*, Paris: Presses Universitaires de France.
- Perez, C. (1985): Microelectronics, long waves and world structural change: new perspectives for developing countries. *World Development*, 13 (3).
- Picot, A. (2000): Die Transformation der Wirtschaft in der Informationsgesellschaft. In *Frankfurter Allgemeine Zeitung*, Donnerstag 24 Februar 2000, Nr 46, S. 29.
- Piore, M. & Sabel, C.F. (1984): *The Second Industrial Divide - Possibilities for Prosperity*. New York: Basic Books.
- Polanyi, M. (1958/1978), *Personal Knowledge*, Routledge & Kegan Paul, London.

- Porat, M.U. (1976): *The Information Economy*. Stanford University.
- Powell, W.W. (1990): Neither Market nor Hierarchy: Network Forms of Organisation, in: *Research on Organisational Behaviour*, 12, 295–336.
- Regini, M. (2000): *Between De-Regulation and Social Pacts. The Responses of European Capitalism*, New York: Vintage.
- Robins, K. & Gillespie, A. (1994): Communication, organisation and territory, in: Robbins, K. (ed.), *Understanding Information Business, Technology and Geography*, (London/New York: Belhaven Press).
- Robins, K & Webster, F. (1997): *From ICTs to Information: Changing Conceptions of the Information Age*, Oxford, unpublished paper.
- Rocha, G. *et al.* (1999) *A situação das mulheres nos Açores*, CES-UA, Ponta Delgada.
- Room, G. *et al.* (1992): *Observatory on national policies to combat social exclusion. Second Annual Report. Report to the Commission of the European Communities*. Lille, European Economic Interest Group: Animation and Research.
- Ruigrok, W. & van Tulder, R. (1995): *The Logic of International Restructuring*, London: Routledge.
- Sahay, S. (1997): Implementation of Information Technology: A Time-Space Perspective, in: *Organization Studies* 18, 2.
- Sampler, J. (1996): Exploring the Relationship Between Information Technology and Organizational Structure. In: Earl, M. (Ed): *Information Management. The Organizational Dimension*, Oxford: Oxford University Press.
- Sassen, S. (1991) *The Global City: New York, London, Tokyo*, Princeton University Press, Princeton.
- Serra, H. (1996/7): Novas tecnologias: influências na organização do trabalho. In: *Organizações & Trabalho*, Lisboa, 16/17: 145–164.
- Schein, E.H. (1986): *Organisational Culture and Leadership: A Dynamic View*, San Francisco, London.
- Schienstock, G. (1993): Management als sozialer Prozeß. Theoretische Ansätze zur Institutionalisierung, in: Ganter, H.-D. & Schienstock, G (Hrsg.): *Management aus soziologischer Sicht. Unternehmensführung, Industrie- und Organisationssoziologie*, Wiesbaden: Gabler Verlag.
- Schienstock, G. (1997): The transformation of regional governance: institutional lock-ins and the development of lean production in Baden-Württemberg, in: Whitley, R & Kristensen, P.H. (eds): *Governance at work: the social regulation of economic relations in Europe*, Oxford: Oxford University Press.
- Schienstock, G. (2001): Social Exclusion in the Learning Economy, in: Archibugi, D.A. & Lundvall, B-Å. (eds): *The globalizing learning economy*, Oxford: Oxford University Press.
- Schienstock, G. and Hämäläinen T. (2001): Transformation of the Finnish innovation system. A network approach, *Sitra Reports series 7*, Hakapaino Oy: Helsinki.
- Sewell, G. and Wilkinson, B. (1992): Surveillance, Discipline and Just-in-Time Process, in: *Sociology* 26,2, pp. 271–289.
- Shaiken, H. (1984): *Work Transformed: Automatisatation and Labour in the Computer Age*, New York: Holt, Rinehart and Winston.
- Soete, L. (1996): Social impacts of the information society - National and community level, in: *Finnish Institute of Occupational Health, Work in the Information Society*, Helsinki.
- Soete L. (2001): *The New Economy: A European Perspective*, in: D. Archibugi and B.Å Lundvall (eds): *The Globalizing Learning Economy*, Oxford University Press, Oxford and New York, pp. 21–44.
- Soete, Luc and Bas ter Weel (1999): *Innovation, knowledge creation and technology policy in Europe*. Unpublished paper, Maastricht University.

- Somogyi, E.K. and Galliers, R.D. (1997): Information technology in business: from data processing to strategic information systems. In: Galliers, R.D. and Baker, B.S.H: Strategic Information Management: Challenges and Strategies in Managing Information Systems.
- Sorge, Arndt and Warner Malcolm (1986) Comparative factory organisation: an Anglo-German comparison of manufacturing, management and manpower. Aldershot: Gower, 1986
- Stahl, Th., Nyhan, B. & D'Aloja, P. (1993): The Learning Organisation. A Vision for Human Resource Development, Commission of the European Communities 1993.
- Stichweh, R. (1997): Inklusion/Exklusion, funktionale Differenzierung und die Theorie der Weltgesellschaft. Soziale Systeme; 1, 3.
- Storper, M. (1997): The regional World: Territorial Development in a Global Economy, The Guilford Press, New York.
- Strassmann, P. (1985): Information Payoff: The Transformation of Work in the Electronic Age, New York: Basic Books.
- Swidler, A. (1986): Culture in Action: Symbols and Strategies, in: American Sociological Review 51.
- Tapscott, D. (1995): Digital economy. Promise and Peril in the Age of Networked Intelligence (McGraw-Hill: New York)
- Teubner (1990): Die Vierköpfige Hydra: Netzwerke als kollektive Akteure höherer Ordnung. In Kuhn, W. & Küpters, G. (Hrsg) Emergenz: Die Entstehung von Ordnung, Organisation and Bedeutung. Frankfurt am Main, S. 189–216
- Thurow L.C. (1999): Building Wealth. The New Rules for Individuals, Companies, and Nations in a Knowledge-Based Economy, Harper Collins Publishers: New York.
- Touraine, A. (1969): La Société post-industrielle, Paris: Denoel.
- Viegas, J.M. and Costa, A.F. (orgs) (1998): Portugal, Que Modernidade?, Celta Editora Oeiras.
- Walsh, J. & Ungson, G. (1991): Organizational Memory. Academy of Management Review, 16.
- Walsham, G. (1993): Interpreting Information Systems in Organisations, Chichester, John Wiley & Sons.
- Ward, J., Griffiths, P., and Whitmore, P. (1990): Strategic Planning for Information Systems (Chichester: Wiley)
- Webster, F. (1995): Theories of the Information Society, London and New York: Routledge.
- Whitley, R. (1992): European business systems: Firms, markets and societies, London: Sage.
- Willke, H. (1989): Controlling als Kontextsteuerung. Zum Problem dezentralen Entscheidens in vernetzten Organisationen, in: Eschenbach, R. (Hg.): Supercontrolling: Vernetzt denken, zielgerecht handeln. (Wien: Service Verlag) pp. 63–93.
- Williams, R., I. Graham and J. Spinardi (1995): The Social Shaping of Electronic Data Interchange (EDI), in European Commission (ed.): The Social Shaping of Interorganisational IT Systems and Electronic Data Interchange, COST A4, Brussels, Luxembourg, Office for Official Publications of the European Commission.
- Williamson, O. E. (1985), The Economic Institutions of Capitalism, New York: Free Press.
- Womack, J. P. & Jones, D. T. & Roos, D. (1990): The Machine That Changed the World. New York: Macmillan.
- Wouters, C. (1992): On Status Competition and Emotion Management, in: Theory, Culture and Society 9, pp. 229–252.
- Wyatt, S. (1998): Technology's Arrow. Developing Information Networks for Public Administration in Britain and the United States, Proefschrift, Universitaire pres Maastricht.
- Xiberras, M. (1993): Les théories de l'exclusion. Paris: Meridiens Klincksieck.
- Yépez del Castillo, I. (1994): A comparative approach to social exclusion: Lessons from France and Belgium, in: International Labour Review, 133, 5–6.

- Zuboff, S. (1988): In the Age of the Smart Machine: The Future of Work and Power. Oxford: Heinemann
- Zuscovitch, E. (1983): Informatisation, flexibilité et division du travail, in: Revue d'Economie Industrielle, 25.