European Foundation for the Improvement of Living and Working Conditions

Work organisation, technology and working conditions

Work organisation, technology and working conditions

About the authors
Steven Dhondt (PhD) is a senior researcher at TNO Work and Employment, the Netherlands, where he leads a research group that investigates the relationship between information and communication technology and work outcomes. **Karolus Kraan** (MA) is a researcher at TNO Work and Employment, and is currently working on a doctoral thesis on organisational and technological change in the Netherlands. **Guurtje van Sloten** (MA) is a junior researcher at TNO Work and Employment, currently investigating the areas of knowledge management and teamwork.

European Foundation for the Improvement of Living and Working Conditions

Work organisation, technology and working conditions

Steven Dhondt, Karolus Kraan and Guurtje van Sloten

Wyattville Road, Loughlinstown, Dublin 18, Ireland - Tel: (+353 1) 204 31 00 - Fax: (+353 1) 282 42 09 / 282 64 56
e-mail: postmaster@eurofound.eu.int - website: www.eurofound.eu.int

Cataloguing data can be found at the end of this publication

Luxembourg: Office for Official Publications of the European Communities, 2002

ISBN 92-897-0140-4

The European Foundation for the Improvement of Living and Working Conditions is an autonomous body of the European Union, created to assist in the formulation of future policy on social and work-related matters. Further information can be found on the Foundation website at www.eurofound.eu.int.

European Foundation for the Improvement of Living and Working Conditions
Wyattville Road
Loughlinstown
Dublin 18
Ireland
Telephone: (+353 1) 204 31 00
Fax: (+353 1) 282 42 09 / 282 64 56
E-mail: postmaster@eurofound.eu.int
www.eurofound.eu.int

Printed in Ireland

The paper used in this book is chlorine-free and comes from managed forests in Northern Europe.
For every tree felled, at least one new tree is planted.

Foreword

European industrial society is gradually transforming itself into a knowledge society, a trend which has implications for all citizens of the European Union. Some changes are predictable – the increased pace of innovation, rapid deployment of new technologies – but many of the consequences of these changes in terms of how we work have yet to be adequately analysed. For example, more and more workers have to deal with direct demands from customers and colleagues in their daily work. Research also confirms that during the 1990s there was a trend towards increased autonomy or job control while at the same time individuals are faced with increased pressures arising from work intensification. Such changes have an impact on working conditions, the health of workers, the skill requirements of workers and on their motivation.

Data from the Foundation's Third European Survey on Working Conditions (2000) allow us to analyse some of these relationships. The survey addresses issues connected to the physical, organisational and social work environment as well as the consequences of work on the health of those employed. The comparison of data from earlier working conditions surveys gives an insight into how the European workplace and European society are changing.

Using the Survey as a basis, this report describes the relationship between technology, work organisation patterns and working conditions and identifies trends and changes in work organisation and the use of technology.

Raymond-Pierre Bodin
Director

Eric Verborgh
Deputy Director

Contents

Introduction

The European Union has seen some significant technological changes during the last decade. The personal computer, computer networks and the Internet have brought the Union into the Information Age. These technological changes have inevitably led to changes in the work environment and the quality of working conditions.

For the third time, the European Foundation for the Improvement of Living and Working Conditions has carried out a questionnaire-based survey on working conditions throughout the European Union, covering all Member States. Previous surveys were carried out in 1991 and in 1995/6[1]. The latest survey was carried out in May 2000 and the results give us some interesting insights into recent changes in working conditions (Paoli and Merllié, 2001). The questionnaire addresses issues relating to the technological, physical, organisational and social work environments, as well as the impact of work on health. Although new questions have been added to the 2000 survey, a number of questions remain the same (core questionnaire), so as to enable the building of time series.

The Foundation has asked TNO Work and Employment to make a statistical analysis of the data relevant to work organisation, technology and working conditions[2]. In addition, trends based on a comparison with previous Foundation surveys will be highlighted. Whenever relevant and possible, results and trends are compared to other data sources (e.g. national surveys, labour force surveys, etc.).

This report begins with a model for the analysis of the relationship between work organisation, technology and working conditions, based on the 'job demands-job control' model (Karasek and Theorell, 1991). TNO has used this model in previous studies for the Foundation (Dhondt, 1994b; 1998). The model, concepts and definitions are clarified in Chapter 2 of this report. The model is broadened for the new technological work situations. The results of the project are described in Chapter 3. The results of the separate analyses are presented in the appendices.

1 We will use the following abbreviations for the Foundation surveys: EF1991, EF1996 and EF2000.

2 The Dutch term for working conditions is 'arbeidsomstandigheden'. This concept can mean two things: 'conditions under which someone works' or 'effects of conditions under which one works'. We will use this concept in the second sense, as a dependent variable.

Model for the analysis of technology and work organisation

1

The issues of technology and work organisation are ranked high on the agenda of the European Commission. Before working out the model for the analysis of these topics in the Foundation surveys, we want to show how these topics are being dealt with by the European Commission and other European institutions. The model for the analysis will be dealt with below.

Policy background

In order to study the relationship between work organisation, technology and working conditions, the European Commission created a working group called EWON (European Network on Work Organisation) in 1998 to advise about the subject (European Commission, 1998). In a recent paper, the Economic and Social Committee (ECOSOC: 2000/C 117/13), gave its opinion on employment, economic restructuring and social cohesion. This paper provides some interesting information about the relationship between work organisation and working conditions. According to this paper, too few companies in the European Union implement innovations or use the knowledge available to them. The European Union should orient itself towards a European production paradigm. The main elements of this paradigm are:

- the highest possible economic growth, coupled with the lowest possible social exclusion and conflict;
- a competing economy and the preservation of a competing social model;
- optimal use of computers within the framework of a strategy that is to the benefit of social and natural resources and environments;
- the preservation of a culture of durability and an adequate entrepreneurial culture, based on a creative approach of lifelong learning and solidarity.

The motivating factors behind this production paradigm are:

- global competition;
- productivity in all sectors;
- human skills;
- restructuring, with IT as a motor, oriented at less hierarchy and more outsourcing;
- the development of the service sector and the stimulation of service employment;
- the rise of flexible working conditions (working places, working hours), more adapted to the 'rhythms of life'.

The ECOSOC paper also concerns itself with the risks and opportunities inherent in these structural changes:

- Knowledge becomes obsolete more quickly, which requires different approaches to training.

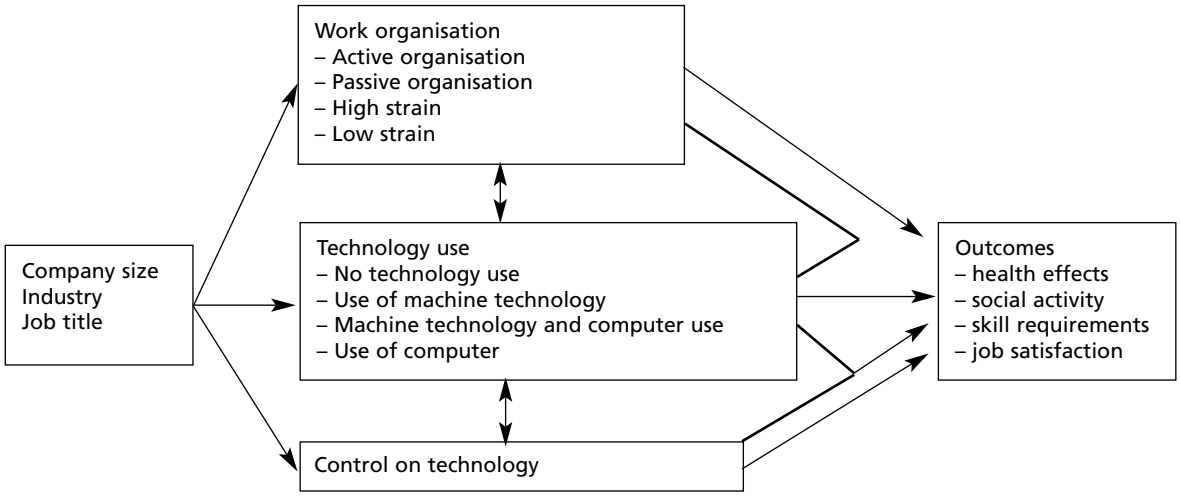
- Labour-intensive industries are replaced with capital-intensive industries, which require better-trained employees and more employee- and company-oriented services.
- New forms of work that give workers more responsibilities and more autonomy are required. Social skills are necessary at every level of the company.
- Job change will occur more often, as well as new contractual relationships (e.g. self-employed).
- High unemployment for workers with low education levels occurs. Training systems need to adapt themselves to this situation.

Information from Foundation research stemming from the surveys can help to address these concerns.

A research model for work organisation, technology and working conditions

Figure 1 summarises the different variables and concepts used for the analysis of the EF2000 survey on technology, work organisation and working conditions.

Figure 1 Analytical framework for the study of technology, work organisation and working conditions



Source: EF2000 survey

Firstly, we are interested in identifying different technologies in the work situation. Our approach is to separate work situations with 'new technology' from situations with 'old technology'. 'New technology' work situations comprise those in which computer use is required. 'Old technology' work situations comprise those in which technology is present (mechanisation, etc.) but in which computer use is not required. We will use the definitions 'use of computer' and 'use of machine technologies'. Using such definitions, there remains a third work situation, which is a technology-free work situation. We are mainly interested in describing the differences in working conditions for each of these work situations, but we will also look at the relationship between these work situations and work organisation.

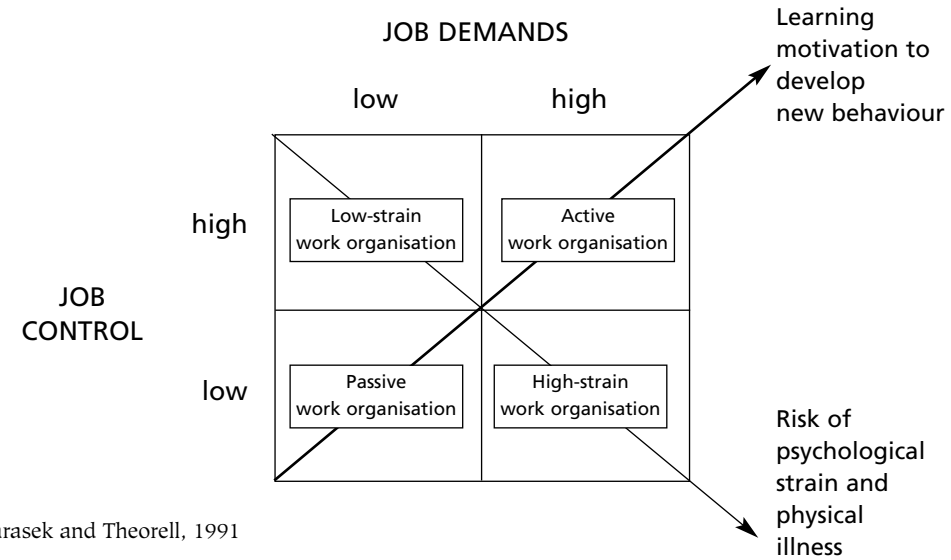
Working conditions can be seen as the requirements that work imposes on the worker. These requirements can vary considerably according to the focus used. When the focus is on work organisation, psychosocial working conditions have to be taken into account. Two dimensions in psychosocial working conditions are important: psychological strain (stress) and competence levels.

Working conditions are influenced by the *work organisation*. There are different research approaches to work organisation. The 'socio-economic' approach, predominant in France, focuses on aspects of work organisation and the functioning of enterprises, according to Rantanen *et al* (2001). In this report, we will approach work organisation from a psychosocial perspective. We will look at the psychosocial consequences that work organisation has on the health and well-being of workers. This approach is more suited to surveys such as the Foundation surveys. The type of work organisation can be described using two major dimensions: time constraints (job demands) and job autonomy (job control). Using these two dimensions, four types of work organisation can be distinguished:

- Active work organisation — workers experience high levels of demands but at the same time enjoy enough opportunities to control these demands.
- Passive work organisation — workers experience no job demands and have no control of possibly changing features of the work situation.
- High-strain work organisation — workers experience high demands but have no way of controlling what happens. They have to passively adapt to ever-changing and possibly conflicting demands.
- Low-strain work organisation — workers experience low demands and have enough control to deal with problems.

Figure 2 summarises the types of work organisation that result from the different combinations of time constraints and job autonomy.

Figure 2 The 'time constraints-job autonomy' model



Source: Karasek and Theorell, 1991

This model contains two predictions. First, psychological strain increases as time constraints increase, relative to decreasing job autonomy. Second, competency levels increase when demands are matched with the required levels of control. This means that passive work organisations might be attractive from a strain point of view, but in such work organisations, workers have no opportunities to develop their skills. Workers in high-strain work organisations are at risk of coronary heart disease, hypertension and arteriosclerosis.

The model and the EF2000 survey

To measure the above concepts, there are several questions from the EF2000 survey that can be used. There are, however, no direct questions that identify technologies or work organisation, So, in order to measure work organisation, we will use the constructs used in a previous study (Dhondt, 1998). The validity of the use of these variables has been thoroughly tested. The central questions in the current questionnaire to measure work organisation deal with time constraints (D1b/c) and job autonomy (D5, D7).

Technology can be measured in an indirect way:

- machine technology: any work situation without computer use, but in which machines or automation is present. In the EF2000 survey, these work situations can be identified with the questions B1 (vibrations from hand tools, machinery), D2d (automatic speed of a machine or moving of a product), D3 (interruptions by machines).
- use of computers: any work situation in which computer use is required (B2d, B2e).
- technology-free: the remaining work environments.

The following work outcomes can be measured: skill requirements (D8, D9), health effects (F1, F2, F3), absenteeism (F4), satisfaction (F5), social activity (G5).

This central model can be enlarged with more concepts/variables. There are several other elements in the work organisation that are relevant to the study of working conditions:

- Work organisations can be investigated for the degree to which short repetitive tasks are dominant. Such work organisations are known as tayloristic work organisations (D1, D2c/d, D4d). The opposite of such work organisations are those that require high skills from workers (D4a, b, c, e).
- Another dimension of work organisations that can be investigated is the constraints that are placed on workers: demands from colleagues, customers or the boss (D2, D3).
- The area of job autonomy can also be broadened by looking at the opportunities workers have of getting help from colleagues (D6), and other control opportunities (D6, D7).
- With correlation and factor analysis, the association between the different work organisations will be analysed. We will try to see which typology of work organisations can arise.

In addition to working conditions, we will also look at the relationship between technology and other variables. An important question is to what degree workers control the technologies used in

the company (D3b, E2b). Such control can work as an intermediate variable in the relationship between technologies and certain health or other effects.

Analytical framework and research questions

Analytical framework

The data from the survey(s) will be used to:

- describe the relationship between technology, work organisation patterns and working conditions;
- identify trends and changes in technological work situations insofar as the survey methodology (questionnaire survey to workers) allows it.
- identify trends and changes in work organisation insofar as the survey methodology (questionnaire survey to workers) allows it.

The analytical framework used for this analysis of the EF2000 survey is summarised in Figure 1. In addition to these concepts, it is important to measure the following company or organisational dimensions and job dimensions:

- Company dimensions, organisational dimensions:
  - company size: self-employed, small, large (A9);
  - branch (A7, A8).
- Job dimensions:
  - job title (A4).

Figure 1 shows which relationships between the variables will be investigated. This framework is used for the analysis of the EF2000 survey. For the trend analysis, the data for the separate cross-sectional analyses will be put next to one another. Because the data of the different surveys are not correlated, no longitudinal analysis is possible.

Research questions

The central questions for the analysis of technology, work organisations and working conditions are:

- What technological situations exist in Europe?
- What changes can be seen over time?
- What work organisations are dominant in Europe?
- Are there changes to be seen in the work organisation used?
- How are technology and work organisation correlated?
- Can improvements in technology and work organisation be detected and can the 'health effects' of working conditions be seen?

These central questions will be investigated with the following more detailed questions:

For the current situation (EF2000):

- What is the main situation for technology and work organisation in Europe? Are there differences according to country, industry and profession?
- What are the main results for the correlation between technology, work organisation and working conditions in Europe? Are there differences according to country, industry and profession?

Developments over time (EF1991, EF1996, EF2000):

- What are the main developments in Europe for technology and work organisation? Are there differences according to country, industry and profession? For technology, we will mainly orient ourselves towards the use of computers and telework.
- What are the main developments in Europe for the correlation between technology, work organisation and working conditions? Are there differences according to country, industry and profession?

Methodology and analysis

Situation 2000

The following methodology for the analysis of the EF2000 data will be used:

- Step 1: Analysis of the quality of the data. Comparable data are available for several countries. The results from the EF2000 survey will be compared to these results. (For more information about data sources see Chapter 3 of this report.)
- Step 2: Construction of concepts. The main concepts as identified above will be constructed by means of correlation and factor analysis. Whenever possible, scales will be constructed in order to comprise the information and increase the reliability of work organisation and working conditions. In order to keep comparability across scales with more and less items, Z-scores will be calculated (mean = 0, sd = 1).
- Step 3: Description of the relationship between work organisation patterns and working conditions, by means of:
  - cross-tabulation;
  - regression analysis.

Trend analysis

The following analysis steps will be executed:

- Step 4: Analysis of comparability of the data. The trend analysis will be limited to those countries that participated in the three surveys. The data will be presented at European level. The total sample per year will be somewhat reduced, not only by the absence of several countries, but also because the sample per country was n = 1000 in the first two surveys, which is only two-thirds of the sample in the third survey. Some more grouping may be necessary for the trend analyses.
- Step 5: Identification of trends and changes in technology and work organisation insofar as the survey methodology (questionnaire survey to workers) allows it, by means of:

– cross-tabulation;
– construction of time series.

Data sources

The main goal of this project was to use European-level data. For comparison purposes, we looked at other nationally representative data on work organisation and working conditions. A request was be made to Germany, the Nordic countries, Spain, France and Austria for certain questions from their questionnaires. These results will be included in a separate supplement to the report (Appendix 5). (For more information about the methodology, see Dhondt, 1998; Lindström *et al*, 1995.)

Results 2

Analysis of the quality of the data and the constructs

In this chapter, we will look at the quality of the separate dimensions that we have distinguished in Figure 1 of this report. The construction of these variables is clarified in Appendix 1 of this report. The analyses are limited to employed workers. A separate analysis of questions for self-employed workers is given in Appendix 6. For the analyses, we have used unweighted data unless otherwise stated.

Technology, work organisation and technology control

Our first research goal is to ascertain the overall situation with regard to technology and work organisation in Europe. Our first variable is technology. In Figure 3, the distribution of technology use is shown for all employed workers.

We can see that just slightly more than one-third of workers report no use of technology in their work situation. Another third of workers use computers, whilst the rest of the employed use only machine technologies or machine technologies combined with computers.

There might be some under-reporting for the use of machine technology because this question wasn't formulated in a direct fashion.

Figures 4, 5 and 6 further clarify the quality of this new variable. Figure 4 compares the use of technology between countries. The Netherlands has the highest use of computer technology, with some 70% of workers using some kind of technology. Portugal is at the other end of the spectrum with nearly half of the workers not using any kind of technology. The graph shows that more workers in the northern European countries use some kind of computer technology than in the southern European countries. The exception is Germany, where the use of computers is relatively limited. This is partly because the eastern part of Germany has fewer workers using computers than the western part. This fact is also seen in the German reports (see Dostal *et al*, 2000).

Figure 5 shows how different jobs involve different kinds of technology use. It is understandable that service workers and shop and market sales workers have the lowest degree of use of any kind of technology. Such jobs involve more customer contact or simple tasks without the use of technology. However, such workers might well use teller machines and/or telephones, but the survey does not make this distinction. Most other white-collar workers use computers. Most blue-collar workers do not use computers; they mainly use machine-related technology. The EF2000 survey doesn't allow for detecting the degree to which these machines have some kind of computer controls, however.

In Figure 6, the use of technology is shown according to industrial sector. In typical white-collar sectors, such as the financial sector and public administration, the use of computers is quite high. In traditional blue-collar sectors, such as the manufacturing industries and construction, the use of machine-related technology is high. Hotels and restaurants do not use any of the technologies identified. The results shown in Figures 5 and 6 are in line with common opinion about such use. These results strengthen the validity of the questions that are used in the EF2000 survey. We can therefore use this variable in the following analyses.

Figure 3 Proportion of workers using technology in the EU

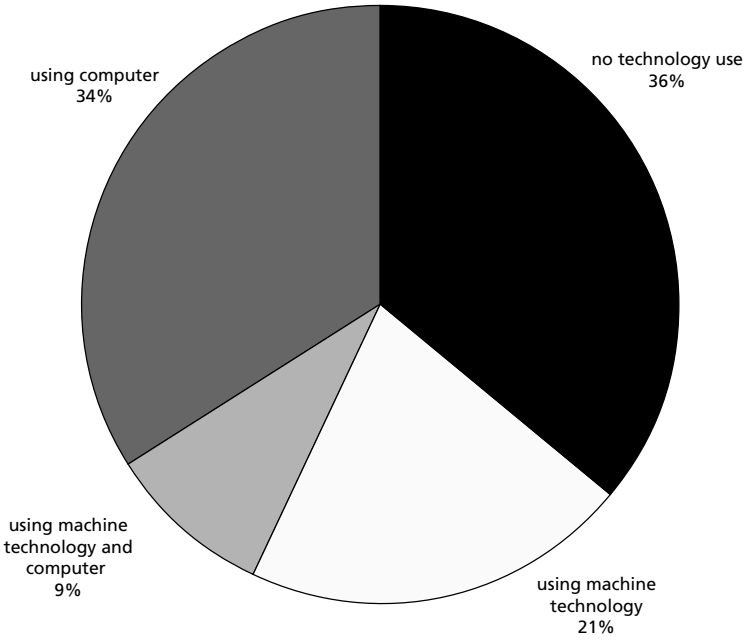


Figure 4 Use of technology in different countries of the EU

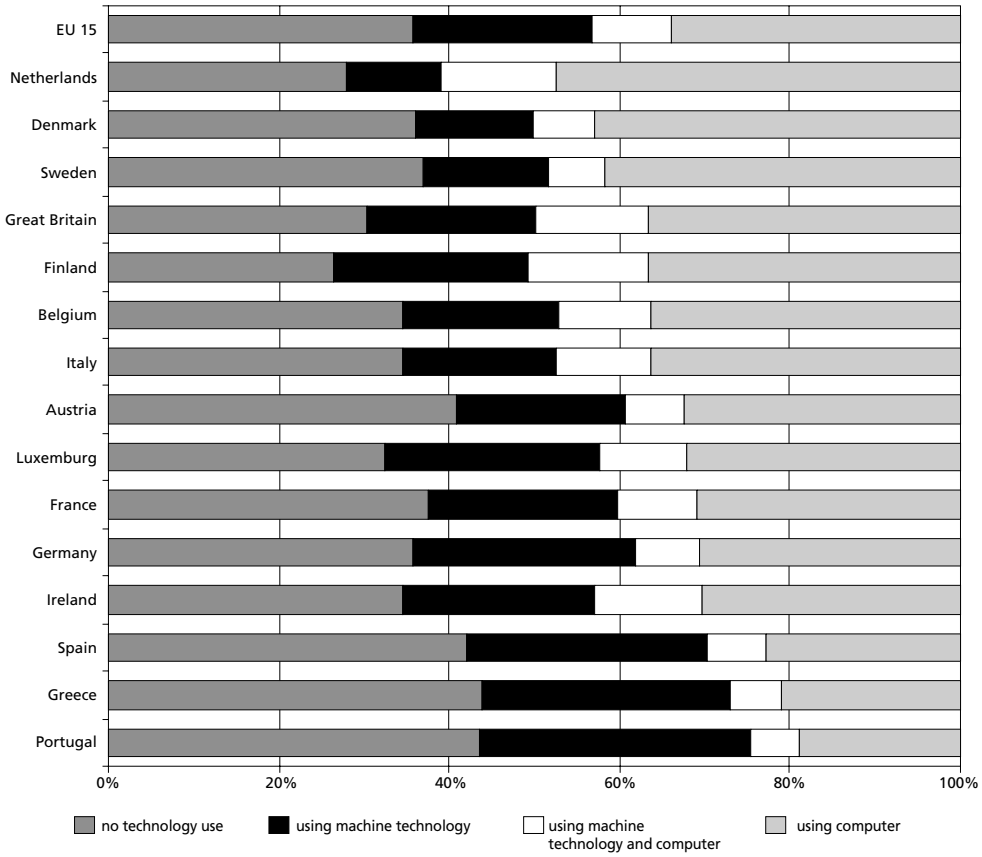


Figure 5 Use of technology in different occupations in the EU

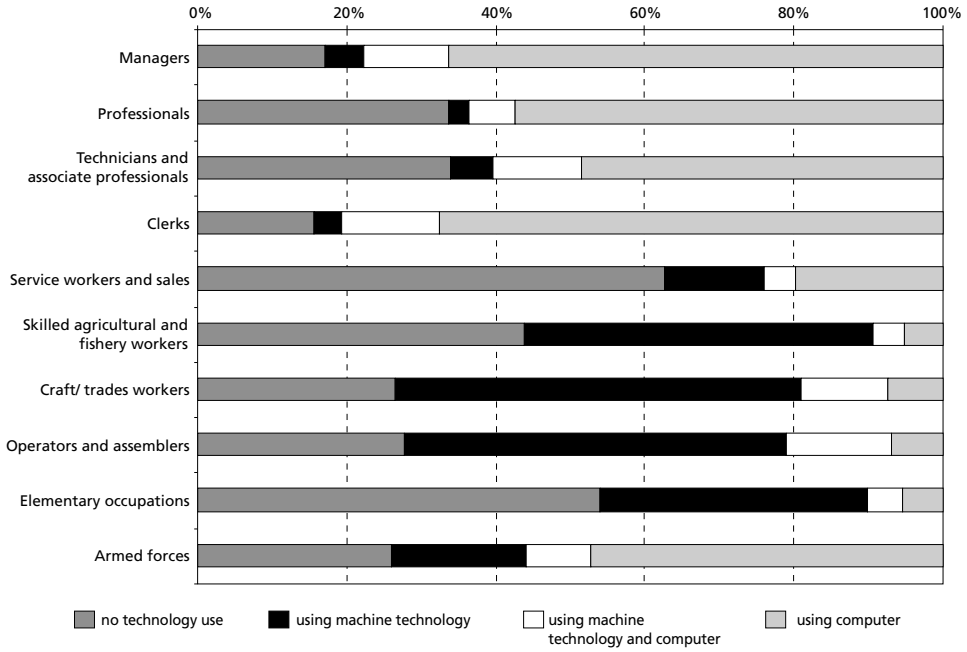
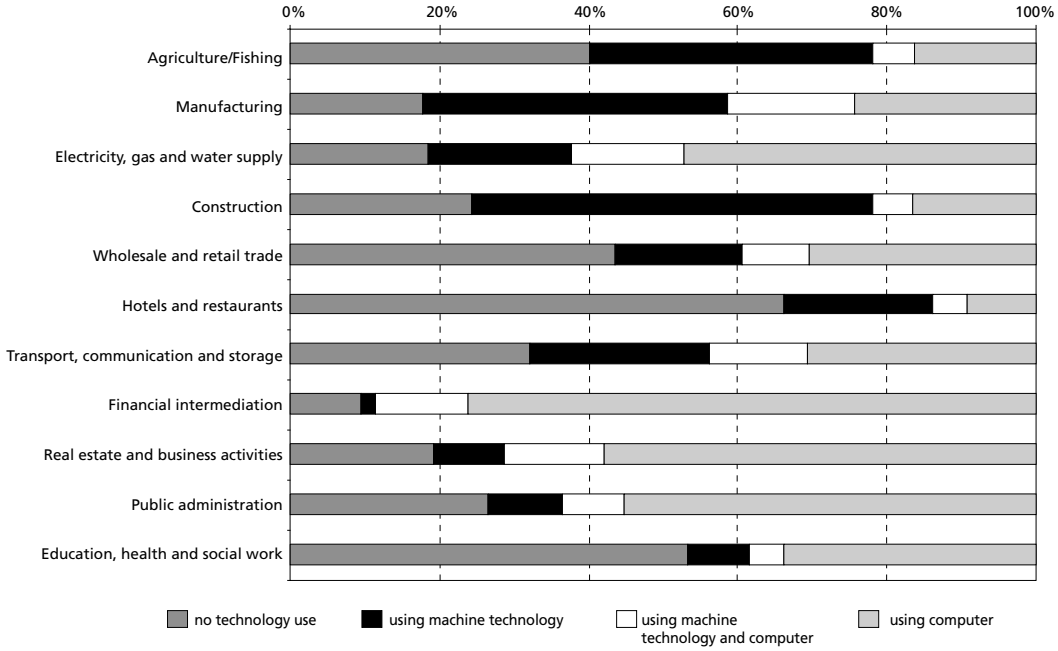


Figure 6 Use of technology in different industrial sectors in the EU



Our second variable is work organisation. As we mentioned in the introductory chapter of this report, we used a psychosocial approach to this topic. Because of a median split on the separate variables to construct these categories, it is understandable (but not inevitable) that each of the four types of work organisation comprise about a quarter of the total workforce. This result is clear from Table 1.

Table 1 Workers and type of work organisation

	%
Passive work organisation	26.56
Low-strain work organisation	25.61
High-strain work organisation	25.71
Active work organisation	22.1
	100

In Figures 7 to 9, we can see how this variable works according to country, job category and branches.

Figure 7 Comparison of type of work organisation between countries

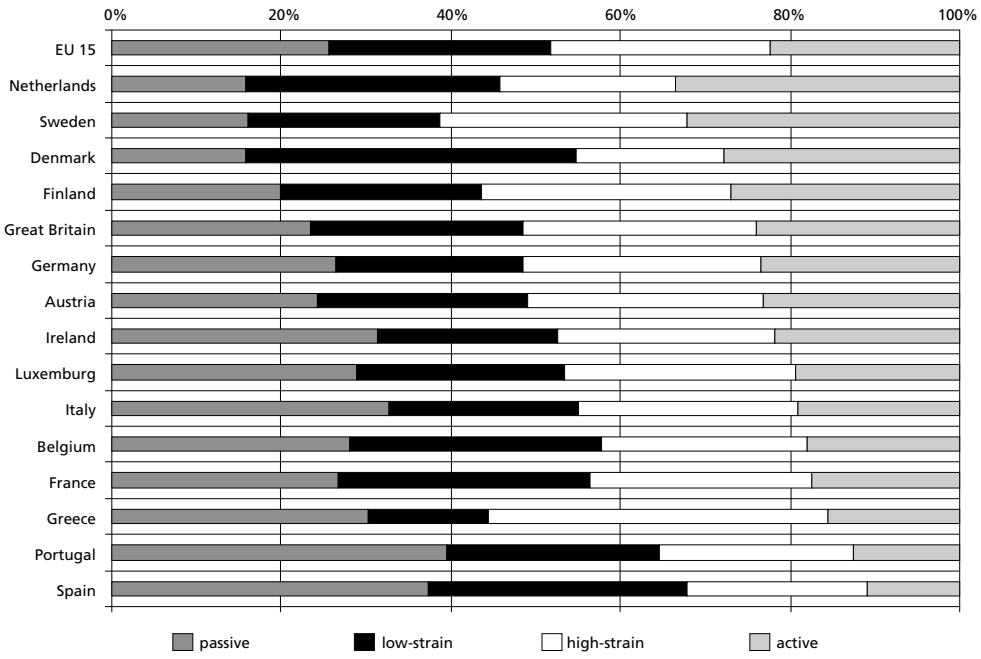


Figure 7 shows how workers are distributed over the four different work organisation situations. The distribution for 'active work organisation situations' is similar to that for technology use. More Dutch workers are working within active work situations than in other countries. Very few southern European workers experience such work situations. Other striking results are the high number of Danish workers who work within low-strain situations and the high number of Greek workers experiencing high-strain work situations.

Work organisation situations are not evenly distributed between job categories. More than 40% of managerial workers have active work situations. High-strain situations are more common among operators/assemblers. Figure 9 shows that the differences between sectors is less distinctive. Most sectors have an evenly distributed amount of work situations. This indicates that it is not so much the industrial sector that is responsible for work organisation, but rather job position. Managers and more highly skilled workers have a better control on job demands than less highly skilled workers. This result is in line with the job demands-job control theory (Karasek, 1979).

Figure 8 Comparison of type of work organisation between occupations

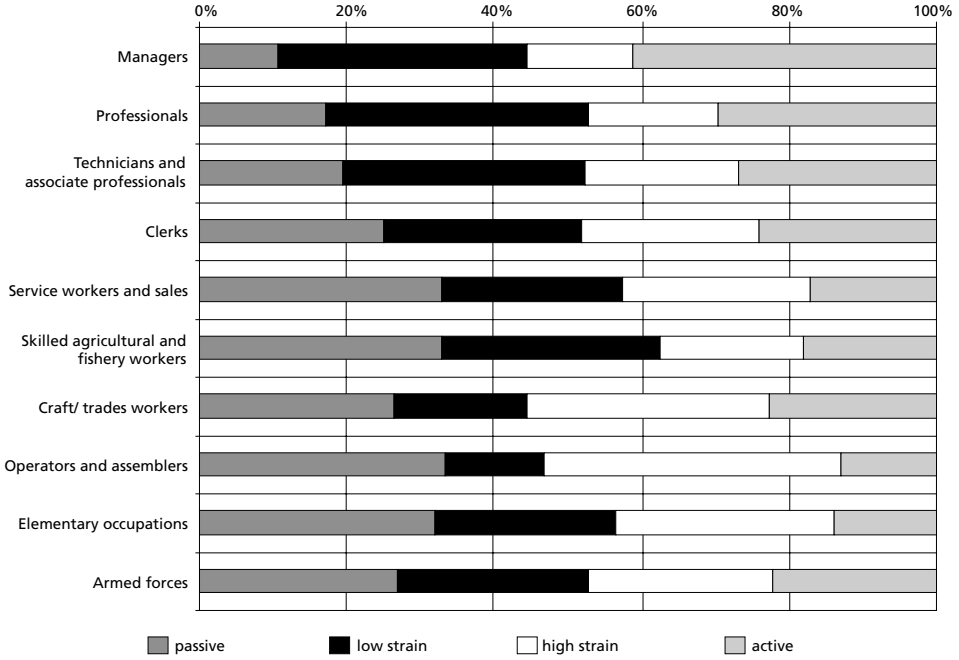
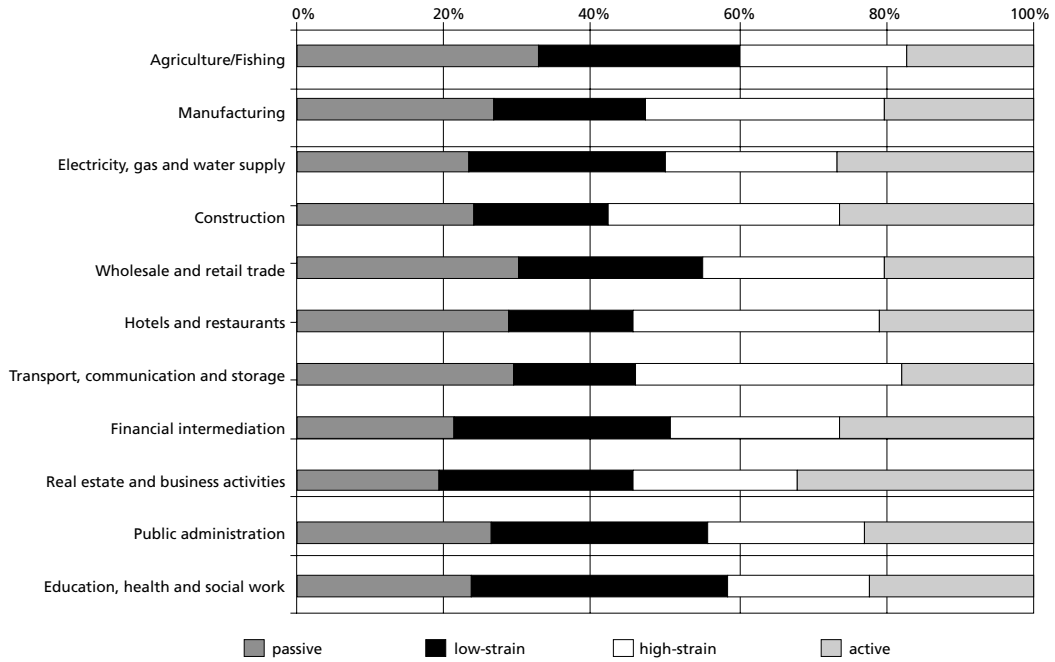


Figure 9 Comparison of type of work organisation between sectors



A separate variable in our investigation is control on technology. Several questions in the survey give some indication of the degree to which workers have control on the technology used in their companies. Such a variable may influence the relationship with technology and the consequences for workers. We have looked more closely at this variable, but it appears that only 1.5% of all

workers report that they do not have any control on the technology they use in their working environment. This is a surprisingly low percentage. It is also clear that a further use of this variable is not very useful because of the small differentiation. There is no real difference in the degree of control according to the different technologies used by workers.

Association with other work organisation dimensions

Technology and work organisation can be differentiated from other work organisation dimensions. The EF2000 survey provides information about repetitive work, social factors driving work and social support at work. In this section, we want to look at these work dimensions and ascertain to what degree technology and work organisation give separate information about these dimensions.

Repetitive work

Repetition in work is seen as a risk to workers because of the possible health outcomes. A distinction must be made between repetitive movements and repetitive tasks. Repetitive tasks can consist of several repetitive movements, but this is not always the case. For example, an operator checking the quality of thousands of products on a conveyor belt is executing a repetitive task, but there are no real repetitive movements. Several non-repetitive tasks can consist of a lot of repetitive movements. For example, a pianist executing a concerto might be performing a complex task, but also a lot of repetitive movements with his or her fingers. Repetitive movements are the basis for Repetitive Strain Injuries (RSI) (Blatter and Bongers, 1999). Repetitive tasks are the basis for monotonous work and have detrimental effects on the learning capacities of workers (Pack and Buck, 1992). It is important to make these distinctions for repetitive work. Not all repetitive work is as uninviting as it may seem. In the survey, there are three questions that are relevant for this analysis. The first question deals with repetitive hand or arm movements, the second question deals with repetitive tasks (5 seconds to 10 minutes) and the third question deals with monotonous tasks. We have combined these three questions into the following typology of repetitive and monotonous work.

Table 2 Distribution of repetitive and monotonous work in the EU (unweighted data)

	Example from automotive industry	Valid %
Non-repetitive, non-monotonous	Production management	48
Non-repetitive, monotonous	Quality control of parts	22
Repetitive, non-monotonous	Car sales job	13
Short repetitive, monotonous	Assembly line work	3
Long repetitive, monotonous	Car paint job	14
Total		100

Most work in the European Union can be qualified as non-repetitive and non-monotonous. Only some 'non-repetitive work' is seen as monotonous. The repetitive and monotonous work situations merit our attention. These can be identified as tayloristic work situations. We have distinguished between short repetitive tasks (less than 5 minutes) and long repetitive tasks (5 minutes or more). Many work situations involving long repetitive tasks can be qualified as monotonous.

In Table 3, an overview of the different repetitive work situations according to professional category is given. Long and short repetitive and monotonous work is most common among plant and machine operators. Elementary occupations also involve this kind of work. Highly skilled white-collar workers mainly experience non-repetitive and non-monotonous work. However, repetitive work situations appear in all type of jobs.

Table 3 Comparison of repetitive and monotonous work between occupations (unweighted data)

	Non-repetitive, non-monotonous	Non repetitive, monotonous	Repetitive, non-monotonous	Short repetitive, monotonous	Long repetitive, monotonous	N =
Legislators, senior officials and managers	66	21	6	2	5	763 (100%)
Professionals	70	17	8	1	5	2068 (100%)
Technicians and associate professionals	62	18	11	2	7	2630 (100%)
Clerks	45	23	13	4	14	2989 (100%)
Service workers and shop and market sales workers	46	23	14	4	13	3089 (100%)
Skilled agricultural and fishery workers	40	23	16	5	15	195 (100%)
Craft and related trades workers	39	19	18	4	20	2653 (100%)
Plant and machine operators and assemblers	31	25	13	8	23	1515 (100%)
Elementary occupations	31	30	12	5	22	1892 (100%)
Armed forces	52	27	10	4	7	116 (100%)
Total	48	22	13	4	14	17910 (100%)

In the case of repetitive work, it is interesting to see to what degree this variable supplies extra information on the technology variable. To what degree are such work situations correlated with types of technology?

Table 4 Repetitive work and use of technology (unweighted data)

	Non-repetitive, non-monotonous	Non repetitive, monotonous	Repetitive, non-monotonous	Short repetitive, monotonous	Long repetitive, monotonous	N =
Not using technologies	52	24	10	3	12	6372 (100%)
Using machine technologies	27	21	19	7	26	3756 (100%)
Using machine and computer technologies	35	23	17	5	20	1688 (100%)
Using computer technologies	61	20	11	2	8	6058 (100%)
Total	48	22	13	4	14	17874 (100%)

Those work situations with no use of machine or computer technologies are associated with non-repetitive and non-monotonous work. Use of machine technology shows a high correlation with short and long repetitive, monotonous work. Machine technology seems to be a requirement for such repetitive work.

Work driven by social factors

A separate distinction in work situations is the way in which colleagues, clients, customers and superiors can 'drive' the work pace. With the de-taylorisation of work (reduction in machine-paced work), we should see a rise in socially controlled work pace. Colleagues are becoming the driving force for a worker's work pace. Next to colleagues, customers (clients, pupils, customers) are putting more demands directly on the worker. And direct control through a superior is replacing the old forms of control. Such work dimensions can be investigated in the EF2000 survey. In the survey, pressure from colleagues and superiors can be classified as internal social pressure. Pressure from clients, customers and pupils can be seen as 'external social pressure'. With these questions, we can make the following distinction:

Table 5 Social factors driving pace of work (unweighted data)

Social factors	Valid %
No social drive	14
Internal social drive	17
External social drive	54
Internal and external	15
Total	100

External social pressure on work pace appears to be the most important drive in the work environment. Only a relatively small group of workers report no social drive on their work pace.

Table 6 Comparison of social factors driving pace of work between occupations (unweighted data)

	No social drive	Internal social drive	External social drive	Internal and external	N =
Legislators, senior officials and managers	10	9	65	16	763 (100%)
Professionals	13	7	71	10	2068 (100%)
Technicians and associate professionals	11	11	67	11	2630 (100%)
Clerks	13	14	55	18	2989 (100%)
Service workers and shop and market sales workers	8	5	69	17	3089 (100%)
Skilled agricultural and fishery workers	25	35	26	14	195 (100%)
Craft and related trades workers	14	29	38	18	2653 (100%)
Plant and machine operators and assemblers	18	33	33	16	1515 (100%)
Elementary occupations	24	30	34	13	1892 (100%)
Armed forces	20	30	30	20	116 (100%)
	14	17	54	15	17910 (100%)

External social pressure is more common in white-collar and service jobs than in blue-collar jobs. But even in the latter, we can see that the work pace of about one-third of workers is driven by external social pressure. We have not investigated time trend information, but it would appear that social pressure at work is more common than recognised in research.

To what degree is there a correlation between social factors driving work pace and technology and work organisation?

Table 7 Social factors driving pace of work and use of technology (unweighted data)

Not using, using old and/or using new technologies?	No social drive	Internal social drive	External social drive	Internal and external	N =
Not using technologies	17	13	59	11	6372 (100)
Using machine technologies	12	32	33	23	3756 (100)
Using machine and computer technologies	8	19	48	24	1688 (100)
Using computer technologies	12	11	64	12	6058 (100)
	14	17	54	15	17874 (100)

We can see from Table 7 that external social pressure is more common for situations without technology or with only computer technology. Work situations with machine technology show more internal social pressure on the work pace.

Table 8 Social factors driving pace of work and work organisation (unweighted data)

Work organisation: job demands-job control model (Karasek, 1979)	No social drive	Internal social drive	External social drive	Internal and external	N =
Passive	15	21	49	15	4448 (100)
Low-strain	20	12	59	9	4501 (100)
High-strain	8	21	48	23	4465 (100)
Active	10	13	63	14	3866 (100)
	14	17	54	15	17280 (100)

Table 8 shows that high-strain work is more associated with internal and external social pressure. Such workers cannot keep social pressure from their work situations. Active work shows a higher correlation with external social drive. Low-strain work shows a slightly higher association with external social drive, but relatively more with 'no social drive'.

Social support at work

A separate opportunity to control possible negative effects of job demands is social support from colleagues (Vaas *et al*, 1995). If a worker cannot solve a job problem, he or she might get help from colleagues. The survey has three questions with which we can investigate this social support at work: support by colleagues, opportunities to discuss work organisation changes with colleagues and working in a team.

Table 9 Social support at work (unweighted data)

	%
No support available	6
Only colleagues	33
Team support	12
Team + colleague support	50
Total	100

Half of all workers report team and colleague support at work. Only in exceptional situations (6% of jobs) is no social support available. Table 10 compares types of social support at work between occupations.

Table 10 Comparison of type of social support at work between occupations (unweighted data)

	No support available	Only colleagues	Team support	Team + colleague support	Total
Legislators, senior officials and managers	3	3	4	5	4
Professionals	3	12	7	13	12
Technicians and associate professionals	7	13	10	18	15
Clerks	16	21	12	15	17
Service workers and shop and market sales workers	22	16	19	17	17
Skilled agricultural and fishery workers	1	1	2	1	1
Craft and related trades workers	7	14	20	15	15
Plant and machine operators and assemblers	10	9	11	7	8
Elementary occupations	31	10	15	8	11
Armed forces	0	1	1	1	1
Total	100	100	100	100	100

We can see from Table 10 that 'elementary occupations' are over-represented in the 'no support available' category, along with a high number of service workers and shop and market sales workers. It is clear that workers with lower qualifications have fewer opportunities to get help from colleagues than those in other job categories.

We can see from Table 11 the degree to which social support is associated with work organisation. Workers who have no social support — and we know that workers with lower qualifications are the ones most frequently found in these situations — seem to work more in passive and low-strain situations. Such workers have little job autonomy and few opportunities for social support. A surprising result in this table is that those workers reporting team support are most frequently found in high-strain work organisations. Support from team members is not sufficient to offset the other variables that contribute to high-strain situations.

Table 11 Type of social support at work and work organisation (unweighted data).

Work organisation: job demands-job control model (Karasek, 1979)	No support available	Only colleagues	Team support	Team + colleague support	Total
Passive	33	28	32	22	26
Low-strain	34	28	15	26	26
High-strain	19	24	37	25	26
Active	15	20	16	26	22
Total	100	100	100	100	100

Conclusions

In this section, we have investigated other work dimensions and have tried to see to what degree these dimensions can be separated from the central constructs of this report: use of technology and work organisation. We found that use of machine technology shows a high correlation with short and long repetitive, monotonous work. An interesting result is that a lot of workers are already working at a socially driven work pace. Customers, clients, pupils, but also colleagues, are responsible for most of the drive at work. Reduction in tayloristic or machine-paced work does not open a 'no drive work situation'; other pressures are already present. Such pressures can be cumulative: workers in high-strain work situations report high internal and external social pressure.

Social support is a separate dimension that can be helpful to workers when job demands are too high. But it is clear that this support is not equally divided among job categories. Workers with lower qualifications are more likely to have no social support available.

We can see that the two constructs, use of technology and work organisation, add separate distinctions to the workplace. But it is clear that we need to use the elements of repetitive work, socially driven work pace and social support to get a complete picture of developments at work.

Outcomes

In Appendix 2, the distribution for the variables *muscular/allergy problems*, *skills* and *stress problems* is given. In this section, we will concentrate on a new variable to the EF2000 survey, 'outside work activities'. Questions relating to this variable cover outside work activities such as voluntary work, political activities and caring for relatives and family. This variable is interesting for our research in the sense that one of the predictions of the job demands-job control model is that workers in active work situations will also benefit socially from their work situation. Such workers would then also be more active outside the working situation (Karasek, 1979).

Table 12 Involvement in activities outside work (row percentages)

How often involved in activities outside work? (EF.20.1, 2, 6, 3)	Never	<2 times a month	>3 times a month	Total
Voluntary or charitable activity	73	19	8	= 100
Political/trade union activity	90	8	2	= 100
Caring for elderly/disabled relatives	77	10	13	= 100
Caring for and educating your children	47	3	50	= 100

Table 12 shows the percentage of workers involved in different outside activities. A quarter of workers participate in voluntary or charitable activities. Political and trade union activities are rare. Caring tasks are executed by those workers who have responsibilities for such tasks, i.e. those with dependent elderly people or with children. Therefore, it is no surprise to see about half of workers taking care of their children.

Conclusion: internal validity of the concepts

Our initial analysis of these new dimensions in the EF2000 survey has shown that we can accept that the technology and the work organisation variables represent valid concepts. If some more insight is to be gained into technological developments, it will be necessary to broaden the concept and use more questions about technology. For example, it will be necessary to insert some more questions into the survey about the technologies used by service workers (e.g. tellers, telecom equipment) or about computerised controlled machinery. Control on technology, on the other hand, is a poor variable and will not be used in the further analyses reported here. We think that it is better to find another theoretical construct for 'control on technology' that gives some more insight into the various types of control on technology. The new variable 'outside work activities' seems to be useful for further analysis, but it remains unclear how reliable the information collected with these questions is.

Analysis of the quality of the models

In this section, we want to investigate the validity of the questions in the EF2000 survey by looking at the relationships between technology, work organisation and outcomes. For each separate analysis, we will clarify our expectations as to which kind of relationship should be found, and investigate to what degree the data confirm these expectations.

Our first question is: What is the relationship between the variables, use of technology and work organisation? Our expectation is that this correlation should be very low, because technological factors should not in themselves determine work organisation settings. Table 13 shows these correlations. Most of these correlations are very low, which is what we expected to find.

Table 13 Correlation between use of technology and work organisation

	Type of work organisation			
	Passive	Low-strain	High-strain	Active
No technology	0.11			–0.12
Use of machine technology		–0.14	0.17	
Use of machine technology and computers				
Use of computers	–0.13		–0.10	0.15

The strongest association in this table is shown by a weak correlation between use of machine technology and high-strain working situations (r = 0.17). Also a small correlation exists between active work situations and use of computers. This means that the way in which work is organised in organisations does not coincide with the use of technology. We will treat these variables as separate dimensions in the work environment.

A separate analysis of differences in these correlations according to industry and job category would not be useful because of the low correlations in the previous table.

A second question is: To what degree might use of technology and work organisation be influenced by industrial sector, profession and company size? In Appendix 3, a separate analysis of the relationships between industry, jobs, company size, technology and work organisation is given. The results show that the use of computer technology is more common among white-collar professions, use of machine technology is more common among construction workers and less common for social services and most white-collar workers, and no use of technology is most common for catering and social services sectors. The larger the company size, the greater the likelihood of the use of any kind of technology.

For work organisation, we see the following result:

- Passive work situations are less common among managers and technical professionals.
- Low-strain work situations are less common among operators and assemblers.
- High-strain work situations are more common among traditional blue-collar workers.
- Active work situations are more common among managers, professionals and technical professionals.
- Sector and company size do not show any great impact on the type of work organisation used. Work organisation can be different for each kind of company, but is strongly influenced by the type of jobs one carries out.

A separate question is: Are there correlations between the use of technology and work organisation, and outcomes for workers? We expect to see positive correlations between the use of machine technology and several physical health problems, and negative correlations between the use of computers and such health problems. Active work situations should show less psychosocial health problems. Table 14 shows the results of regression analyses between these variables (controlled for other variables). Only those effects (expressed as betas) that are sufficiently strong (above 0.10) have been included in this table. The complete results are included in Appendix 4.

This table shows the following association:

- Musculoskeletal health problems and allergies/asthma are correlated with the use of machine technology, but also with high-strain work. Use of computers, etc., and low-strain work situations are negatively correlated with such health problems. More machine technology means more musculoskeletal health problems.
- High-strain work situations are correlated with more stress-related problems. Low-strain work situations are correlated with fewer stress-related problems.
- Use of machine technology is also correlated with fewer opportunities for developing skill requirements. Use of computer technologies and active work situations lead to more skill development opportunities.

- The same tendencies can be found for satisfaction with working conditions. Workers who use machine technology or who have high-strain working situations are less satisfied with their working situations.
- Such workers are also less likely to have training, sport, cultural or leisure activities or other social activities outside their jobs. Workers using computers will do just the opposite: more training, etc. and more voluntary or charitable activities. No correlation is visible between these activities and the type of working situation, as we would have expected following the Karasek-model.

Table 14 Association (betas) between technology, work organisation and health problems (- = no significant outcome or beta <.10)

	No use of technology	Use of machine technology	Use of machine technology and computers	Use of computers	Passive work situation	Low-strain work situation	High-strain work situation	Active work situation	Control technology
Work-related health outcomes concerning:									
Muscular/limb/back pains (high=many)	–	0.20	–	–0.16	–	–0.10	0.13	–	–
Headaches/stress/fear, etc. (high=many)	–	–	–	–	–	–0.10	0.11	–	–
Allergies/asthma (high=many)	–	0.22	–	–0.16	–	–	–	–	–
Absent due to an accident at work? (Q.36.a.)	–	–	–	–	–	–	–	–	–
Absent due to health problems caused by your work? (Q.36.b.)	–	–	–	–	–	–	–	–	–
Skills and satisfaction									
Skills (high=less)	0.24	0.11	–0.12	–0.26	0.23	–	–	–0.22	–
Skills too high for job? (Q28)	–	–	–	–	–	–	–	–	–
Skills too low for job? (Q28)	–	–	–	–	–	–	–	–	–
Satisfaction with working conditions? (high=less)	–	0.14	–	–0.12	–	–0.15	0.16	–	–
Social factors									
Training, sport, cultural, leisure activities (0=never; 5=average of 1 hour every day)	–	–0.12	–	0.16	–	–	–	–	–
Societal activity: mean of voluntary/ charitable and political/trade union activity	–	–	–	0.10	–	–	–	–	–
Cooking and housework activities (0= never; 5=average of 1 hour every day)	–	–0.17	–	–	–	–	–	–	–

Use of machine technology and high-strain work situations show negative outcomes for nearly every work dimension we have investigated. Use of computer technology and active work situations show positive outcomes. These results are in line with our expectations and with the results in other surveys (Dhondt and Kraan, 2001).

Trend analysis of technology and work organisation

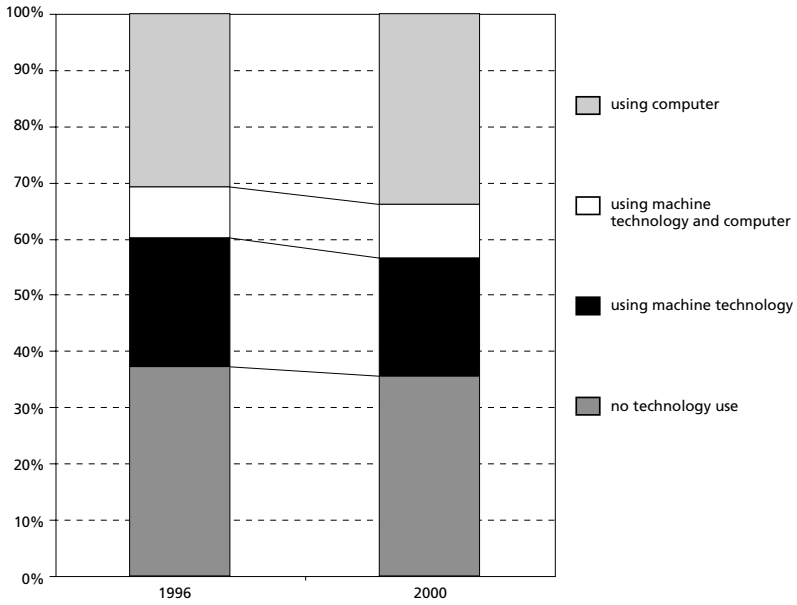
Our third analysis orients itself at the possibility of detecting trends within the Foundation surveys. For this it is necessary to investigate to what degree the different surveys show consistent

relationships between the different variables over time. This is a further test of the internal validity of the surveys. Of course, we must not forget that it is possible that the relationships between variables can change over time. However, given the relatively short periods between the surveys, this must be the exception. In this analysis, we will first look back at the different Foundation surveys and try to see to what degree developments in technology and work organisation can be detected. Next, we need to see to what degree the correlations detected in the previous section remain stable over time.

Trends in the use of technology

In Figure 10, the development of the use of technology from the EF1996 survey to the EF2000 survey is shown. It is not possible to create the technology variable from the EF1991 survey.

Figure 10 Changes in the use of technology from the EF1996 survey to the EF2000 survey



The use of computers has clearly risen over the two periods. Situations in which no technology is used have decreased; the other situations remain very much the same. From the other reports (Paoli and Merllié, 2001), we already know that the different time constraints continue to rise (high speed: from 48% of workers in 1991 to 56% of workers in 2000; tight deadlines: from 50% of workers in 1991 to 60% of workers in 2000), and the different autonomy levels have levelled off in the last survey. This means that high-strain work situations have risen over time. More and more workers are confronted with stressful work situations.

Developments according to industry and profession

We have also investigated the development over time of the technology variable according to industry and profession. (The development within the separate countries will be looked at in the country analysis below.) Figures 11 and 12 show these developments within industries and professions.

In both figures, we can see small changes over time. The changes within the separate industries and jobs remain limited. Most sectors show a small increase in the use of computers. The only

industry that shows a counter-intuitive development is agriculture, in which a strong rise in the 'no use of technology' category took place in 2000. This result is confirmed at the job level, in which skilled and agricultural workers show a similar development. Because both groups are quite small, this development could be caused by sampling errors. In general, the developments are as we would expect — a continuous rise in the use of computers.

Figure 11 Changes in the use of technology within different industrial sectors

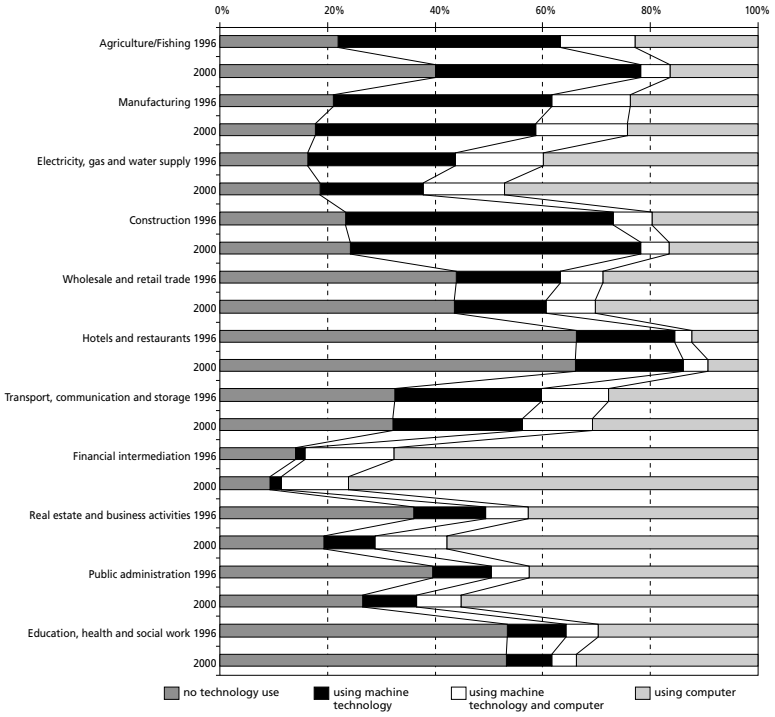
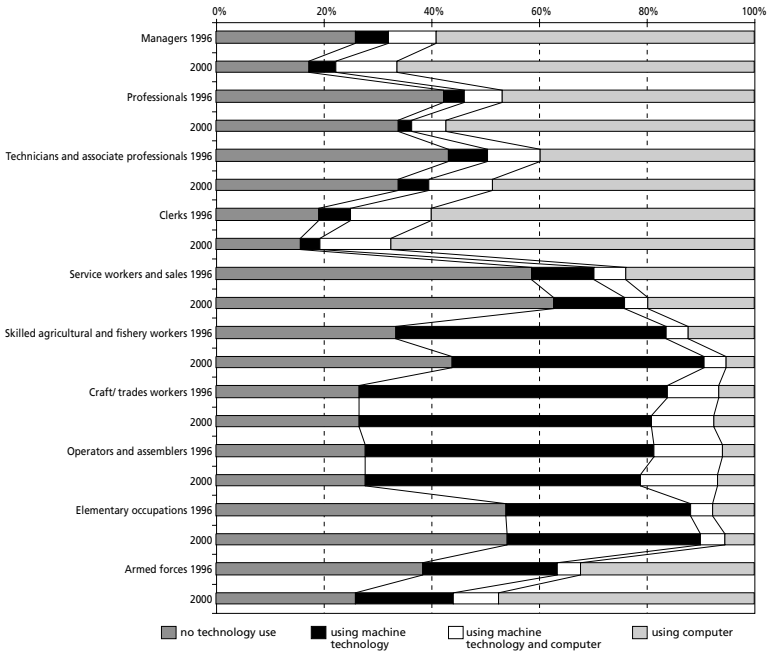


Figure 12 Changes in the use of technology within different occupations



Outcomes over time

Our last analysis consists of an investigation of the stability over time of the relationships between the different variables. Table 15 shows the correlation between the use of technology and several outcome variables such as health, safety and motivational risks (e.g. learning opportunities) in 1996 and in 2000. We want to see to what degree the correlations between these variables are the same in the two samples. From this table, it is clear that the correlations remain stable over time. In all cases, the strength of the correlation as well as the sign of the correlation remains the same.

Workers who report the use of computers or no use of technology show fewer health and safety risks, fewer stress effects, less absenteeism, fewer unrealistically high demands in comparison to the skills available, and more job satisfaction. Workers who report no use of technology have fewer learning opportunities at work, whereas workers using computers do report learning new things. Workers using machine technology show negative results for nearly all dependent variables (except for one variable, the correlations of which are not significant). When using both machines and computers, the learning opportunities are comparable to when only using machine technologies: and these are now positive. Overall, however, the correlations are rather small.

Table 15 Results of correlations between use of technology, health and motivational aspects

		No technology use	Using machine technology	Using machine technology and computer	Using computer	N
Q34bis 'Do you think your health/safety is at risk because of your work, or not?' (1='yes'; 0='no')	1996	–	0,243	–	–0,171	12014
	2000	–	0,193	–	–0,156	17309
Scale stress effects: 'Work-related health problems concerning: headaches, stomach ache, heart disease, stress, overall fatigue, sleeping problems, anxiety, irritability' (high=many complaints).	1996	–	–	–	–	12440
	2000	–	–	–	–	17874
Work-related absenteeism: number of days over the past 12 months, due to health problems, caused by main paid job.	1996	–	0,11	n.s.	–	12440
	2000	–	–	–	–	17590
Learn new things (1='yes'; 0='no')	1996	–0,137	–0,13	0,093	0,203	12284
	2000	–0,197	–0,109	0,094	0,234	17663
Q28: 'How well do you think your skills match the demands imposed on you by your job?' (1='demands too low'; 0='match/too high demands)	1996	n.s.	n.s.	n.s.	–	12248
	2000	n.s.	n.s.	n.s.	–	17516
Q28: How well do you think your skills match the demands imposed on you by your job?' (1='demands too high'; 0='match/too low demands')	1996	–	–	n.s.	–	12248
	2000	–	–	–	–	17516
'On the whole, are you very satisfied, fairly satisfied, not very satisfied or not at all satisfied with working conditions in your main paid job?' (1='very satisfied'; 2='fairly satisfied'; 3='not very satisfied'; 4='not at all satisfied')	1996	–	0,141	n.s.	–0,101	12390
	2000	n.s.	0,142	n.s.	–0,129	17744

Note: only significant correlations shown: p<0.05 and only correlations r>.10 shown.

Table 16 shows the results of the bivariate analyses (betas)[3]. These results are controlled for work organisation, sector, job title, company size and interaction in terms of technology and work organisation. Only in the case of using computers and stress effects do we see signs that the relationship has changed. In all other cases, the effects remain the same. The importance of the effect remains quite small in the different situations. The strongest relationships are between the use of machine technology and health effects. This use is detrimental to health and safety. Use of computers (especially in combination with machine technology) shows positive learning effects.

Table 16 Results of bivariate analyses (betas): bivariate results controlled for work organisation, sector, job title, company size and interaction terms of technology and work organisation

		Using machine technology	Using machine technology and computer	Using computer
Q34bis 'Do you think your health/safety is at risk because of your work, or not?' (1='yes'; 0='no')	Beta (1996) Beta (2000)	0,165 0,123		– –
Scale stress effects: 'Work-related health problems concerning: Headaches, stomach ache, heart disease, stress, overall fatigue, sleeping problems, anxiety, irritability' (high=many complaints).	Beta (1996) Beta (2000)			– –
Work-related absenteeism: number of days over the past 12 months, due to health problems, caused by main paid job.	Beta (1996) Beta (2000)		n.s. n.s.	– n.s.
Learn new things (1='yes'; 0='no')	Beta (1996) Beta (2000)	n.s.	0,12 0,136	0,153 0,189
Q28: 'How well do you think your skills match the demands imposed on you by your job?' (1='demands too low'; 0='match/too high demands')	Beta (1996) Beta (2000)	n.s. n.s.	n.s.	n.s. n.s.
Q28: 'How well do you think your skills match the demands imposed on you by your job?' (1='demands too high'; 0='match/too low demands')	Beta (1996) Beta (2000)			n.s. n.s.
'On the whole, are you very satisfied, fairly satisfied, not very satisfied or not at all satisfied with working conditions in your main paid job?' (1='very satisfied'; 2='fairly satisfied'; 3='not very satisfied'; 4='not at all satisfied')	Beta (1996) Beta (2000)		n.s. n.s.	n.s.

Note: only significant betas ($p<0.05$) and betas stronger than 0.10 shown.

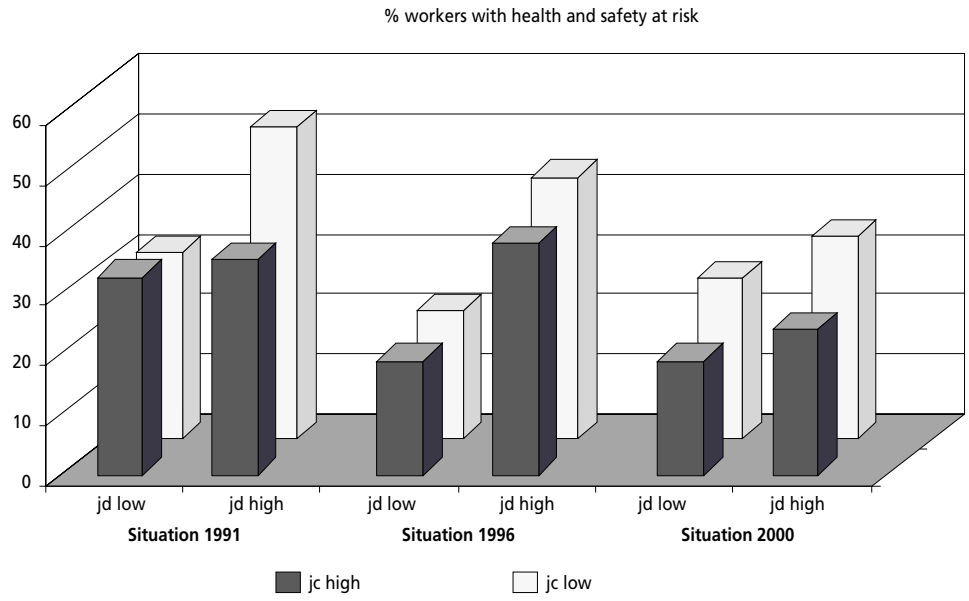
Both results make it clear that the Foundation surveys show consistent relationships over time. This reinforces our belief that the surveys are capable of detecting harmful or helpful working situations. It indicates that the use of computers seems to lead to positive work outcomes, and that machine technology is still an important risk factor in the working environment.

In Figure 13, we give a graphical analysis of the relationship between work organisational situations and health and safety outcomes over time. We are able to show these results for the

3 For statistical reasons, the situation of 'no technology' has been left out because we had to reduce the variable to a dummy.

EF1991, EF1996 and EF2000 surveys. The outcome variables have changed in wording and content over time (see Dhondt, 1998). The health and safety variable has a more reduced content than in the past. This could explain the lower percentage of workers with health and safety risks reported in 2000. It is clear from these figures that the predictions of the Karasek job demands-job control model remain intact over time. The low-strain situation shows the lowest percentages of complaints. The high-strain situation always shows the highest percentages of complaints.

Figure 13 Work organisation and perceived health at risk in the EF1991, EF1996 and EF2000 surveys



Note: jd = job demand; jc = job control.

Conclusions of the trend analyses

The analyses in this section have again confirmed the internal validity of the Foundation surveys. The surveys are capable of showing trends in the use of technology, which are consistent with our common knowledge of these developments. The surveys clearly show the rising use of computers. Another result is that the trends within industries and occupations are also consistent with our prior expectations. The differences between industries and occupations remain bigger than within the industries and occupations over time. A last result is that the relationships between variables and outcomes also remain consistent over time. Use of machine technology shows greater risks to health, fewer learning opportunities and less job satisfaction than situations in which workers do not use any technology or in which they use computers.

Comparability of the data to other countries

Introduction

The previous sections have investigated the validity of the Foundation surveys by looking at the internal validity of the questions. In this section, we want to look at some outside sources to see to what degree the Foundation surveys emulate results from other national surveys. Such external validity would give major support to the quality of the Foundation surveys.

Surveys on working conditions

Table 17 contains an overview of questionnaires in the different Member States of the European Union. We have tried to find the latest possible surveys from each country. The results from some of these surveys will be compared to the Foundation surveys. In Appendix 5 we list the separate questions on the topics of technology use and work organisation.

Table 17 Questionnaire-based surveys in the EU countries on working conditions

Country	Questionnaire	Year	Data collection	Data analysis and reporting
EU-level				
	– Working Life Survey – Labour Force Survey 1999 – Accidents survey 1993 – Causes des accidents 2000 – Accidents 2001 (common methodology) – Maladies professionelles 2001 (common methodology) – Health Consequences of Work problems (trailer LFS 1999)		– Eurostat – Dimarso (Gallup)	– national statistical offices
	– European Value Systems Questionnaire	1978 1981 1991		– Foundation of the European Value Systems Group
	– European Survey on Working Conditions	1991 1996 2000	– INRA – European Coordination Office	– European Foundation
	– EPOC	1997	– INRA – European Coordination Office	– European Foundation
Country level				
France	– Enquête sur l'Emploi * Questionnaire Complémentaire sur les Conditions du Travail (a.) (10.000 workers) * Questionnaire Complémentaire sur les Techniques et l'Organisation du Travail (b.)	A: 1978 1984 1991 1998 B: 1987 1993 1998	– INSEE	– DARES (Ministère du travail) – universities
	SUMER (biological risk factors): 45.000 workers (1990, 2001)	1990 2001		
	RÉPONSE (1992 (worker representatives); 1998 (worker representative; workers): organisation – travail	1992 1998		
	Conditions de travail & informatique (workers): 1997	1997		
	Bonheur de travail 1997	1997		
Spain	– Encuesta nacional de condiciones de trabajo (National Survey on Working Conditions)	1992 1990	– INSHT	– INSHT; SOFEMASA Marketing
	– Encuesta nacional de condiciones de trabajo en el sector de la construction 1987	1998 2000		

Country	Questionnaire	Year	Data collection	Data analysis and reporting
Country level				
Germany	– BIBB/IAB-Erhebung – Mikrozensus – Health Reporting Survey – IAB Panel Survey – company level – Beschäftigungstatistik (career information) – Deutsche Ekonomische Verein Panel (6000 families: 20 years old)	1979 1986 1992 1999	– GFK, MARPLAN – Infratest, GETAS, EMNID – Infratest and MARPLAN	– BIBB – IAB – universities
The Netherlands	– (Doorlopend) Leefsituatie Onderzoek (Continuous) Life Situation Research (from 1989 on, each year)	1974 1977 1980 1983 1986 89-00	– Centraal Bureau voor de Statistiek (CBS)	– CBS – universities – NIPG-TNO
Denmark	– Kortlægning af danske lønmodtageres arbejdsmiljø og helbredsforhold (Questionnaire on working conditions and health) – Company level 2001 Working Conditions (clean environment in 2005); 2003; 2005 (seven areas; management – employees)	1972 1983 1990 1995 2000	– Danish National Institute of Occupational Health (DNIOH) – Danish National Institute of Social Research	– Danish National Institute of Occupational Health (DNIOH) – Danish National Institute of Social Research
Sweden	– Arbetsmiljön (two yearly) (Working Conditions) – Health survey (yearly) (yearly) – Accident statistics	1989-1999 …. 2001	– Statistics Sweden	– Statistics Sweden
Finland	– Arbetskivets kvalitet/ Työelämän laatu (Quality of Working Life Survey) – Work and Health Interview – Gender Barometer	1977 1984 1990 1997 2000 1999	– Central Statistical Office of Finland – FIOH	– Finnish Institute of Occupational Health
Norway	– Arbeidslivsundersøkelse, arbeidstakerskjema (Working conditions research)	1989	– Statistical Office – Institute of Social Research	
Austria	Mikrozensus 1998 Labour Inspectorate Survey			
UK	Labour Force Survey – trailer (Eurostat module)) HSE – survey 1995 (household survey Great Britain, current workers, report 1997) 1998 Workplace Employee Relations Survey (Workplace Industrial Relations Survey)	1990 1995 1999 1995		
Greece	2001: training project for labour inspectorate National Board of Health & Safety2001/2002: design of Working Conditions Survey (Ministry + University of Athens)			

We will concentrate on the Finnish, Dutch, Swedish, German and French surveys, because we received the most information from them. We also received relevant information from the Spanish survey, but because the data was presented in a different fashion (another cut-off point), trend information could not be constructed. We analysed the data for Austria in a previous study, but there has not been any new data since 1994. A new national census is currently being conducted in Austria that might deliver some new information.

Variables in the different surveys

In a previous study (Dhondt, 1998), we investigated the degree to which the different European surveys contained questions about job demands, job control and dependent variables. Most of this information is still valid. We want to limit our focus here to the questions about technology in these general surveys. There are, of course, economic and technology surveys that contain a lot of information about the technological state of the different countries. However, our focus here is on these general working conditions surveys and the degree to which they also contain technology questions. It is from these surveys that the Foundation can learn the most. Our goal is to develop new questions to investigate the correlation between technological factors and health outcomes.

In Table 18, an overview is given of several technology questions that can be found in the Swedish, French and German surveys. Other surveys, such as the Spanish, Austrian, Dutch and Finnish surveys, have been checked, but they do not contain questions that can be used to analyse the technological state of those countries.

Table 18 Topics about technology in the Swedish, French and German questionnaires

	Automatic speed of a machine	Types of mechanical instruments and tools	Teleworking	Use of computers	Use of computerised machines	Use of elements of the computer	Use of types of software
Sweden	+	+		+	+	+	
France	+			+			
Germany	+			+	+		

It is clear from this table that the Swedish survey contains the largest series of questions on technology. A lot of attention is directed at describing the use of different instruments on or around the computer, such as keyboards, mouse, etc. Strangely enough, there are no direct questions on teleworking, nor on the type of software used on the computer systems, in any of the surveys. The latter is probably somewhat difficult to construe in general surveys; all surveys are mainly oriented at the hardware. There are also a number of questions about mechanisation in the surveys. So, with these questions it should be quite possible to describe the technological situation in the different countries. We will look at these questions and try to compare their results with the EF data.

Comparability of the trends in work organisation and technology

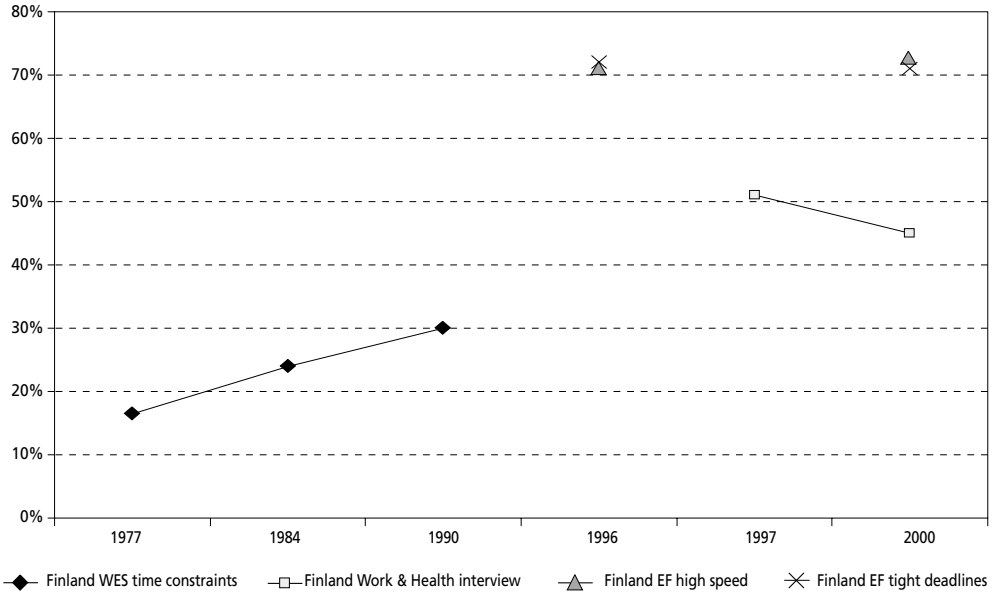
In this section, we will try to compare the various national data on work organisation and technology with the information in the Foundation surveys. Firstly, we will look at the correlation

between the reported levels for each of the variables, and, secondly, we will look at the trend information.

Finland

Figure 14 shows the development of time constraints from 1977 to 2000 in the Working Environment Survey (Finnish Statistical Office) and the Work and Health Interview conducted by the Finnish Institute for Occupational Health (FIOH). No data is available on autonomy, though there are some questions about the opportunity to influence one's work. Time constraints have risen in this period of time quite considerably. At the end of the 1970s, only 17% of workers experienced time constraints. Now about half of the working population experience time pressure.

Figure 14 Finland: comparison of questions on time pressure in the Finnish surveys and the EF surveys



In the 2000 FIOH survey, high psychological workload was reported by 35% of the employees, as compared to 40% in 1997. The opportunities to influence one's own work organisation have remained at the same level. About half of the workers reported having good influence opportunities, although earlier many people reported having poor opportunities to influence their own work (Kauppinen *et al*, 2000). The figures in the Foundation surveys show higher levels of time pressure and seem to point at a stabilisation of these levels. This is somewhat in contradiction with the Finnish information, but it is unclear to what degree the categories used in the European surveys coincide with the Finnish. The Finnish surveys do not contain any information about the use of technologies.

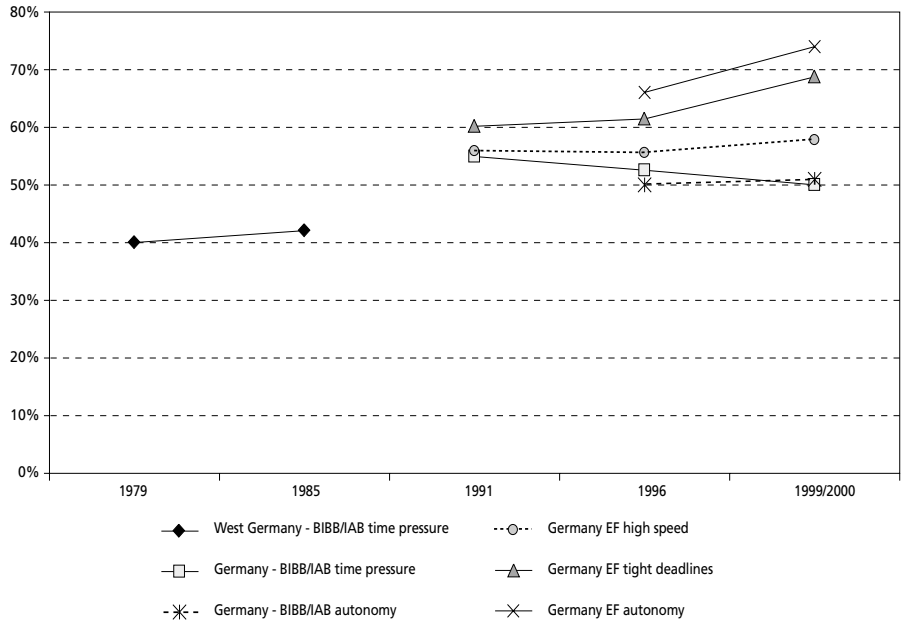
Germany

Working conditions

In Germany, there is some long-term trend information on working conditions but it is incomplete because of the historical changes in 1989. Figure 15 shows a clear rise in time constraints, even after the 'Wende'. The questions on time pressure have changed somewhat over the years. Also, there was a change in the survey bureaus carrying out the surveys. For these reasons, the BIBB/IAB

did not use trend information from the surveys, although trends are discussed in the latest report (Dostal *et al*, 2000). In that report, it is pointed out that time pressure has been reduced somewhat in the last decade, but that it must be noted that the figures for 1991 were unusually high. The unification process is seen as one of the reasons for this figure. Since that date, time pressure has reduced somewhat, but remains high if compared to the historical data.

Figure 15 Germany: comparison of questions on time pressure in the BIBB/IAB survey and the EF survey



Note: Germany: all of the time and often; EF: 25% of the time and more.

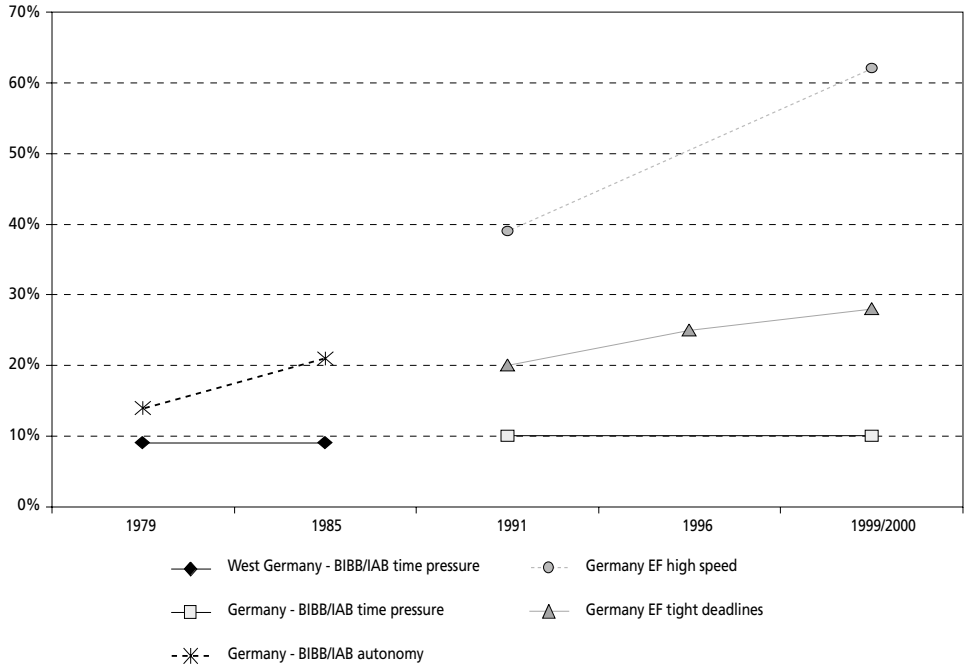
For the previous European surveys, we collated the information for the Western and Eastern parts of Germany. The levels of time pressure seem to be the same in the different surveys. The European surveys, however, do not show a decrease in time pressure in the last years; on the contrary, they show an increase. Job autonomy in the German questionnaire was constructed from the question 'work prescribed into great detail'. We collated the categories 'seldom' and 'almost never'. The difference in levels between the two questions is quite striking, but the questions are quite different. The German trend toward more autonomy is less pronounced in the German data than in the EF data.

Technology

The German BIBB/IAB survey contains quite detailed questions about the technology used by German workers. One question is about repetition of tasks in a job. This percentage has decreased only slightly, down from 48% (1992) to 45% (1999). Because of the changes in the EF survey questions, the figures cannot be compared. The questionnaire also shows the use of different types of technologies, such as numerical-type machinery (e.g. used by tellers) and computer-controlled machinery. In all cases there has been increased use of such kinds of technologies. These figures can also be found in the EF data, though we are comparing questions that have been reformulated over time. The EF data (>25% of the time) show a gradual increase in the use of computers. The

figures from the different surveys coincided quite nicely in 1992. The difference in 1999 is considerable, and it is unclear how such a disparity came about. The formulation of the German question is clearly much broader than the EF survey question, which could explain the higher levels of use.

Figure 16 Germany: comparison of questions on technology use in the BIBB/IAB survey and the EF



Note: Germany: all of the time and often; EF: 25% of the time and more.

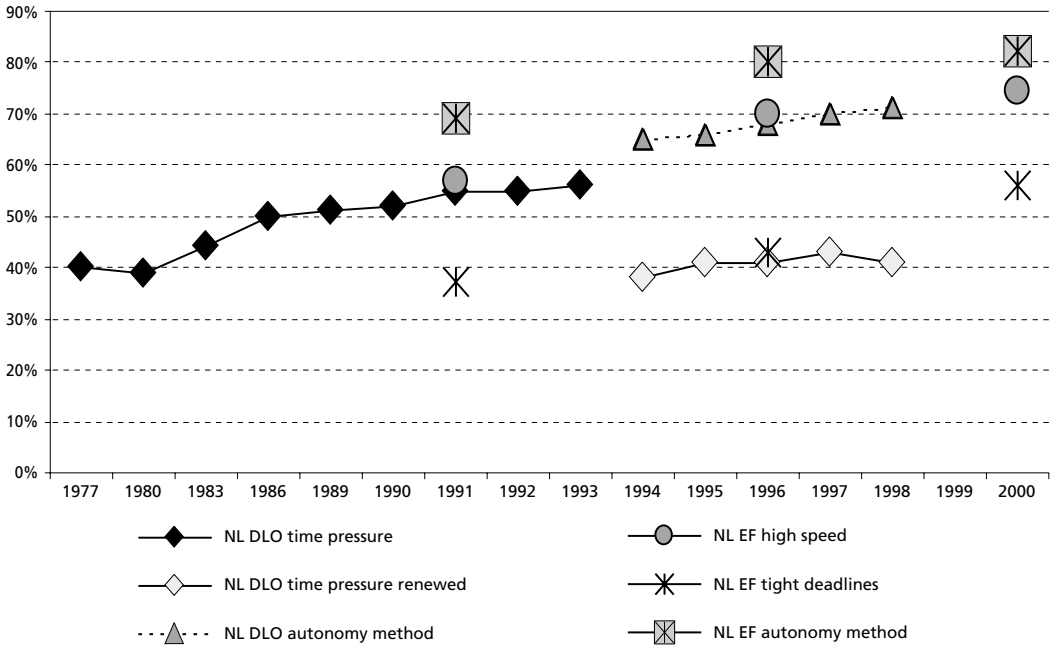
The Netherlands

Figure 17 shows the development of time constraints and autonomy in the Netherlands in the DLO surveys. Because the survey was radically changed in 1994 (new answering categories), the figures are not completely comparable over time. The most important development in the DLO survey is the increase in time pressure. It is the only percentage that has continued to rise since the measurements were begun (Houtman and Kompier, 1997).

In 1994 a rupture seems to have occurred in the series, mostly because of rephrasing of the answering categories. From 1996 on, time pressure has risen again, but the latest figures show a stabilisation. We do not have the data from the last three years, so a full comparison could not be made. This stabilisation is in contradiction with the EF data, which show a continuous increase in time pressure in the Netherlands. Strangely enough, we can see that the old formulation of time pressure in the Dutch questionnaire coincided with the 'high speed' question in the EF survey. Now the levels coincide with the 'tight deadlines' question. We expect that this is a statistical anomaly.

The figures for method autonomy show considerable agreement: the level and the trend are in conjunction with one another. The content of both questions is quite similar, so there is some confirmation from both data sources on this trend.

Figure 17 The Netherlands: comparison of questions on time pressure and autonomy in the DLO survey and the EF survey

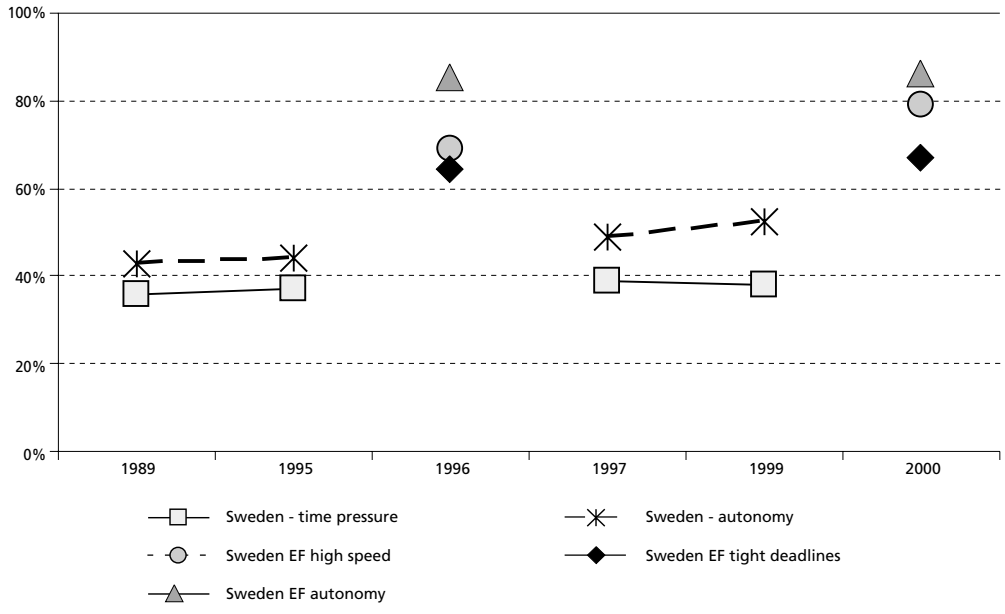


Sweden

Working conditions

In Figure 18 we can see the development of time pressure ('Work is so stressful that there is no time to talk or even think of anything other than work' — at least ½ of working time) and autonomy ('Can set own work tempo' — at least ½ of working time) for Sweden.

Figure 18 Sweden: comparison of questions on time pressure and autonomy in the SC survey and the EF survey



Time pressure rose at the beginning of the 1990s and stabilised in 1999. In the EF data we see a continuous rise in time pressure between 1996 and 2000, certainly for the 'high speed' question, but less pronounced for the 'tight deadlines' question. Job autonomy is on the rise in both surveys, but the level of autonomy is quite different because of the different questions (Statistika Centralbyrån, 2001).

Technology

The number of workers in the Swedish survey who use some form of computer equipment has increased throughout the 1990s. In 1999, 63% of women worked with computer equipment (up 4 percentage points from the 1997 result and up 22 percentage points from 1991). The corresponding figure for men in 1999 was 68% (up 5 percentage points from 1997 and 20 from 1991). More than 90% of those who use computerised equipment state that they work at a screen. The EF survey data on Sweden only dates from 1996. The trend is comparable, with a rise from 1996 to 2000 of about 3% (29% of workers using computers more than 50% of the time in 1996; and 32% in 2000). This is a more restrictive definition than the Swedish questions.

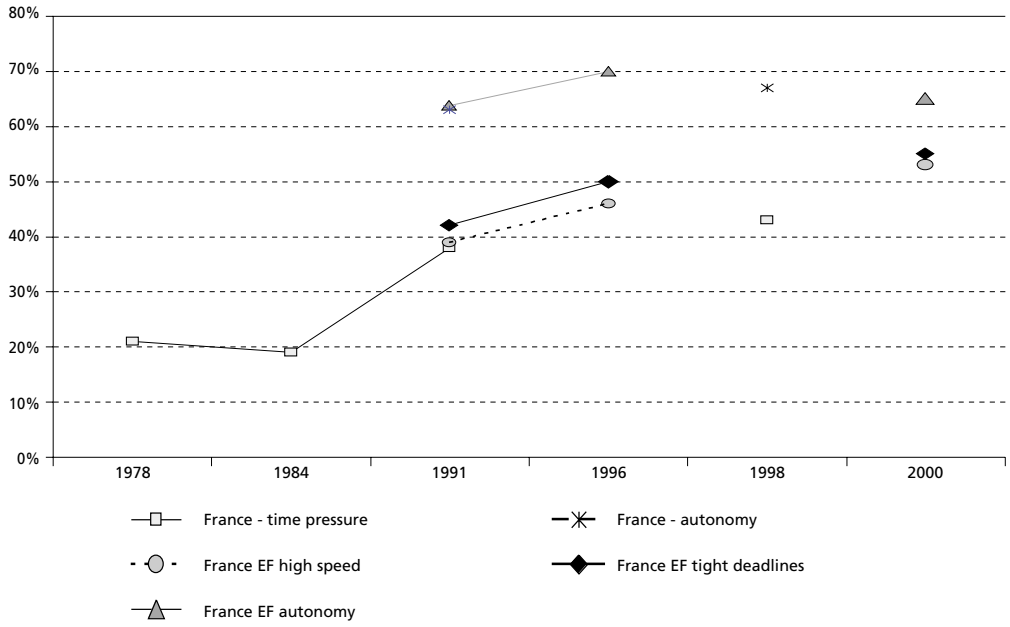
The 1999 Swedish survey was broadened, with new questions that shed light on whether computer users mainly use a mouse or keyboard. Of those who use a computer in their work, 85% (the same proportion for women and for men) state that they use a mouse as part of the computer equipment. Approximately 96% of both women and men use a keyboard. The Swedish survey also contains information about the goal of the use of computers. Among all those in employment, 36% of women and 40% of men reported in 1999 that they use a computer in their work mainly to search for information. The corresponding figures in 1997 were 32% of women and 37% of men. Working duties that chiefly involve monitoring information have risen slightly (up one percentage point). Thirteen per cent of women and 20% of men now have jobs of this kind (Statistika Centralbyrån, 2001).

France

After a slight dip in the trend of time pressure between 1978 and 1984, Figure 19 shows a dramatic increase in time pressure (work rhythm depending on production norms or delays of less than one day) in France. This development is partly caused by a change in the administration of the questionnaire: the way the questions were presented to the respondents changed slightly (Dares, 1993). However, this increased trend is mainly influenced by a real change in time constraints in all sectors of industry. The trend is not influenced by gender, educational level of workers, number of employees per company, or sector.

The EF survey does not have the same question as the French survey. However, the EF data confirm the trend information that can be seen in the French data. Time pressure is rising. There are several questions in the French survey that confirm this further intensification of work in general. All the advances seen in job autonomy are countered by the rise in job demands (Hamon-Cholet and Rougerie, 2000). The EF data shows that after a rise in job autonomy, these figures are starting to fall back.

Figure 19 France: comparison of questions on time pressure and autonomy in the Totto survey and the EF survey



Conclusions of the comparison between country and European Foundation data

Table 19 summarises the main findings from the comparison between the work organisation and technology questions in the EF surveys and several national surveys.

Table 19 Comparison of results between national surveys and EF data on the use of technology and work organisation

	High speed		Tight deadlines		Autonomy		Technology	
	Levels	Trend	Levels	Trend	Levels	Trend	Levels	Trend
Finland	(–)	–	(–)	+/–				
The Netherlands	+/–	+	+	+	+	+		
Germany	+	–	+/–	–	+/–	+	+/–	+
Sweden	–	–	+/–	+	–	+	+/–	+
France	+	+	+	+	+	+/–		

Note: (–): uncertain because of differences in definition; + = convergence of results; +/– = partly convergence; – = no convergence.

The difficulty with this comparison lies in the differences in the questions, answering categories and timing of the surveys. Such small differences can cause deviations between surveys. Limited developments in certain questions can be influenced by such differences. We think that the validity of the EF surveys cannot be judged on comparisons with each of the separate national surveys, but rather on a higher level of several questionnaires together. This limits the impact of small deviations that have been caused by chance. From Table 19 it would seem that there is more disparity in the 'high speed' question and the national figures on time pressure. The figures are more in line for tight deadlines, autonomy and technology. For technology, the comparison is still quite limited because we can only compare two countries with the EF data. Trend information seems to correlate

for tight deadlines, autonomy and technology. This does say that the EF surveys are measuring the developments in these separate countries. In several cases where there is a disparity in results between the national data and the EF data, these differences arise only when there are slight changes in the direction of the trends. For such changes, it is necessary to have longer time series to be sure that the EF surveys are not getting it right.

Overall, we can see that time pressure has risen quite considerably in the last decade and that in most of the countries job autonomy has not kept up with this development. This means that more and more workers are being confronted with high-strain working situations, which are detrimental to health. On the basis of our analysis of technological factors, we can see that a rise in the use of computers is not a cause of this. A second result is that this trend in rising time pressure seems to be 'levelling off'. The rise is not as high as it was at the beginning of the 1990s.

Conclusion 3

This report is about technology and work organisation in the European Union, based on the results of the European Foundation for the Improvement of Working and Living Conditions 2000 Survey. In a previous study, we showed how the distinction of four different types of work organisations showed different health and other work outcomes (Dhondt, 1998). This result is repeated in the EF2000 survey. In this report we have added technology as a new dimension to work organisation. A focus on technology is important because of the technological changes that are taking place in our industrial society. It is a common belief among researchers and policy makers that Europe should direct more attention to the study of work organisation and technology. But the means to investigate developments in work organisation and technology have remained quite limited. The new EF2000 survey contains several items that can provide valuable insights into these subjects. The goal of this report is to investigate the quality of these items by looking at several methodological questions: To what degree do the new constructs (technology, work organisation) give a valid and reliable representation of 'real' developments within the working environment? To what degree do these constructs make it possible to investigate consequences for health outcomes, learning opportunities and job satisfaction? A separate methodological question is: To what degree do the EF surveys corroborate survey results from other national sources? Our main conclusion is that the EF2000 survey gives a valid representation of developments in work organisation and technology within the European work environment. We want to comment on this main conclusion.

The first point that needs to be discussed is the quality of the technology variable used in this report. We have shown that with several simple criteria (use of machines, use of computers), it is possible to make sound distinctions between work situations and to analyse consequences of technological change. We can see that the use of computer technology is higher in white-collar sectors and professions. Workers who do not use any kind of technology tend to work in very small companies. Use of machine technology is higher in blue-collar industries and professions. Such results are in line with common opinion about such technologies. It is also clear from our analysis that this technological dimension is a separate dimension from, for example, work organisation and that it needs to be analysed separately for issues such as health outcomes, learning opportunities and job satisfaction. We will comment on these outcomes later. However, the current distinctions that we have developed remain quite broad: we can only look at the categories of 'no use of technology', 'use of machines' and 'use of computers'. We are still not quite sure if these distinctions are completely reliable. It is necessary to separate these work situations from one another to be sure that we can comment on technological developments. For example, should a worker report the use of computer when using a computer-controlled machine? These subjects remain unclear. We need to be able to make a more precise distinction between types of technology. The EF2000 survey can learn from the Swedish and German experiences, which give several questions to distinguish between types of technology. Another distinction that is relevant to this research is the way in which technology is used. This needs to be investigated, particularly in the case of new technologies. If we are interested in investigating learning opportunities at work, it should be clear to what degree workers are using computers and certain types of tools. The Swedish survey gives interesting questions on this subject.

A separate technological issue that remains under-investigated is software developments. Health and work outcomes can be very different between users of different types of software technology. This subject is clearly new for such large-scale surveys. In our analysis of the various other national surveys, this subject remains a blind spot. Future Foundation surveys could experiment with several questions and lead the way for the national surveys.

An area that needs to be improved in the Foundation surveys is the subject of 'control of technology'. The current survey questions (control of interruptions: technology) are too broad in their formulation. It is necessary to think about more 'levels of control' within the work environment so that it is possible to see which kinds of control on technology are helpful to workers, for example, how these might affect certain health outcomes. Possibilities are: 'Is information about technological decisions or investments sufficient for improved work outcomes?' or, 'Should workers be able to co-decide on such issues?'

Secondly, we have shown in this report that the EF2000 survey makes it possible to separate work organisations and technological situations from one another. Another result from this analysis is that the different surveys from the Foundation make it possible to investigate trends in the work environment. This is an important conclusion because there are clear weaknesses with the Foundation data (weighting problems, reformulation of questions over the different surveys). Despite these weaknesses, our analysis shows that the surveys make it possible to analyse situations within the different countries and to make comparisons over time. This is one of the strengths of the survey and attention should be focused on trying to maintain the reliable questions in the survey.

Finally, in relation to contents, the Foundation surveys show that time pressure in Europe continues to rise, and that work autonomy is stabilising at the same level as that of 1996. This means that high-strain working situations are becoming more predominant, a trend that was detected in 1996 (Dhondt, 1998). High-strain work situations are organisational contexts in which pressure is exerted on workers to deliver more results and output, while the means provided to cope with problems in such demanding situations are not sufficient. The consequence of this development is rising health risks for workers. This development is not strongly correlated with technology developments. Managers are organising work in such a fashion that workers have to work harder. Technology can be used to reinforce such goals, but equally technology can be used to lighten the burden on the shop floor. From the data in this report, our prediction is that the workplace of the future will remain a stressful one. The opposite result also remains true in the new survey. Workers in low-strain working situations are more satisfied and show some favourable work-related health outcomes (in relation to musculoskeletal health problems, stress and allergies/asthma).

There are some remarks to be made about this development. Our comparison of the various surveys carried out in other countries has shown a 'levelling off' of time pressure, which was not detected by the EF2000 survey. It is unclear if this result was not detected because of the smaller sample size of the EF2000 survey. It could also be that the national surveys show a temporary dip in time pressure, which is again rising, now detected by the EF2000 data. Because these latest developments are very small, it is not clear what is going on. In all cases, however, it is clear that time pressure has risen to high levels.

Another development, which is consistent between the national surveys and the European surveys, is the rising use of new technologies. All over Europe, we can see a rise in the use of computers. The northern European countries are front-runners in this regard, but other parts of Europe are catching up. Use of computers shows positive outcomes for workers, such as more learning opportunities, lower health risks and improved job satisfaction. It is possible that technological developments may help to counteract high-strain work environments.

References

Andries, F., *Automation is the Work of Humans*, Leiden, NIPG-TNO, 1990.

Andries, F., Bijleveld, C.C.J.H. and Pot, F.D., 'Working conditions and mental strain of automation personnel', *International Journal of Human–Computer Interaction*, No. 3, 1991, pp. 363–73.

Bijleveld, C.C.J.H., Andries, F. and van Rijckevorsel, J.L.A., 'Positive and Negative Aspects of the Work of Information Technology Personnel: and Exploratory Analysis', *Behaviour & Information Technology*, Vol. 19, No. 2, March–April 2000, pp. 125–38.

Blatter, B.M. and Bongers, P.M., *Work-Related Neck and Upper Limb Symptoms (RSI): High-Risk Occupations and Risk Factors in the Dutch Working Population*, Hoofddorp, TNO Arbeid, 1999.

Cully, M., and Marginson, P., 'The Workplace Industrial Relations Survey: Donovan and the Burden of Continuity', *Warwick Papers in Industrial Relations*, No. 55, University of Warwick Industrial Relations Research Unit, School of Industrial and Business Studies, 1995.

Dhondt, S., *Monitoring Occupational Health and Safety in Europe: Time Constraints and its Implications*, Leiden, TNO-PG, 1994a.

Dhondt, S., European Foundation for the Improvement of Living and Working Conditions, 'The Netherlands: TNO Questionnaires on Working Conditions', in *Monitoring the Working Environment*, Report of Second European Conference, Luxembourg, Office for Official Publications of the European Communities, 1994b.

Dhondt, S., European Foundation for the Improvement of Living and Working Conditions, *Time Constraints and Autonomy in Nine National and International Surveys*, Luxembourg, Office for Official Publications of the European Communities, 1998.

Dhondt, S., Andries, F., Jansen, R., Kandolin, I., Kauppinen-Torpainen, K. and Nogarena, C., *Monitoring Occupational Health and Safety in Europe: Time Constraints and Autonomy. Description and Implications*, Leiden, TNO-PG, 1995.

Dhondt, S. and Houtman, I.L.D., European Foundation for the Improvement of Living and Working Conditions, *Indicators of Working Conditions in the European Union*, Luxembourg, Office for Official Publications of the European Communities, 1998.

Dhondt, S. and Kraan, K., *Work in the Information Society*, Utrecht, Lemma, 2001.

Dostal, W., Jansen, R. and Parmentier, K., *Wandel der Erwerbsarbeit: Arbeitssituation, Informatisierung, berufliche Mobilität und Weiterbildung*, Nürnberg, Bundesanstalt für Arbeit, 2000.

Economic and Social Committee, Advies van het Economisch en Sociaal Comité over 'Werkgelegenheid, economische hervorming en sociale samenhang – Naar een Europa van innovatie en kennis' (C 117/13), Brussels, 2000.

European Commission, *Modernising the Organisation of Work – A Positive Approach to Change*, COM (1998) 592 final, Brussels, 1998.

Favre, F., François, J.P. and Greenan, N., *Changements organisationnels et informatisation dans l'industrie*, Paris, Sessi, 1998.

Geary, J., *Surveying Employees in Future Workplace Industrial Relations Surveys: A Research Note*, Centre for Employment Relations and Organisational Performance, Graduate School of Business, University College Dublin, Working Paper No. 19, 1996.

De Gier, H.G., Bloemhoff, A. and Dhondt, S., *Public Servants and Working Conditions: Regulations and Policy in the Netherlands, Great Britain, Spain, Germany and France*, Den Haag, Netherlands Ministry of the Interior, 1994.

Gollac, M., Greenan, N. and Hamon-Cholet, S., 'L'informatisation de "ancienne économie": nouvelles machines, nouvelles organisations et nouveaux travailleurs', *Économie et statistique*, No. 339–40, 2000, pp. 9–10.

Greenan, N. and Mairesse, J., *Organisational Change in French Manufacturing: What Do We Learn from Firm Representatives and from their Employees?* National Bureau of Economic Research, Working Paper No. 7285, 1999.

Hamon-Cholet, N. and Rougerie, C., 'La charge mentale au travail: des enjeux complexes pour les salaries', *Économie et statistique*, No. 339–40, 2000, pp. 9–10.

Houtman, I.L.D., Hildebrandt, V.H. and Dhondt, S., *Monitoring Stress and Physical Load: Construction and First Test of an Instrument*, Publ. No. 93.075, Leiden, NIPG-TNO, 1993.

Houtman, I.L.D., Bloemhoff, A., Dhondt, S. and Terwee, C., *WEBA and NOVA-WEBA in Relation to the Health and Well-Being of Employees*, Publ. No. 94.003, Leiden, NIPG-TNO, 1994.

Houtman, I.L.D., Bongers, P.M., Smulders, P.G.W. and Kompier, M.A.J., 'Psychosocial stressors at work and musculoskeletal problems', *Scandinavian Journal of Work, Environment & Health*, No. 20, 1994, pp. 139–45.

Houtman, I.L.D. and Kompier, M.A.J., 'Risk Factors and Occupational Risk Groups for Work Stress in the Netherlands', in S.L. Sauter and L.R. Murphy (eds), *Organisational Risk Factors for Job Stress*, Washington, APA, 1995, pp. 209–25.

Houtman, I.L.D. and Kompier, M.A.J., 'Mental Health', in *Encyclopaedia for Occupational Health and Safety*, Geneva, ILO, 1997.

Houtman, I.L.D., *Trends in Work and Health*, Amsterdam, NIA TNO, 1997.

Houtman, I., Goudswaard, A., Dhondt, S., Van der Grinten, M.P. and Hildebrandt, V.H., 'Dutch Monitor on Stress and Physical Load: Risks: Consequences and Preventive Action', *Occupational and Environmental Medicine,* No. 55, 1998, 73–85.

Houtman, I.L.D. and Kornitzer, M., 'The Job Stress, Absenteeism and Coronary Heart Disease European Cooperative Study (the JACE Study) – Design of a Multicenter Prospective Study', *European Journal of Public Health,* No. 9, 1999, 52–7.

Houtman, I.L.D., Smulders, P.G.W. and Klein Hesselink, D.J. (eds), *Trends in Work 1999*, Alphen a/d Rijn, Samsom, 1999.

Karasek, R., 'Job demands, job decision latitude, and mental strain: implications for job redesign', *Administrative Science Quarterly 24*, pp. 285–308, 1979.

Karasek, R. and Theorell, T., *Healthy Work: Stress, Productivity, and the Reconstruction of Working Life*, New York, Basic Books, 1991.

Karasek, R., Brisson, C., Kawakami, N., Houtman, I., Bongers, P. and Amick, B., 'The Job Content Questionnaire (JCQ): An Instrument for Internationally Comparative Assessments of Psychological Job Characteristics', *Journal of Occupational Health Psychology*, Vol. 3, No. 4, 1998, pp. 322–55.

Kauppinen, T, Heikkilä, P., Lehtinen, S. *et al*, *Työ ja Terveys: Suomessa v. 2000*, Helsinki, Työterveyslaitos, 2000.

Kraan, K.O., Blatter, B.M., Dhondt, S. and Bongers, P.M., *ICT, Production and Work Organisation in Relation to Work: Qualificatory Demands, Labour Market Position and Repetitive Strain Injuries (RSI)*, Hoofddorp, TNO Arbeid, 2000.

Kraan, K.O. and Wiezer, N.M., 'Work in the Information Society. ICT, Networks and New Production Concepts in Relation to Quality of Work', in R. Weehuizen (ed.) *Future@work.nl:Reflections on Economy, Technology and Work*, Den Haag, STT (Stichting Toekomstbeeld der Techniek), 2001.

Kraan, K.O. and Dhondt, S. 'ICT, Production Concepts and Quality of Work, *Tijdschrift voor Arbeidsvraagstukken* (submitted 2001).

Lindström, K., Borg, V., Dallner, M., Elo, A.L., Gamberale, F., Knardahl, S., Orhede, E. and Raivola, P., *Measurement of Psychological and Social Factors at Work: Description of Selected*

Questionnaire Methods Employed in Four Nordic Countries, Copenhagen, Nordic Council of Ministers, 1995.

Pack, K. and Buck, H. *Arbeitsystemgestaltung in der Serienmontage Bestandsaufnahme und Gestaltungsmöglichkeiten*, Düsseldorf, VDI Verlag GmbH, 1992, Fortschr.-Ber, VDI Vol. 2, No. 261.

Paoli, P, and Merllié, D., European Foundation for the Improvement of Living and Working Conditions, *Third European Survey on Working Conditions*, Luxembourg, Office for Official Publications of the European Communities, 2001.

Pot, F.D., Peeters, M.H.H., Vaas, S. and Dhondt, S., 'Assessment of Stress Risks and Learning Opportunities in the Work Organisation', *The European Work and Organisational Psychologist,* Vol. 4, No. 1, 1994, pp. 21–37.

Rantanen, J., Kauppinen, T., Toikkanen, J., Kurppa, K., Lehtinen, S. and Leino, T., *Country Profiles and National Surveillance Indicators in Occupational Health and Safety*, Helsinki, Finnish Institute of Occupational Health, 2001.

Smart, D. and Stevens, M., *A Guide to Questions in the Workplace Industrial Relations Survey (WIRS) Series*, Great Britain Employment Department Group, Sheffield, 1992.

Statistika Centralbyrån, 'The Work Environment 1999', *Statistika meddelanden*, Supplement to the Statistical Report AM 68 SM 0001, January 2001.

Vaas, S., Dhondt, S., Peeters, M.H.H. and Middendorp, J., *De WEBA-analyse*, Alphen aan den Rijn, Samsom Bedrijfsinformatie, 1995.

Vink, P., Koningsveld, E.A.P. and Dhondt, S. (eds), *Human Factors in Organisational Design and Management*, Amsterdam, 1998, Vol. 6, p. 801.

Wiezer, N., *Control in Organisations: An Empirical Investigation of the Relationship between Control and Success in 52 Companies* (Thela Thesis), Amsterdam, 1999.

Wilson, J.R. and Corlett, E.N., *Evaluation of Human Work: A Practical Ergonomics Methodology*, 2nd Edition, London, Taylor & Francis, 1995.

Appendices

Appendix 1
Survey variables and constructs

The construction of the main variables is presented in this table. The table also shows the quality of the scale used in the report.

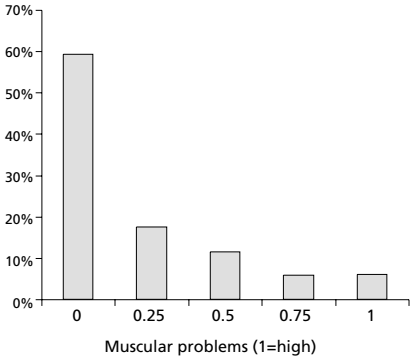
VARIABLE	SPSS CODE	ITEM(S)	Number of values	Direction of coding (measurement level)	Cronbachs alpha
Demographic and background variable					
Age & Sex combined	Age_sex	EF 30	8	(nominal)	n.a. (not applicable)
Age & Sex dummies	mal_1524 mal_2539 ('ref.') mal_4054 mal_ge55 fem_1524 fem_2539 fem_4054 fem_ge55	EF 30	2	0, 1 (indicator variable: interval)	n.a.
Company size	Comsize	q7	8	Higher = larger (ordinal)	n.a.
Company size dummies	cs_1 ('ref.') cs_2_4 cs_5_9 cs_10_49 cs_50_99 cs_100_9 cs_250_9 cs_500			0, 1 (indicator variable: interval)	
Branch	Nace11	q5r2	11	(nominal)	n.a.
Branch dummies	b_ag ('ref.') b_manu b_nut b_cons b_sale b_hor b_tra b_fin b_rea b_pub b_soc				
Job title	Jobtitle	q2r	10	(nominal)	n.a.
Job title dummies	jb_srleg ('ref.') jb_prof jb_tech jb_clerk jb_serw jb_agri jb_craft jb_opera jb_elem jb_armed				
Technology variables					
Technology-free work situation	Notech	Applicable when technology in work situation absent (see below)	2	0 'using'; 1 'not using'; 0, 1 (indicator variable: interval)	n.a.

VARIABLE	SPSS CODE	ITEM(S)	Number of values	Direction of coding (measurement level)	Cronbachs alpha
Machine technology	Oldtech	q11a; q2204	2	1 'yes'; 0 'no'; 0, 1 (indicator variable: interval).	Correlation = .34
Use of computers	Newtech	q12d, q12e	7	Higher =use less often (ordinal/'interval')	n.a.
Use of computers: dummy	Newtechd	Ibid.	2	0 'no'; 1 '1/4 or more of the time'; 0, 1 (indicator variable: interval)	n.a.
Technology use 2000: reduced variable	Tech2000	notech, oldtech, newtechd, dummies and one combination hereof	3	0 'not using technologies'; 1 'using old technologies'; 2 'using oldànd use of computers'; 3 'using computers'	n.a.
Control on technology	Conttech	q23bc5; q23bc6; q30c1; q30c2; q30c3	2	0 'no control on interruptions with cause: technology' 1 'other'	n.a.
Work organisation variables					
Job demands	Jobd	q21b1; q21b2	(0-100)	higher is more job demands (interval)	correlation= 43
Control	Control3	q2501 q2502 q2503	(0-100)	higher is less job autonomy	.77
Karasek's quadrants	Quadrant	combination jobd and control3 (see above)	4	see below (ordinal); median split on scales	n.a.
– active situations – dummy	– Quadrant=4 – q_activ		2	– 'jd high, jc high' – 0, 1 (indicator variable: interval)	n.a.
– passive situations – dummy	– Quadrant=1 – q_passiv		2	'jd low, jc low' – 0, 1 (indicator variable: interval)	
– low strain – dummy	– Quadrant=2 – q_lo_str		2	'jd low, jc high' – 0, 1 (indicator variable: interval)	
– high strain – dummy	– Quadrant=3 – q_hi_str		2	'jd high, jc low' – 0, 1 (indicator variable: interval)	
Work-related outcomes					
Health					
backache, pains in shoulder and neck, pains in upper limbs pains in lower limbs	muscular	q35c05 + q35c08 + q35c09 + q35c10	scale (0-1)	Higher score means more complaints (interval)	.76

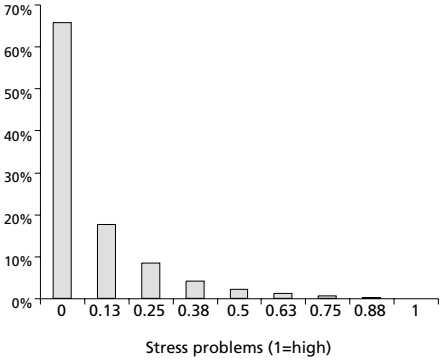
VARIABLE	SPSS CODE	ITEM(S)	Number of values	Direction of coding (measurement level)	Cronbachs alpha
headaches stomach ache heart disease stress overall fatigue sleeping problems anxiety irritability	stress	q35c06 + q35c07 + q35c12 + q35c15 + q35c16 + q35c18 + q35c19 + q35c20	scale (0-1)	Higher score means more complaints (interval)	.72
hearing problems skin problems respiratory difficulties injury allergies	allergy	q35c02 + q35c04 + q35c11 + q35c13 + q35c17	scale (0-1)	Higher score means more complaints (interval)	.61
Work-related sick leave – due to accident at work – due to work-related health problems	Q36a; Q36b	Q36a; Q36b	number of days in year, 0-365	(interval)	n.a.
Social and societal activity					
Home activities: cooking, housework	gezactiv	ef2004 ef2005	scale (0-5)	Higher = more often (interval)	Correlation = .78
Family activity	separate item: gezin1		5 (0, 1,.,5)	('interval')	
Training, sport, cultural, leisure activities	ontactiv	ef2007 ef2008 ef2009 ef2010	scale (0-5)	Higher = more often (interval)	.57
Societal activities/participation: – voluntary or charitable activity – political/trade union activity – caring for elderly/disabled relatives	3 separate items: vrijwil1, vrijwil2, vrijwil3	ef2001 ef2002 ef2006	5 (0,1,.., 5)	Higher = more often ('interval')	.27 (no scale)
Skills					
Skills required by job	skills	q2402 q2403 q2405 q2406	scale (0-100)	higher is less possibilities for developing skill requirements (interval)	.63
'Over'employment	q28high	q28	2	1 'demands too high'; 0 'match/too low demands' (nominal as dependent variable)	
'Under'employment	q28low	q28	2	1 'demands too low' 0 'match/too high demands' (nominal as dependent variable)	
Job dissatisfaction					
Job dissatisfaction	q38bis	Q38	4	higher is less satisfied ('interval')	

Appendix 2
Graphs representing survey variables

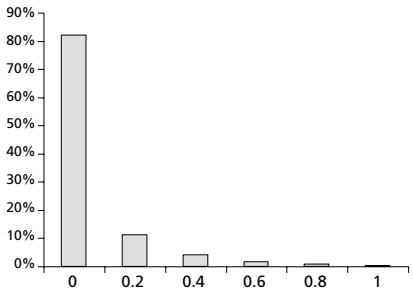
The distribution for the different dependent variables used in this report are presented in the graphs below.



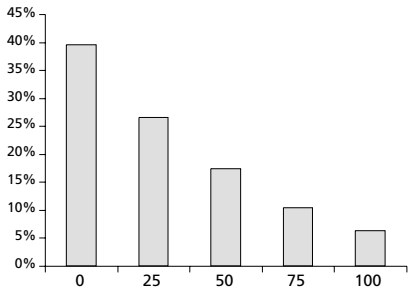
Muscular problems (1=high)



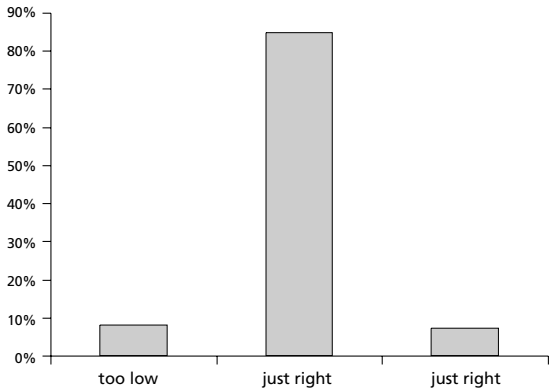
Stress problems (1=high)



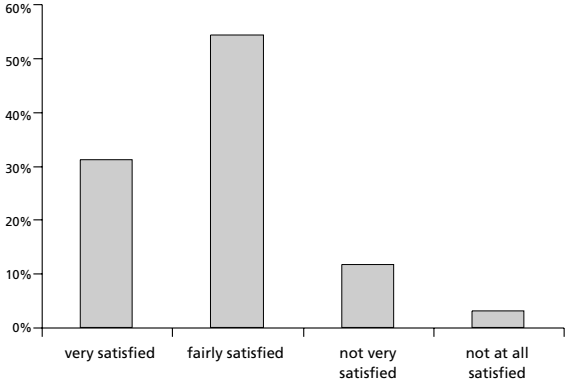
Allergy problems (1=high)



Skills (100=high)



Skills match job demands



Job satisfaction

Appendix 3
Regression analysis tables

The comparisons made in the following tables use dummy variables for industries and jobs. Company size is a numerical variable. The following dummy variables have been left out of the analysis and can be seen as the reference value for the comparisons: agricultural sector and agricultural jobs. Only those regression parameters (betas) higher than +/- 0.08 are listed. The following results have been found:

- Work situations with no technology use are more common for catering and social services sectors. Most white-collar workers, except service workers, are less likely to be in such 'no technology situations'. Also, such situations are less common in bigger companies.
- Work situations with the use of machine technology are more common for construction workers and less common for social services workers and most white-collar workers.
- Work situations with machine technology use and computer use together are more common for manufacturing companies and for bigger companies.
- Work situations with computer use are less common for workers in the catering and social services. Use of computers is more common in white-collar professions.

Not using technologies		Explained variance (Rsq):	18,1	
		Standardised Coefficients	t	Sig.
		Beta		
(Constant)			12,99	0,00
B_MANU	Manufacturing	-0,08	-3,43	0,00
B_HOR	Catering	0,10	7,26	0,00
B_SOC	Social services	0,22	8,87	0,00
JB_SRLEG	Managers	-0,11	-6,34	0,00
JB_PROF	Professionals	-0,14	-5,23	0,00
JB_TECH	Technicians and associate professionals	-0,12	-4,03	0,00
JB_CLERK	Clerks	-0,22	-7,26	0,00
JB_CRAFT	Craft and related trades workers	-0,08	-2,77	0,01
Comsize	Company size	-0,08	-10,43	0,00

Using machine technologies		Explained variance (Rsq):	26,9	
Dependent Variable: OLDTECDU		Standardised Coefficients	t	Sig.
		Beta		
(Constant			18,79434	1,77E-23
B_CONS	Construction	0,08	5,26	0,00
B_SOC	Social services	-0,09	-3,64	0,00
JB_SRLEG	Managers	**-0,20**	-12,37	0,00
JB_PROF	Professionals	**-0,31**	-12,69	0,00
JB_TECH	Technicians and associate professionals	**-0,33**	-12,09	0,00
JB_CLERK	Clerks	**-0,37**	-13,20	0,00
JB_SERW	Service workers and shop and market sales workers	**-0,28**	-9,84	0,00

Using machine technology and computers		Explained variance (Rsq):	4,1	
Dependent Variable: OLDNEWDU		Standardised Coefficients	t	Sig.
		Beta		
(Constant)			1,41	0,15
B_MANU	Manufacture	0,12	5,07	0,00
COMSIZE2	Company size	0,09	10,95	0,00

Use of computers		Explained variance (Rsq):	30,7	
Dependent Variable: NEWTECDU		Standardised Coefficients	t	Sig.
		Beta		
(Constant)			1,96	0,04
B_HOR	Catering	-0,09	-7,55	0,00
B_SOC	Social services	-0,14	-6,03	0,00
JB_SRLEG	Managers	0,28	17,25	0,00
JB_PROF	Professionals	0,40	16,80	0,00
JB_TECH	Technicians and associate professionals	0,36	13,73	0,00
JB_CLERK	Clerks	0,50	18,18	0,00
JB_SERW	Service workers and shop and market sales workers	0,20	7,05	0,00

In the following tables, the likelihood for type of work organisation is analysed for sectors, professions and company size. Only regression parameters (betas) higher than 0.10 are listed:

- Passive work situations are less common among managers and technical professionals.
- Low-strain work situations are less common among operators and assemblers.
- High-strain work situations are more more common among traditional blue-collar workers.
- Active work situations are most common among managers, professionals and technical professionals.

Passive work organisation		Explained variance (Rsq):	2,4	
Dependent Variable: Q_PASSIV		Standardised Coefficients	t	Sig.
		Beta		
(Constant)			9,74	2E-22
JB_SRLEG	Managers	-0,10	-5,32	0,00
JB_TECH	Technicians and associate professionals	-0,10	-3,19	0,00

Low-strain work organisation		Explained variance (Rsq):	3,1	
Dependent Variable: Q_LO_STR		Standardised Coefficients	T	Sig.
		Beta		
(Constant)			8,94	4,27079E-19
JB_OPERA	Plant and machine operators and assemblers	-0,08	-3,15	0,00

High-strain work organisation		Explained variance (Rsq):	2,9	
Dependent Variable: Q_HI_STR		Standardised Coefficients	t	Sig.
		Beta		
(Constant)			6,07	1,26428E-09
JB_CRAFT	Craft and related trades workers	0,09	2,67	0,01
JB_OPERA	Plant and machine operators and assemblers	0,10	4,04	0,00

Active work organisation		Explained variance (Rsq):	3,1	
Dependent Variable: Q_ACTIV		Standardised Coefficients	t	Sig.
		Beta		
(Constant)			6,079931309	1,22845E-09
JB_SRLEG	Managers	0,11	5,81	0,00
JB_PROF	Professionals	0,09	3,23	0,00
JB_TECH	Technicians and associate professionals	0,08	2,42	0,02

Dependent Variable: Control on interruptions with cause technology > improvements work station/unit/establishment?		Explained variance (Rsq):	0,8	
		Standardised Coefficients	t	Sig.
		Beta		
(Constant)			82,776729	1,78055E-23
	No variables retained.			

Appendix 4
Regression analysis of technology, work organisation and outcomes for workers, controlled for industry, job title and company size

Dependent Variable: SKILLS	Explained variance (Rsq):	24,1	
	Standardised Coefficients	t	Sig.
	Beta		
(Constant)		8,367725946	6,36203E-17
Clerks	0,151334579	10,89460398	1,79058E-23
Service workers and shop and market sales workers	0,125824229	8,662825378	5,04298E-18
Plant and machine operators and assemblers	0,144219377	11,79271804	1,79058E-23
Elementary occupations	0,239586211	19,03642574	1,79058E-23
10-49 employees	-0,10355911	-5,361762914	8,35758E-08
Use of machine technology and computers	-0,170724295	-21,21203064	1,79058E-23
Use of computers	-0,208473838	-22,00084866	1,79058E-23
Low-strain work situation	-0,181446406	-20,47501373	1,79058E-23
High-strain work situation	-0,097591377	-11,17029708	1,79058E-23
Active work situation	-0,242602716	-27,62707973	1,79058E-23

Dependent Variable: Q28: How well do you think your skills match the demands imposed on you by your job?	Explained variance (Rsq):	1,9	
	Standardised Coefficients	t	Sig.
	Beta		
(Constant)		4,6187682	3,89026E-06
Use of machine technology	0,177099143	3,264609504	0,001098449
Interaction machine technology, control technology	-0,122504308	-2,279418295	0,022655293

Dependent Variable: Q28: How well do you think your skills match the demands imposed on you by your job?	Explained variance (Rsq):	1,4	
	Standardised Coefficients	t	Sig.
	Beta		
(Constant)		3,621134714	0,000294218
Elementary occupations	0,082228395	5,790332993	7,15613E-09
Use of computers	0,15250174	2,262593092	0,023674107
Interaction use of computers, control technology	-0,142276577	-2,127115685	0,033425695

Dependent Variable: Work-related health problems concerning muscular/limb/backpains (high=many	Explained variance (Rsq):	8,6	
	Standardised Coefficients	t	Sig.
	Beta		
(Constant)		6,512008683	7,63192E-11
Service workers and shop and market sales workers	0,094710535	5,985679896	2,20002E-09
Craft and related trades workers	0,117739839	7,463002792	8,88315E-14
Elementary occupations	0,099744592	7,30403542	2,9216E-13
Use of machine technology	0,124091982	13,03656059	1,78072E-23
High-strain work situation	0,097923494	10,47368686	1,78072E-23

Dependent Variable: Work-related health problems concerning headaches/stress/fear etc. (high=many)	Explained variance (Rsq):	4,8	
	Standardised Coefficients	t	Sig.
	Beta		
(Constant)		9,621089021	7,44525E-22
High-strain work situation	0,094601384	10,03141277	1,78072E-23
Interaction computers and new , control technology	0,108544131	2,423131776	0,015398156

Dependent Variable: Work-related health problems concerning allergies/astma (high=many)	Explained variance (Rsq):	9,6	
	Standardised Coefficients	t	Sig.
	Beta		
(Constant)		3,691895956	0,000223314
Craft and related trades workers	0,152385696	9,715115686	2,98687E-22
Use of machine technology	0,324235727	6,289089661	3,27462E-10
Interaction machine technology, control technology	-0,168979373	-3,309809493	0,000935619

Dependent Variable: Q.36.a. - In your main paid job, how many days over the past 12 months were you absent due to an accident at work?	Explained variance (Rsq):	0,8	
	Standardised Coefficients	t	Sig.
	Beta		
(Constant)		3,164224572	0,001557854
Manufacture	-0,067612907	-2,088698618	0,036750495
Sales`	-0,060920434	-2,036798881	0,041686491
Social services	-0,07201004	-1,975476399	0,048231125

Dependent Variable: Q.36.b. - And due to health problems caused by your work?	Explained variance (Rsq):	0,8	
	Standardised Coefficients	t	Sig.
	Beta		
(Constant)		2,873592774	0,004063628
Use of machine technology	-0,162457977	-3,001356406	0,002691917
Interaction machine technology, control technology	0,160722283	2,992687862	0,002769518

Dependent Variable: Cooking and housework activities (0= never; 5=average of 1 hour every day)	Explained variance (Rsq):	12,5	
	Standardised Coefficients	t	Sig.
	Beta		
(Constant)		16,83591105	1,78237E-23
Social services	0,209685577	6,14493777	8,18645E-10
Clerks	0,149300152	10,08497894	1,78237E-23
Service workers and shop and market sales workers	0,143551663	9,241886123	2,71628E-20

Dependent Variable: EF.20.3. - How often involved in activities outside work—CARING FOR AND EDUCATING YOUR CHILDREN	Explained variance (Rsq):	2,1	
	Standardised Coefficients	t	Sig.
	Beta		
(Constant)		7,774800103	8,09757E-15
Social services	0,113114174	2,878074327	0,004007337

Dependent Variable: Training, sport, cultural, leisure activities	Explained variance (Rsq):	7,8	
	Standardised Coefficients	t	Sig.
	Beta		
(Constant)		13,91720728	1,7822E-23
Plant and machine operators and assemblers	-0,101082912	-7,578722712	3,67774E-14
Elementary occupations	-0,10446129	-7,604144761	3,02455E-14
Use of computers	0,116067424	11,43053864	1,7822E-23

Dependent Variable: EF.20.1. - How often involved in activities outside work—VOLUNTARY OR CHARITABLE ACTIVITY	Explained variance (Rsq):	3,8	
	Standardised Coefficients	t	Sig.
	Beta		
(Constant)		5,893990515	3,84607E-09
Clerks	-0,061882352	-3,946469801	7,96531E-05
Use of computers	0,074184753	7,094758712	1,35046E-12
Active strain work situation	0,06938492	7,155450165	8,70405E-13

Dependent Variable: EF.20.2. - How often involved in outside work—POLITICAL/TRADE UNION ACTIVITY	Explained variance (Rsq):	2,1	
	Standardised Coefficients	t	Sig.
	Beta		
(Constant)		3,683156326	0,000231131
Public sector	0,068254492	2,984774917	0,002842205
Social services	0,07559517	2,079217237	0,037613446
Clerks	-0,063557244	-4,004596812	6,24069E-05
Service workers and shop and market sales workers	-0,060521951	-3,632073114	0,000282041
Interaction computers and new, control technology	0,096007504	2,089476089	0,036680811

Dependent Variable: EF.20.6. - How often involved in activities outside work—CARING FOR ELDERLY/DISABLED RELATIVES	Explained variance (Rsq):	1,1	
	Standardised Coefficients	t	Sig.
	Beta		
(Constant)		3,67509648	0,0002386
Social services	0,1121705	2,937070222	0,003318401

Dependent Variable: On the whole, are you very satisfied, fairly satisfied, not very satisfied or not at all satisfied with working conditions in your main paid job?	Explained variance (Rsq):	7,1	
	Standardized Coefficients	t	Sig.
	Beta		
(Constant)		26,69928457	1,78258E-23
Craft and related trades workers	0,096418235	6,061300802	1,38017E-09
Elementary occupations	0,101603614	7,372405979	1,75665E-13
Use of machine technology and computers	-0,103318509	-2,309566105	0,020924699
Low-strain work situation	-0,128367446	-13,50576229	1,78258E-23
Interaction old and new, control technology	0,109098169	2,455893557	0,0140639

Appendix 5
Comparison of country questionnaires

Table 1 Comparison of questions on **'high speed work'** in the different questionnaire-based surveys (countries not shown: no national data available).

Country	Questions	Last year	Comment
Austria	Professional demands: work under time pressure	1994	Question not identifiable in new surveys. Apparently, the time pressure question has been abandoned.
Denmark			No information about new surveys
France	Do you have to hurry in your job?		
Finland	Is there time pressure and tight time schedules in your work (environment)? If yes, then ask supplementary question: Is time pressure and tight time schedules a burden that affects your work?	2000	
Germany	Are you placed under strong deadline or performance pressure?	1999	
Greece			Sources indicate that comparable data to the EF2000 survey should be available. These results would coincide with the EF2000 data. However, we could not obtain this data.
Netherlands	Do you work at a high speed?	1997	
Spain	In your work, do you need to support a high work pace?	2000	
Sweden	Is the amount of work you have to do so great that you do not have time to talk or think about anything else during working hours?		
United Kingdom	Does your job ever involve working very fast? How often does this happen?	1995	

Table 2 Comparison of questions on **'machine-dictated work pace'** in the different questionnaire-based surveys (countries not shown: no national data available).

Country	Questions	Year	Comment
France	Is your pace of work dependent on the automatic speed of a machine? (74) Do you use an automatic machine or installation?	1998 1997	
Finland			No question available
Germany	How frequently during the course of your work are you required to perform tasks for which the procedure method is precisely, down to the last detail, predetermined?	1999	
Netherlands			No question available
Spain	Your work pace is dictated by: 1- A machine	1999	Data not available to us.
Sweden	Technical equipment, working with machines – Handheld or portable (moveable) machines – Equipment in which the driver sits (not buses or cars) – Stationary machines – Automatic or semi-automatic stationary machines – Manual work at stationary, automatic machines Supervisory work of stationary, automatic machines 1999		

Table 3 Comparison of questions on **'monotonous work'** in the different questionnaire-based surveys (countries not shown: no national data available).

Country	Questions	Year	Comment
Finland	Is your work highly monotonous, rather monotonous, rather varied or highly varied?	1997 2000	
Germany	How frequently during the course of your work are (you?) required to perform monotonous tasks?	1999	
Netherlands	Do you do monotonous work?	1997	
Spain	Is your work monotonous? (Spanish: el trabajo que usted realiza, le resulta monótono?)	1997	
Sweden	How do you experience your work? Monotonous work – Varied work	1999	
United Kingdom	Do you ever have too much work to do? How often does this happen?	1995	

Table 4 Comparison of questions on **'teleworking'** in the different questionnaire-based surveys (countries not shown: no national data available)

Country	Questions
France	Only available by combining questions.
Germany	Only available by combining questions.
Sweden	Only available by combining questions.

Table 5 Comparison of questions on **use of computers** in the different questionnaire-based surveys (countries not shown: no national data available).

Country	Questions	Year	Comment
France	(52) Do you use, even occasionally, in your work … a – a computer or workstation at your work? b – a computer screen or information screen c – any other information tool	1997	
Germany	Do you use – Automatic machines (e.g. lathes) – Computer-controlled machines (CNC-, NC-Machines, Computer, PC, Laptop, Notebook, etc..)		
Sweden	**Work with any of the following computer equipment:** – Cash register/computerised cash register – Personal computer, computer terminal or similar – Programmable mechanical tools – Computer-controlled production process – Computerised control or measurement – Only portable PC – Both stationary and portable PC **Use computer equipment (one or more of above)** – Work with computer equipment (at least $^1/_2$ of working time) – Working at a display monitor – Display monitor (at least $^1/_2$ of working time) – Type of computer equipment – Mouse at computer – Trackball, touch pad, joystick, etc., at computer – Keyboard at computer – Barcode reader at computer – Mostly using mouse **Using computer equipment mainly to** – Key in data, word process the work of others – Search for information – Process data, analyse data, programming, etc. – Monitor/control information		

Appendix 6
Situation of the self-employed

In the report, we have analysed the situation of employed workers. In this appendix, we want to give some details about the self-employed in relation to work organisation and technology. When analysing work organisation or technology use, we expect to see a lot of differences between both groups, mainly because of the different hierarchical relationships these types of employees have. In Figure 1, we can see that there are fewer computer users among the self-employed than among employed workers. A higher proportion of self-employed workers report no use of technology, while the use of machine technology is somewhat higher among the self-employed. The differences are bigger when we compare the work organisational settings of both groups. More self-employed workers enjoy active and low-strain work situations. This is a result of the fact that the self-employed experience higher levels of autonomy than the employed. It must be pointed out that this higher control is somewhat 'self-delusional': the self-employed have to work much longer hours than the employed do.

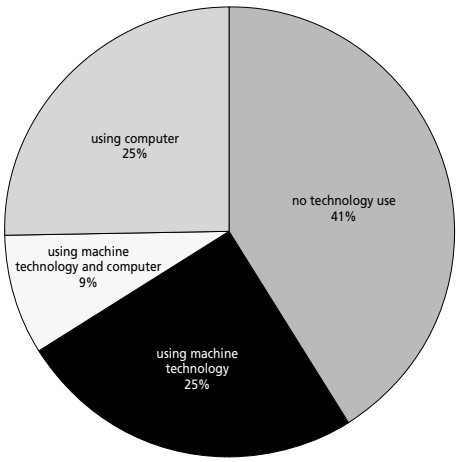


Figure 1 Self-employed and use of technology

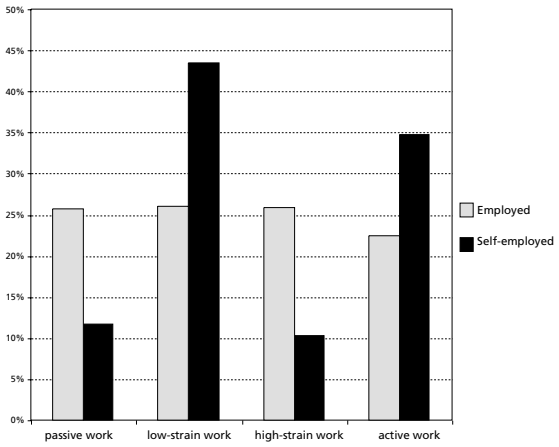


Figure 2 Self-employed and work organisation

Figure 3 compares the technology use of the self-employed in the different countries. The differences here are greater than those among the employed. The self-employed in northern European countries have more access to computers than the self-employed in southern European countries. This is particularly the case for Portugal, Greece and Italy, where very few of the self-employed use computers in their work. More than half of the self-employed in Germany use computers, which is in great contrast with the employed in Germany.

Figures 4 and 5 show the technology use for different types of jobs and industrial settings among the self-employed. These figures are very similar to those for the employed, except in the case of managers and clerks, where the self-employed show considerably lower degrees of computer use.

Figure 3 Self-employed: comparison of use of technology between countries

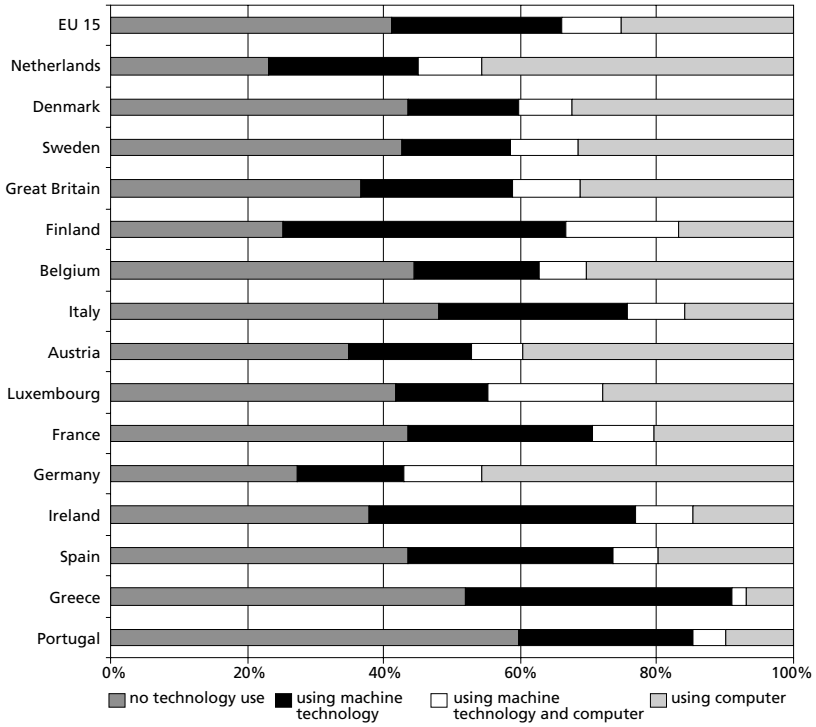


Figure 4 Self-employed: comparison of use of technology between industrial sectors

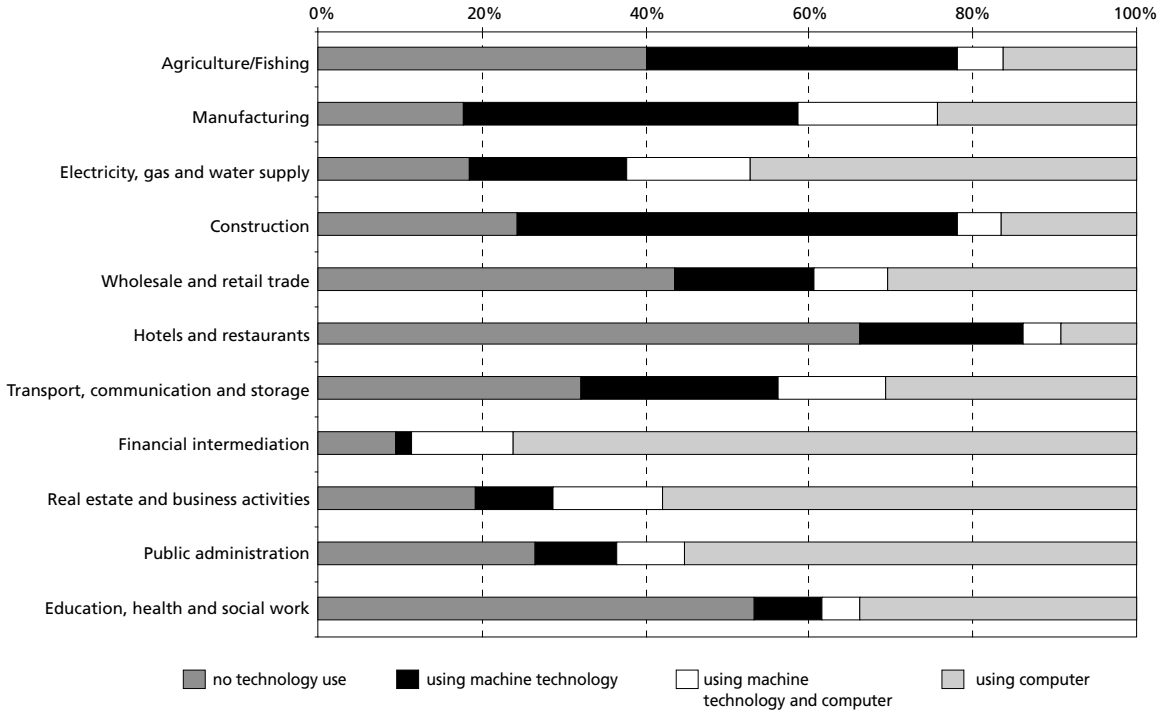
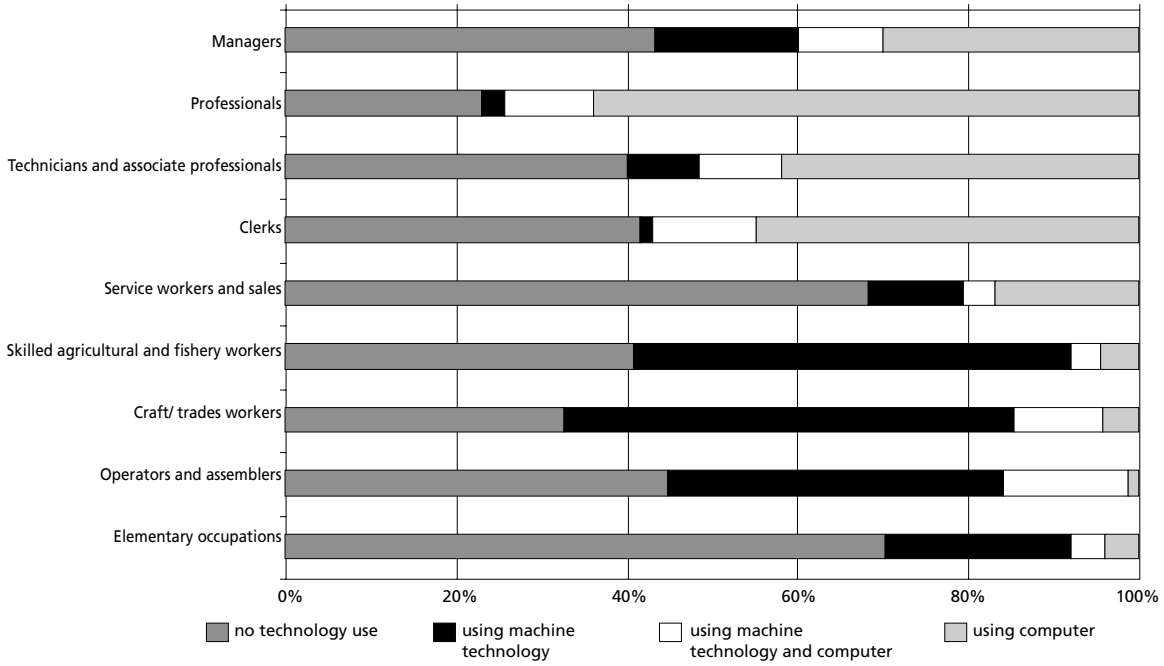


Figure 5 Self-employed: comparison of use of technology between occupations.



European Foundation for the Improvement of Living and Working Conditions

Work organisation, technology and working conditions

Luxembourg: Office for Official Publications of the European Communities

2002 – VIII, 70 pp. – 21 x 29.7 cm

ISBN 92-897-0140-4

Venta • Salg • Verkauf • Πωλήσεις • Sales • Vente • Vendita • Verkoop • Venda • Myynti • Försäljning
http://eur-op.eu.int/general/en/s-ad.htm

BELGIQUE/BELGIË

Jean De Lannoy
Avenue du Roi 202/Koningslaan 202
B-1190 Bruxelles/Brussel
Tél. (32-2) 538 43 08
Fax (32-2) 538 08 41
E-mail: jean.de.lannoy@infoboard.be
URL: http://www.jean-de-lannoy.be

**La librairie européenne/
De Europese Boekhandel**
Rue de la Loi 244/Wetstraat 244
B-1040 Bruxelles/Brussel
Tél. (32-2) 295 26 39
Fax (32-2) 735 08 60
E-mail: mail@libeurop.be
URL: http://www.libeurop.be

Moniteur belge/Belgisch Staatsblad
Rue de Louvain 40-42/Leuvenseweg 40-42
B-1000 Bruxelles/Brussel
Tél. (32-2) 552 22 11
Fax (32-2) 511 01 84
E-mail: eusales@just.fgov.be

DANMARK

J. H. Schultz Information A/S
Herstedvang 12
DK-2620 Albertslund
Tlf. (45) 43 63 23 00
Fax (45) 43 63 19 69
E-mail: schultz@schultz.dk
URL: http://www.schultz.dk

DEUTSCHLAND

Bundesanzeiger Verlag GmbH
Vertriebsabteilung
Amsterdamer Straße 192
D-50735 Köln
Tel. (49-221) 97 66 80
Fax (49-221) 97 66 82 78
E-Mail: vertrieb@bundesanzeiger.de
URL: http://www.bundesanzeiger.de

ΕΛΛΑΔΑ/GREECE

G. C. Eleftheroudakis SA
International Bookstore
Panepistimiou 17
GR-10564 Athina
Tel. (30-1) 331 41 80/1/2/3/4/5
Fax (30-1) 325 84 99
E-mail: elebooks@netor.gr
URL: elebooks@hellasnet.gr

ESPAÑA

Boletín Oficial del Estado
Trafalgar, 27
E-28071 Madrid
Tel. (34) 915 38 21 11 (libros)
913 84 17 15 (suscripción)
Fax (34) 915 38 21 21 (libros),
913 84 17 14 (suscripción)
E-mail: clientes@com.boe.es
URL: http://www.boe.es

Mundi Prensa Libros, SA
Castelló, 37
E-28001 Madrid
Tel. (34) 914 36 37 00
Fax (34) 915 75 39 98
E-mail: libreria@mundiprensa.es
URL: http://www.mundiprensa.com

FRANCE

Journal officiel
Service des publications des CE
26, rue Desaix
F-75727 Paris Cedex 15
Tél. (33) 140 58 77 31
Fax (33) 140 58 77 00
E-mail: europublications@journal-officiel.gouv.fr
URL: http://www.journal-officiel.gouv.fr

IRELAND

Alan Hanna's Bookshop
270 Lower Rathmines Road
Dublin 6
Tel. (353-1) 496 73 98
Fax (353-1) 496 02 28
E-mail: hannas@iol.ie

ITALIA

Licosa SpA
Via Duca di Calabria, 1/1
Casella postale 552
I-50125 Firenze
Tel. (39) 055 64 83 1
Fax (39) 055 64 12 57
E-mail: licosa@licosa.com
URL: http://www.licosa.com

LUXEMBOURG

Messageries du livre SARL
5, rue Raiffeisen
L-2411 Luxembourg
Tél. (352) 40 10 20
Fax (352) 49 06 61
E-mail: mail@mdl.lu
URL: http://www.mdl.lu

NEDERLAND

SDU Servicecentrum Uitgevers
Christoffel Plantijnstraat 2
Postbus 20014
2500 EA Den Haag
Tel. (31-70) 378 98 80
Fax (31-70) 378 97 83
E-mail: sdu@sdu.nl
URL: http://www.sdu.nl

PORTUGAL

Distribuidora de Livros Bertrand Ld.ª
Grupo Bertrand, SA
Rua das Terras dos Vales, 4-A
Apartado 60037
P-2700 Amadora
Tel. (351) 214 95 87 87
Fax (351) 214 96 02 55
E-mail: dlb@ip.pt

Imprensa Nacional-Casa da Moeda, SA
Sector de Publicações Oficiais
Rua da Escola Politécnica, 135
P-1250-100 Lisboa Codex
Tel. (351) 213 94 57 00
Fax (351) 213 94 57 50
E-mail: spoce@incm.pt
URL: http://www.incm.pt

SUOMI/FINLAND

**Akateeminen Kirjakauppa/
Akademiska Bokhandeln**
Keskuskatu 1/Centralgatan 1
PL/PB 128
FIN-00101 Helsinki/Helsingfors
P./tfn (358-9) 121 44 18
F./fax (358-9) 121 44 35
Sähköposti: sps@akateeminen.com
URL: http://www.akateeminen.com

SVERIGE

BTJ AB
Traktorvägen 11-13
S-221 82 Lund
Tlf. (46-46) 18 00 00
Fax (46-46) 30 79 47
E-post: btjeu-pub@btj.se
URL: http://www.btj.se

UNITED KINGDOM

The Stationery Office Ltd
Customer Services
PO Box 29
Norwich NR3 1GN
Tel. (44) 870 60 05-522
Fax (44) 870 60 05-533
E-mail: book.orders@theso.co.uk
URL: http://www.itsofficial.net

ÍSLAND

Bokabud Larusar Blöndal
Skólavördustig, 2
IS-101 Reykjavik
Tel. (354) 552 55 40
Fax (354) 552 55 60
E-mail: bokabud@simnet.is

SCHWEIZ/SUISSE/SVIZZERA

Euro Info Center Schweiz
c/o OSEC Business Network Switzerland
Stampfenbachstraße 85
PF 492
CH-8035 Zürich
Tel. (41-1) 365 53 15
Fax (41-1) 365 54 11
E-mail: eics@osec.ch
URL: http://www.osec.ch/eics

BĂLGARIJA

Europress Euromedia Ltd
59, blvd Vitosha
BG-1000 Sofia
Tel. (359-2) 980 37 66
Fax (359-2) 980 42 30
E-mail: Milena@mbox.cit.bg
URL: http://www.europress.bg

CYPRUS

Cyprus Chamber of Commerce and Industry
PO Box 21455
CY-1509 Nicosia
Tel. (357-2) 88 97 52
Fax (357-2) 66 10 44
E-mail: demetrap@ccci.org.cy

EESTI

Eesti Kaubandus-Tööstuskoda
(Estonian Chamber of Commerce and Industry)
Toom-Kooli 17
EE-10130 Tallinn
Tel. (372) 646 02 44
Fax (372) 646 02 45
E-mail: einfo@koda.ee
URL: http://www.koda.ee

HRVATSKA

Mediatrade Ltd
Pavla Hatza 1
HR-10000 Zagreb
Tel. (385-1) 481 94 11
Fax (385-1) 481 94 11

MAGYARORSZÁG

Euro Info Service
Szt. István krt.12
III emelet 1/A
PO Box 1039
H-1137 Budapest
Tel. (36-1) 329 21 70
Fax (36-1) 349 20 53
E-mail: euroinfo@euroinfo.hu
URL: http://www.euroinfo.hu

MALTA

Miller Distributors Ltd
Malta International Airport
PO Box 25
Luqa LQA 05
Tel. (356) 66 44 88
Fax (356) 67 67 99
E-mail: gwirth@usa.net

NORGE

Swets Blackwell AS
Hans Nielsen Hauges gt. 39
Boks 4901 Nydalen
N-0423 Oslo
Tel. (47) 23 40 00 00
Fax (47) 23 40 00 01
E-mail: info@no.swetsblackwell.com
URL: http://www.swetsblackwell.com.no

POLSKA

Ars Polona
Krakowskie Przedmiescie 7
Skr. pocztowa 1001
PL-00-950 Warszawa
Tel. (48-22) 826 12 01
Fax (48-22) 826 62 40
E-mail: books119@arspolona.com.pl

ROMÂNIA

Euromedia
Str.Dionisie Lupu nr. 65, sector 1
RO-70184 Bucuresti
Tel. (40-1) 315 44 03
Fax (40-1) 312 96 46
E-mail: euromedia@mailcity.com

SLOVAKIA

Centrum VTI SR
Nám. Slobody, 19
SK-81223 Bratislava
Tel. (421-7) 54 41 83 64
Fax (421-7) 54 41 83 64
E-mail: europ@tbb1.sltk.stuba.sk
URL: http://www.sltk.stuba.sk

SLOVENIJA

GV Zalozba
Dunajska cesta 5
SLO-1000 Ljubljana
Tel. (386) 613 09 1804
Fax (386) 613 09 1805
E-mail: europ@gvestnik.si
URL: http://www.gvzalozba.si

TÜRKIYE

Dünya Infotel AS
100, Yil Mahallessi 34440
TR-80050 Bagcilar-Istanbul
Tel. (90-212) 629 46 89
Fax (90-212) 629 46 27
E-mail: aktuel.info@dunya.com

ARGENTINA

World Publications SA
Av. Cordoba 1877
C1120 AAA Buenos Aires
Tel. (54-11) 48 15 81 56
Fax (54-11) 48 15 81 56
E-mail: wpbooks@infovia.com.ar
URL: http://www.wpbooks.com.ar

AUSTRALIA

Hunter Publications
PO Box 404
Abbotsford, Victoria 3067
Tel. (61-3) 94 17 53 61
Fax (61-3) 94 19 71 54
E-mail: jpdavies@ozemail.com.au

BRESIL

Livraria Camões
Rua Bittencourt da Silva, 12 C
CEP
20043-900 Rio de Janeiro
Tel. (55-21) 262 47 76
Fax (55-21) 262 47 76
E-mail: livraria.camoes@incm.com.br
URL: http://www.incm.com.br

CANADA

Les éditions La Liberté Inc.
3020, chemin Sainte-Foy
Sainte-Foy, Québec G1X 3V6
Tel. (1-418) 658 37 63
Fax (1-800) 567 54 49
E-mail: liberte@mediom.qc.ca

Renouf Publishing Co. Ltd
5369 Chemin Canotek Road, Unit 1
Ottawa, Ontario K1J 9J3
Tel. (1-613) 745 26 65
Fax (1-613) 745 76 60
E-mail: order.dept@renoufbooks.com
URL: http://www.renoufbooks.com

EGYPT

The Middle East Observer
41 Sherif Street
Cairo
Tel. (20-2) 392 69 19
Fax (20-2) 393 97 32
E-mail: inquiry@meobserver.com
URL: http://www.meobserver.com.eg

MALAYSIA

EBIC Malaysia
Suite 45.02, Level 45
Plaza MBf (Letter Box 45)
8 Jalan Yap Kwan Seng
50450 Kuala Lumpur
Tel. (60-3) 21 62 92 98
Fax (60-3) 21 62 61 98
E-mail: ebic@tm.net.my

MÉXICO

Mundi Prensa México, SA de CV
Río Pánuco, 141
Colonia Cuauhtémoc
MX-06500 México, DF
Tel. (52-5) 533 56 58
Fax (52-5) 514 67 99
E-mail: 101545.2361@compuserve.com

SOUTH AFRICA

Eurochamber of Commerce in South Africa
PO Box 781738
2146 Sandton
Tel. (27-11) 884 39 52
Fax (27-11) 883 55 73
E-mail: info@eurochamber.co.za

SOUTH KOREA

**The European Union Chamber of
Commerce in Korea**
5th FI, The Shilla Hotel
202, Jangchung-dong 2 Ga, Chung-ku
Seoul 100-392
Tel. (82-2) 22 53-5631/4
Fax (82-2) 22 53-5635/6
E-mail: eucck@eucck.org
URL: http://www.eucck.org

SRI LANKA

EBIC Sri Lanka
Trans Asia Hotel
115 Sir Chittampalam
A. Gardiner Mawatha
Colombo 2
Tel. (94-1) 074 71 50 78
Fax (94-1) 44 87 79
E-mail: ebicsl@slnet.ik

T'AI-WAN

Tycoon Information Inc
PO Box 81-466
105 Taipei
Tel. (886-2) 87 12 88 86
Fax (886-2) 87 12 47 47
E-mail: euitupe@ms21.hinet.net

UNITED STATES OF AMERICA

Bernan Associates
4611-F Assembly Drive
Lanham MD 20706-4391
Tel. (1-800) 274 44 47 (toll free telephone)
Fax (1-800) 865 34 50 (toll free fax)
E-mail: query@bernan.com
URL: http://www.bernan.com

ANDERE LÄNDER
OTHER COUNTRIES
AUTRES PAYS

Bitte wenden Sie sich an ein Büro Ihrer Wahl/Please contact the sales office of your choice/Veuillez vous adresser au bureau de vente de votre choix

Office for Official Publications of the European Communities
2, rue Mercier
L-2985 Luxembourg
Tel. (352) 29 29-42455
Fax (352) 29 29-42758
E-mail: info-info-opoce@cec.eu.int
URL: publications.eu.int

2/2002

EF/02/05/EN

4 5 TJ-42-02-812-EN-C

European industrial society is rapidly transforming itself into a knowledge society and this has implications for all citizens of the European Union. This report looks at the impact of the growing use of machine and computer technology on the work environment and the quality of working conditions. What are the implications for workers' health, for their skills requirements and their work motivation? Is the increase in the level of worker autonomy experienced by workers counterbalanced by higher degrees of stress and health problems? The report describes the relationship between technology, work organisation patterns and working conditions and identifies trends and changes in both work situations and use of technology.

The European Foundation for the Improvement of Living and Working Conditions is a tripartite EU body, whose role is to provide key actors in social policy making with findings, knowledge and advice drawn from comparative research. The Foundation was established in 1975 by Council Regulation EEC No 1365/75 of 26 May 1975.

OFFICE FOR OFFICIAL PUBLICATIONS
OF THE EUROPEAN COMMUNITIES
L-2985 Luxembourg

ISBN 92-897-0140-4

9 789289 701402