TELEWORKING: FROM A TECHNOLOGY POTENTIAL TO A SOCIAL EVOLUTION

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Abstract

The present paper elaborates on the prospective developments of teleworking, as these relate to the dynamics of ICTs developments. The paper presents various types of teleworking applications, linked to the evolving potential of technological developments; then discusses the evolving patterns of teleworking, followed by emerging trends and applications appearing at a macro and micro level with their prospective impacts; and finally it explores the implications of teleworking on the restructuring of the social patterns.

Keywords: ICTs, working patterns, teleworking, business organization, societal changes
JEL classification: R10, R11., R30, R40.

1. Introduction

The emergence of Information Society through the fast deployment of communication infrastructures and services as well as their applications in many domains of the everyday life, implies a structural transformation of society, leading to the strengthening of the competitive advantages of businesses, greater flexibility, among others, in employment and jobs, as well as new sustainable economic growth (EC [4]).

The evolution of interactive digital networks has greatly affected the above transition, where the revolutionary network technologies have influenced the network business characteristics. New location and time-independent working structures are now offering the potential for decentralization of work through various teleworking schemes. As telecommunications and IT technologies evolve, network structures become realistic options for the vast majority of companies, as opposed to the early days where 'network business' was an option for just a few large organizations. As a result, firms' organizational structures and markets rapidly evolve, driven by the lower transaction costs, the removal of boundaries, the shifts in power relationships, the globalization, the competition and the new organizational models, enabled by network technologies, with certain impacts on spatial patterns and the world society.

Decision-makers, firms and individuals are facing new challenges, induced by the increasing flexibility in time and place, as well as the impacts implied by the changing working cultures upon economy, society and private life-style, characterizing the Information Economy.

Teleworking, in this context, appears as an option, opening new possibilities for work and business development. Various definitions of teleworking can be met in the literature. Olson [15], in his broad definition embracing a range of various

opinions, claims that 'teleworking describes organizational work, performed outside the normal organizational limits of space and time, supported by computer and communication technologies'. Another more general definition describes teleworking as 'work enabled by network technologies, which actually incorporates a shift in performance focus from physical presence to results, empowerment and location - time independence' (EC [4], Nilles [14], EC [5]).

Several empirical surveys though indicate that, despite the technology potential available, teleworking has not gained yet as much ground in practice as someone could expect. This is due to the fact that teleworking is not simply another network application, but involves decisions at various levels, which have both direct and indirect impacts on the economy and the society at large. Absolute numbers do indeed support the above argument, but at the same time indicate a certain shift towards the potential applications offered by teleworking to private companies and public organizations (Nilles [14], EC [5]).

Apart from the structural constraints implied by the nature of these applications, several other issues have to be taken into consideration for the revision of the 'work' concept and the restructuring of the work relations as such. These issues concern technical connectivity and security requirements, working patterns, work relations and social aspects of work itself.

Despite the technological and work-specific constraints involved in such a context, several types of teleworking applications appear already in practice and have been the field of study for several years. These may range from 'self-employment' applications, referring to individual working schemes, to 'telecottages', referring to collective working schemes, adopted by businesses in order to increase effectiveness through geographical distribution and better manage business costs. Both of them introduce geographical dispersion of activities and operation of both companies and employees. As can also be seen in previous research findings, teleworking applications appear to be closely related to the restructuring of socio-economic patterns. Moreover, they involve a broad range of positive impacts upon employee and employer as well, influencing life styles, leisure time, flexibility, household location, work satisfaction etc. (EC [5]).

The focus of the present paper is on the prospective developments in teleworking, as these relate to the dynamics of technological developments. In the first section, the various types of teleworking applications are somehow linked to the evolving potential of technological developments. In the second part, the evolving patterns of teleworking are presented; while the final part, on prospective impacts, elaborates on emerging trends and applications at a macro and micro level. This is followed by a discussion on the positive and negative impacts of teleworking on the restructuring of the social pattern.

2.   Technological Evolution Supporting Teleworking

In this section a brief discussion on the evolution of enabling Information Technologies and network technologies supporting teleworking is presented, before going further into the impacts of teleworking upon the organization of work and the society at large. The rapid evolution of technology offers potentially a range of possibilities for the restructuring of the work concept, which cannot be adopted at equal pace by the society and business environments as such. Three generations of technologies relating to teleworking can be distinguished: the early days, the first days of corporate networks and the current technologies, including wireless access. Although these three generations have certain degree of overlapping, the term 'generation' is used not in the strict temporal sense, but in the broader sense of 'category'.

2.1 The early days

In the early days of teleworking, the technologies involved were proprietary technologies for connecting dump terminal stations (workstations with no processing power of their own) to centralized computing facilities. By that time, a computer-related workplace required the connectivity of terminal stations to some mainframe or mini-computer, using the terminology of the time. This was achieved through special equipment called a 'terminal server'. The remote access to a terminal server, which could be achieved by using a modem connected to a public or private line, was enabling access to a main computer from a distant location. In the simplest case of an individual teleworker, a one-to-one connection allowed a single workstation

to access the main computer by using a dummy terminal or a personal computer with some terminal emulation software, as shown on the left hand side of Figure 1.

In a more complex setting, a multiplexer could be used to share the communication line and allow access of multiple terminals to the central facility, enabling the creation of satellite offices or telecottages / televillages, shared by more than one type of teleworkers, as shown on the right side of Figure 1. In this case, the telecom line had to be of higher bandwidth, and thus, more expensive. In both cases, the communication protocols, the billing and the implementation of communications security were mostly proprietary, depending on the specific implementation of the host computer, the remote access equipment or both. Even today, this deployment is by no means 'ancient useless history', since there are domains where it is still used, such as ticket reservations or other applications.
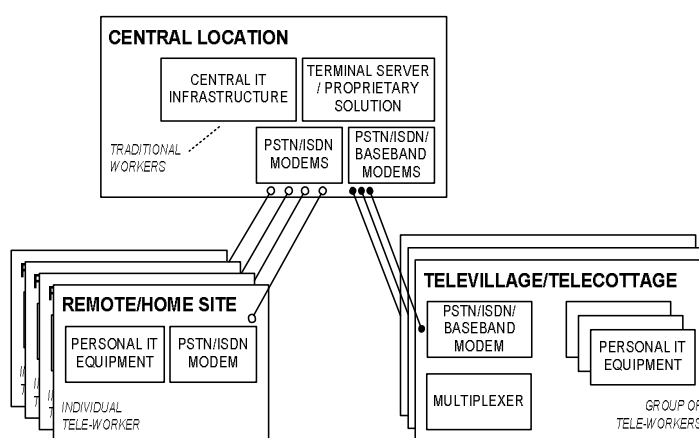

Figure 1: The early days of teleworking technology

2.2 The first corporate networks

In the 80's, as the small corporate local area networks (LANs) become popular, more companies could use alternative methods allowing employees to work partially or more infrequently completely remote. A LAN enabled the connectivity of the newly introduced 'personal computers' and the sharing of resources, mainly hard disks and printers. The mainframe was not required, since the computing power was distributed to small 'cells' and was there only as legacy equipment. Remote connectivity to the company's computer actually meant remote access to the company's LAN and ability to work as if one was physically present at the company's offices. A quite popular way for achieving this was the remote control of workstations, connected to the company's LAN. Using one modem for each remotely controlled workstation and one modem and some remote control software on the other side, it was possible to work on the company's LAN without physical presence to the company's premises, as can be seen in Figure 2. The actual data that was transferred over the telecom line was the keystrokes of the remote station, which were reproduced at the controlled station by the remote control software, while the same would happen for the video terminal output, which was sent over the telecom line to the remote station. The telecom lines required were ordinary ISDN/PSTN lines, having their ends both at the company's offices and the teleworker's location. Solutions for remote control through the Internet were also present, although they became quickly rather obsolete due to the native/naive networking ability of the operating systems of the 90's.
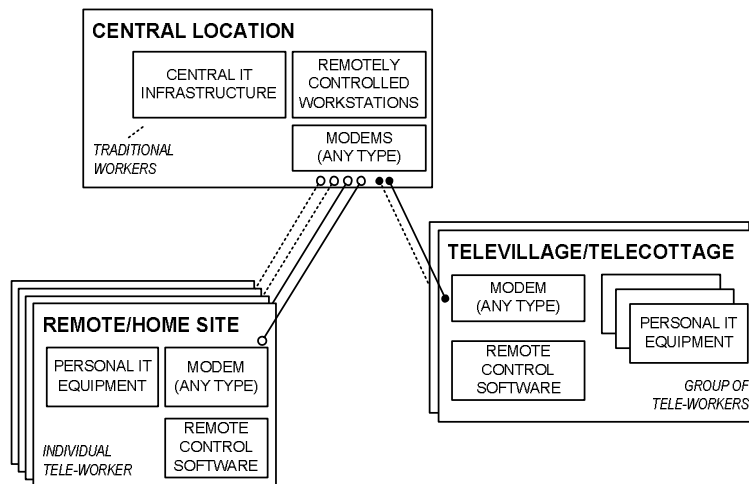
Figure 2: The first corporate networks

Provided that, at the time, the computer applications were text-based (no graphical interfaces), this worked quite satisfactorily, with few shortcomings and a major advantage. The most important shortcoming of the idea was the fact that the controlled workstations (those on the company's LAN) where dedicated and could be used either locally or remotely, but not both at the same time. Some operating system utilities could overcome this, but not without creating other technical concerns. The major advantage was that the remote control was no more based on proprietary technologies, which, from the technical perspective, allowed several versions of the concept to be introduced as remote control solutions, as well as enabling technologies from the teleworking point of view.

2.3 Current technologies

As main characteristic of the current networking technologies could be described the 'transparent IP connectivity'. By transparent is meant that the network physical connection is no more of concern: ISDN, cable, xDSL and public data packet switching networks are all choices that offer remote wired connectivity with very high bandwidth. GSM, GPRS, 3G, IEEE 802.11b, satellite, microwave, and more, are wireless connectivity technologies that are no longer science fiction either in terms of potential or in terms of cost, while the locational aspect is not an issue anymore. By IP is meant that everything is now based on the Internet Protocol (IP) the next version of which (IPv6) is expected to provide secure connectivity and identification to any possible device that could use it, regardless of its nature (computers, PDAs, phones, as well as cars and …refrigerators). Finally, the current trend for connectivity is that it is no more made upon request (as is the case of any dial-up connection), but is always active.

IP networking capabilities are now part of all popular computer operating systems and are the only required element that makes remote connections possible, as shown in Figure 3. It is now clear that IP networks are location-independent utilities, as power and phone telephony networks were in the early 1900's. Through IP networks many services can be offered, ranging from the traditional voice telephony to computer/PDA connectivity, to multi-party videoconference, to 'view on demand' TV broadcasts.
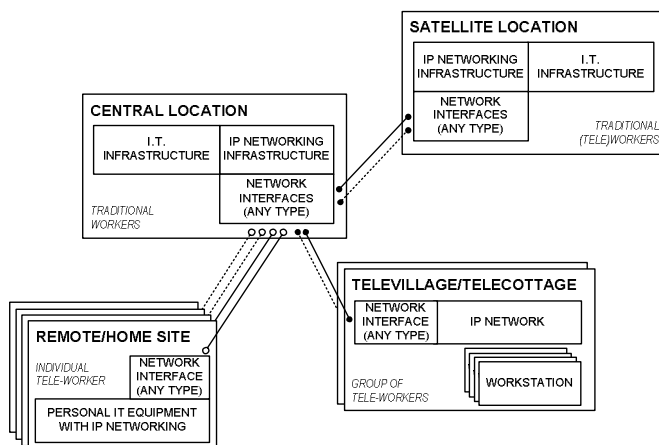
Figure 3: Current teleworking deployments

Table 1 below provides a summary of the three generations of teleworking technologies along with the characteristics of their potential users. The left column contains generic teleworking deployments for each generation of supporting technologies. A shift from custom-made teleworking sites to more flexible structures can be noted, which has come possible through the evolution of ICTs. The columns of the table contain the following attributes for each of such deployments the:

- equipment used at the central location and at the teleworkers' location;
- telecommunication lines that are required;
- kind of technology with regard to its proprietary, third-party, or open nature;
- implementation of security;
- availability of standards;
- communication/information services available; and
- rough estimate of the cost involved.

As can be seen in Table 1, in the early days of teleworking (Generation 1), the requirements for both the central and remote sites' infrastructure were rather high. A dump terminal or a terminal server had to be connected to the company's mainframe, using dedicated lines and proprietary communication protocols and solutions, implemented and offered usually by the vendor of the central infrastructure. In this case, remote sites that supported more than one teleworkers, such as televillages, was rather difficult to be connected to central locations of many different companies, due to technical constraints and incompatibilities.

Table 1: Summary of teleworking technologies

	Equipment (central)	Equipment (teleworker)	Telecom lines	Techno-logy	Security	Open stds	Services	Cost
GENERATION 1. EARLY TELEWORKING TECHNOLOGIES								
Individual teleworker sites	Mainframe/mini computer	Dump terminal or software emulator	Private or dedicated, low speed	Proprie-tary	Proprietary solution	No	Text-based terminals	Mid to high
Telecottages/ televillages	Mainframe/mini computer	Multiplexer, terminal server, dump terminals	Private or dedicated, mid-to-high speed	Proprie-tary	Proprietary solution	No	Text-based terminals	High
GENERATION 2. CORPORATE LANS								
Individual teleworker sites	LAN, mainframe	PC, remote control software	Dedicated or internet, low speed	Third party	Pre-standard	Partly	Remote control of text/graphics workstation, chat, voice	Low
Telecottages/ televillages	LAN, mainframe	PC LAN, remote control software	Dedicated or internet, mid-to-high speed	Third party	Pre-standard	Partly	Remote control of text/graphics workstation, chat, voice	Mid to low

GENERATION 3. CURRENT TECHNOLOGIES							
Individual teleworker sites / SoHos	Any IP network	Any IP client	Internet, any speed, wired or wireless	IP-based	Standard	Yes	Integrated chat, voice, video, distr. applications	Low to mid
Mobile sites / Satellite offices / telecottages / televillages	Any IP network	Any IP network	Internet, any speed, wired or wireless	IP-based	Standard	Yes	Integrated chat, voice, video, distr. applications	Mid to high

The evolution of *corporate LANs* improved this situation by lowering the barrier of cost through the technical requirements of new equipment that was performing better and was more widely available. The 'remote control solutions' allowed the connectivity of single or multiple work places to the main company LAN and enabled more flexible and affordable teleworking deployments. No proprietary technology was required, since the remote connectivity solutions were provided by third-party vendors, required cheaper communication lines and allowed flexible connectivity of the (single or multiple) teleworker's site to more than one employers, which was a turning point for the evolution of the labour relation, as will be discussed later in this paper. Telecottages and group-based remote-working sites could then be offered both to teleworkers and employers as a service of the community or private companies.

However it was the domination of IP connectivity (based on the open 'Internet Protocol') that practically eliminated any technical barrier to flexible teleworking. As can be seen in Table 1, any IP device can be connected to any IP central network, through any telecommunication line, wired or wireless. This connectivity is based on open standards, and uses equipment and solutions offered by multiple vendors at very competitive prices. The services offered are not only considerably broader than in the past, but also the costs are remarkably lower, provided that *many-to-many connectivity is now readily available*, embedded as a service of modern operating systems and devices.

Although security still remains of heavy concern, it can now be claimed that the connectivity-related enabling technologies for teleworking are already here and what remains to be discussed is less technical and more oriented to the social aspects of teleworking.

3. Teleworking Applications on the Move

In this part, teleworking schemes adopted through time are presented, as these relate to the opportunities offered by the technological developments presented above.

At the early stages, home was the most popular work location. Work results could be transferred to the company either by traditional media such as mail, courier etc. - a broader point of view of teleworking, characterized by low level of ICTs use - or by establishing a communication link between the employee and the employer / contractor - a more focused point of view, characterized by high level of ICTs use. Teleworking, at that time, was applied more in the context of clerical, routine work.

Home-based teleworking could be applied both on a full and a part time basis, having always home as a base location. Changing needs of both teleworker and the company have given rise to alternating work (or multi-locational), having the same characteristics as home-based work, where the workplace of teleworkers could be shifted between an office-based and a home-based option (Nilles [14]).

A specific application of home-based teleworking is the Small Offices-Home Offices (SoHos) development, which took place in several European countries (EC [5]). The above type was based on traditional forms of already existing firms with one or more persons. The introduction of ICTs in these firms offered the possibility to telework, communicating with customers and business partners. Owners of such firms could either stand-alone or be partners / associates of one or more than one companies.

In the mid 1990's, a growing interest appeared in teleworking applications among various economic groups or agents, realizing that teleworking had a serious impact on the productivity and creativity of firms, as well as their organizational

options for distant co-operation. This was followed by a take-off in teleworking applications (1997-98), where both economic agents and employees, each for their own reasons, took advantage of the potential offered by teleworking (EC [5]).

This take-off had been largely advocated by the developments in mobile computer systems and telecommunications, which led to portable systems, computers and telecommunications advances, enabling teleworkers to practically work anywhere. Mobile or flexible teleworking becomes an option, in which place of work may vary from work at home or main work place to work at any place, depending on work demands. This evolution has given ground to managerial, professional and innovative teleworking applications, both at a work and business level.

The adoption of ICTs led to the emergence of new types of self-employment working structures. Free agents are such an example, appearing recently in many countries (USA but also Europe). Based on the traditional free-lance form and taking full advantage of ICTs, they extend geographical scope of their business and number of markets they mobilize through intensive use of network capabilities. They can be completely flexible and have total control over how, where and when they work, picking-up work opportunities from a great number of potential clients (EC [5]). This type of business is becoming of growing presence worldwide.

The strong influence of ICTs on the organizational structure of firms has laid emphasis on the potential of carrying specific tasks by independent contractors. This has supported the emergence of freelancers, namely contractors who are electronically connected – e-lancers – running networks with temporal goals. Main characteristics of these networks are their horizontal structure and temporal character.

Teleworking centers can be considered as a collective approach to teleworking, as opposed to individual patterns of work. Their scope is reflecting the efforts of business strategies to cope with new challenges, to retain and attract qualified labour in a region, to exploit new markets for their products, to offer technical support as well as access to administrative services and sophisticated technology, to cope with social and business isolation of workers etc. Public initiatives are mainly oriented towards developing teleworking centers in support of employment in less advantageous regions or managing environmental problems in urban centers e.g. traffic pollution.

The various types of collective teleworking schemes - telecenters, are the outcome of either private initiatives e.g. parent firms, groups of firms or public initiatives, taking the form of:

- *Satellite offices* created by a parent firm at a certain location;
- *Offshore offices* created by a parent firm in order to take advantage of lower labour costs at a certain location;
- *Neighbourhood offices* created and supported by several organizations/firms;
- *Televillages* operating in rural areas, which gave teleworkers, living in a specific area, the opportunity to telework;
- *Resort Offices*, introducing an integrated approach of work and relaxation;
- *Business Centers*, serving business travelers to get access to computing and telematic services, while they are on the move.
- *Telecottages*, known also as Telehouses or Community Teleservice Centers or Telecenters, which are fully equipped locations, based on public initiatives, in support of individuals and SMEs.

The above described evolution of teleworking schemes reveals that teleworking at the early stages was considered as a possibility to remove time and space barriers and give employees the possibility to better combine private life with work, having home as a work basis. Early teleworking activities were placing emphasis on personal aspects of life-styles, family life and home settings.

At a later stage though, teleworking becomes much more than that. Its value lies on the flexibility in space (mobile schemes) and the range of employment options and schemes (work independence e.g. freelancers) it provides, both for employers and employees, which keeps growing in parallel with the evolution of technology and its specific applications (Figure 4).
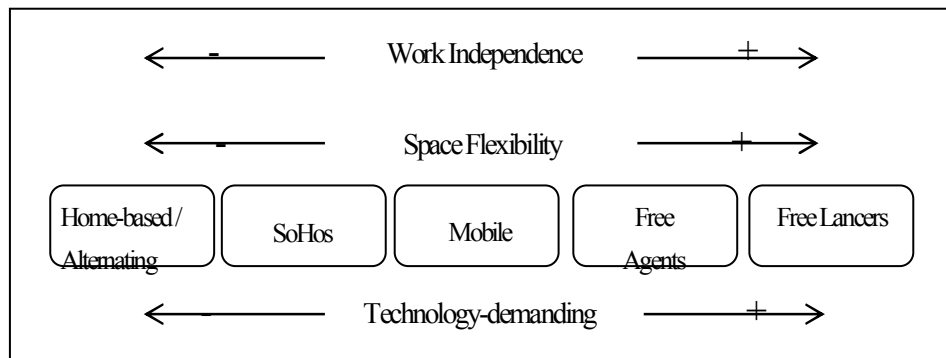
Figure 4: Teleworking in perspective

These developments have largely affected work relations through a growing shift towards more independent working schemes, wherein employees can work and cooperate with anyone, anytime, anywhere in the world. Of course, this strongly depends on the type of work and its commitment to technological applications, but it can also apply to certain types of clerical work e.g. translation work. These developments enable also greater freedom in terms of business organization, by providing opportunities for new schemes, which are more task-oriented and of wider geographic scope. These represent new options for business organization, in reality, where the type of organization is considered as 'one of the tools to carry out a task' (EC [5]).

4. The Context of Teleworking

The introduction of teleworking applications at the various levels of the economic and social life has already formulated certain trends as to the advantages and disadvantages at the individual, business as well as societal domain (Stratigea and Giaoutzi [20]).

More specifically, in Table 2 below are presented the advantages and disadvantages of teleworking at the individual level in respect to the work domain.

Table 2: Advantages and disadvantages of teleworking at the individual level

Individual level - Work domain	
Advantages	*Disadvantages*
- Greater *work flexibility* in terms of *time*, leading to a better combination of work with other activities of the everyday life. - Greater *flexibility* in terms of *space*, resulting to a greater freedom in respect to the *residential choice*. - Greater work *satisfaction*. - Savings in *travel time* and *travel costs* for commuting, which is quite important especially for those living in large urban centers. - Improvement in the *quality of life* following the above aspects. - Better *balance* between company tasks and personal needs, which leads to a better time management. - Increase in *work productivity* and *quality* as various empirical studies show (Korte and Wynne [10], Korte [11]). - An increase in the prospects of *disabled* or *specific groups of people* to have equal access to the labour market.	- Need for *employees' adaptability* to a continuously changing work environment, which is skill-demanding and, even more, involves a rapidly changing skill mix, continuous need for education and evolution of work portfolios. This may exclude many workers, especially those employed in traditional jobs (EC [5], EC [6]). - *Social isolation*, which could be more pronounced in future generations of teleworkers, who have as an option for teleworking from the very start of their professional lives. - *Career perspectives* in purely orthodox career terms (Bibby [1]). Many researchers argue the career prospects of teleworkers, mainly due to their isolation from the work environment, their ambiguous work status and their limited training opportunities to new work skills. This seems to be the case, at least for certain categories of working staff. - Employees lose sight of developments within the company (Bibby [2]).

Table 3: Advantages of teleworking at the business domain

Business Level – Advantages	
Work Level	*Organization Level*

- Significant *cost savings*, related to labour, central facilities, overhead costs, parking etc. (EC [5]).
 	
- More *effective use of labour resources* through better retention of staff and recruitment from a wider pool of staff (Nilles [14]).
 	
- *Restructuring of jobs* within a business, which gives rise to a "re-engineering" in a more radical and effective way.
 	
- Increase of firms' *competitive advantages*.
 	
- Improvement of the *quality and performance of work* (EC [5]).
 	
- Better management of different types of work, tasks and skills level, maximizing thus workforce *efficiency*.
 	
- Teleworking is viewed as a mean to achieve a more flexible allocation of skilled people, currently possible only within a centralized office environment.
 	
- Retention and recruitment of *scarce skills*, which they would not be able to acquire otherwise (EC [4]).
 	
- Recruitment of *qualified staff* or individuals, which provide services at a lower cost for the company, resulting in a skill upgrading of employees.
 	
- Improvement of the company's possibility to cope with *work peak periods* in terms of both employees and office space.
 	
- Enhancement of *motivation* and *creativity* of teleworkers as well as their *productivity* (EC [5]).
 	
- *Flexible office space arrangements*, where firms are getting more value from existing office space since they are able to rearrange office space for staff needs and avoid expensive office expansions or relocations (EC [5]).
	- A plurality of *organizational forms* is at firm's disposal, each corresponding to a different organizational status ranging from old traditional hierarchical schemes to virtual corporations (Schwarzer and Kremar [18], Skyrme [19], Sandhoff [17]).
	
	- Developments in the field of firm's organization have influenced both the *internal structure* and the *cooperation schemes* adopted, in order to cope with increasing competition.
	
	- *Spatial dispersion* of firm's activities in their efforts to take advantage of resources or networked cooperation schemes respectively as well as in marketing and delivering their products.
	
	- *Trans-border links* and cooperation possibilities are enhanced (EC [4], EC [6]).
	
	- *Networking*, enabling various forms of alliances and new division of labour in developing a product and providing specific services, are emerging (Powell [16], Holm et al. [9]).
	
	- *Virtual organization* of firms is increasing their ability to leverage their knowledge and resources without extending their fixed overhead. This has as a result the amplification of their skills and competencies, skills, resources, knowledge management and infrastructure (Dembski [3]).
	
	- New types of *interaction* with *clients* and *customers*, providing the potential for (EC [5]):
	  ✓ Round the clock interaction with clients and customers.
	  ✓ Continuously increasing market for networked information services.
	  ✓ Globalization of trade and markets.
	  ✓ Development of electronic commerce.

At the business domain, advantages are gained at the work level, through teleworking schemes, but also at the business level, through new organizational structures. Advantages at both levels are shown in Table 3. Disadvantages at this level, on the other hand, are mainly associated with the: security and safety aspects of ICT and their application to different regulatory frameworks; pace of technological reform of different nations; competition rules etc. (EC [6]).

The increasing commitment to new technologies has influenced every aspect of the everyday life, either at work or home/leisure time. This is the outcome of the rapid diffusion of home and office technological platforms, providing access to information and interactive services with new multimedia features, including video and data at any time and place, overcoming thus time and space barriers (EC [4]). The advantages and disadvantages of new patterns of work and business organization structures at the *societal level* are shown in the Table 4 below.

Table 4: Advantages and disadvantages of flexible working patterns at the societal level

Societal level	
Advantages	*Disadvantages*
- Reduced *traffic congestion*, especially in urban centers due to e.g. support of car sharing in case of telecentres; impacts on traffic patterns emerging from the decentralized working patterns (Teleport Sachsen-Anhalt [21]). - *Environmental quality* due to the reduction of unnecessary commuting (Teleport Sachsen-Anhalt [21], Korte and Wynne [10]). - *Energy savings* and maintenance costs for cars by reducing commuting trips (Korte and Wynne [10]). - Impacts on *employment*, substantial new job creation coupled with a very strong job growth in the service sector (Korte and Wynne [10]; EC [5]). - Impacts on *cross-border cooperation* among companies and institutions, contributing to social and economic cohesion (transborder teleworking and cooperation) (EC [4], EC [5]). - *New ways of delivering social services* such as health services, education, public services etc. - The emergence of the *24-hour society*, where availability of services runs around the clock (EC [5]). - *Social inclusion* in terms of new working possibilities for disabled people or disadvantaged regions e.g. remote regions (EC [6]).	- *Social isolation* of employees (EC [5]). - *Uncertainty* of both individuals and businesses by sweeping away from old secure certainties. - *Restructuring of jobs* leading to the loss of certain types of jobs. Routine work is mainly affected, while managerial and professional work as well as work committed to innovation is relatively increased (EC [6]). - Decline of *employment* in traditional business sectors unable to join the ICT developments (EC [6]). - Difficulty to *adapt* to a continuously changing situation and demand, involving risks of exclusion. - *Time* and *resource consuming* processes inherent for those who are able to adapt to the new working patterns. - Lack of *social security systems rules* for teleworkers (EC [5]). - Lack of *legislative and regulation framework* coping with the teleworking issues e.g. definition of work, relationship between employee and employer, place of work, working hours, health and safety aspects etc. (Bibby [2]). - Difficulties in the process of integrating home and work activities in case of home teleworking. - Lack of *boundaries* between work and private time (Hodson [7]).

5. Prospective Impacts of Teleworking

Teleworking has formed the basis for a whole range of developments and innovations in work and business strategy and organization. It exhibits a wide range of types and characteristics and applies to a large number of sectors and levels, all of them having at their core the use of teleworking. Electronic commerce, knowledge management, globalization of trade and markets, virtual organizations and teams, intellectual capital development, skills and competence development, organizational teaming, smart organizations, digital or network economy, de-materialized or intangible production etc. can be thought as further evolutions in the field, largely based on teleworking (EC [5]). The above developments stress the importance of *information exchange* at a global level and advocate the necessity for further enhancing the potential of teleworking in a globalized world.

The broad range of teleworking applications has considerably marked its penetration not only into work and business organization processes, but also into many social processes, where the number of teleworkers worldwide is continuously growing. At a European level, it is expected that further technological advances and speed of work and business innovation will support dramatical changes in the field, which will affect 'almost everybody in Europe at some stage of his working live' (EC [4]). The same picture is given by Nilles [14], in his work on the future of teleworking in the various world regions.

Prospective future impacts of teleworking appear to be based not on the technology itself, but on applications, methods and services as well its adoption rates, which will provide the ground for further opportunities in work, business and social processes. It is now rather clear that technology will no further be the 'filtering point' in any innovative teleworking concept. Progress in the field shows, that the technological advances enable the implementation of a broad range of teleworking applications. Some major trends of work and business innovations as well as social processes enabled by teleworking are presented in the following.

First, it is discussed the emergence of a *new working culture* that places workers at the center of work. This has mainly been the outcome of the mobile teleworking potential and the Internet explosion. In this new working culture, work is attached to persons and not to places, and as a trend it appears that 'the fundamental unit of the future network economy will be the

individual rather than the corporation' (EC [5]). The traditional form of organization based on a space of places, specific working conditions, hierarchical organizational structures etc. is gradually replaced by groups of people sharing common goals that are determined by the changing needs of the market. In this context, the corporate culture is gradually replaced by a new, small-teams oriented, working culture. This is the case especially among those working in fields highly committed to specific ICT applications, who are able to take advantage of space and time independence, provided by teleworking innovations.

The above developments enable also the joining of fluid and temporary networks in their activities (Dembski [3]). In that sense, working relationships are becoming vaguer and of a dynamic nature, determined on the basis of changing tasks and challenges worldwide and based on trust and confidence among collaborators. Electronically connected freelancers (e-lancers), namely independent contractors cooperating on specific purposes, are a distinct example of the new working culture.

The social change marked by the increasing familiarization of people with technological innovations is touching many aspects of social processes, which were previously characterized by their mass nature and commuting. Examples are shopping (e-commerce), education (tele-education), scientific conferences (teleconferences), medical services (tele-medicine), leisure, information searching and acquaintance, etc. Many of them are now shifting towards less and less mass procedures, as well as less and less commute-demanding. Commuting has been gradually shifted to communicating, remodeling thus many fields of social life apart work (EC [5]).

Teleworking is having a great impact on *work definition and rules*. Indeed, traditional forms of work were very clearly defined in terms of labour relations, working hours, work location, health and social insurance systems, vacations, time budgeting, rewards, tax systems, labour chambers organization, etc. in every country's labour legislation framework. The revision of the work concept, introduced by teleworking, has changed to a large extent not only the rules but in many cases the substance of these terms, implying the re-definition of their characteristics as well as their adjustment to the new working schemes. For example, vacations, in the traditional sense, may have no meaning for a teleworker, since he/she can combine work and entertainment in resort centers, following thus an integrated scheme of work and relaxation. By realizing the rapid diffusion of teleworking schemes in the society, the European Labour Unions have already taken action along reviewing their policies (Bibby [2], EC [5]).

Another major trend is associated with the widening of the *geographical scale*, in which businesses are searching for potential skilled employees and vice versa, i.e. employees searching for employment opportunities at a distance. This, of course, implies certain transaction costs, as widely dispersed skilled employees need to offer their services at a distance. The progress of telecommunications technology and more specifically ground and satellite wireless communications as well as the increasing competition among telecommunication providers disentangle even more the role of distance between employees and employers as a cost element. As various empirical studies show, communication costs, which are already exhibiting declining trends, will in the future consist a small part of the total cost of teleworking transactions (Nilles [14]). This will encourage businesses to search for their potential employees in a global rather than a local labour pool. The new option encompasses the increase of competition among specific labour skills, which, in open market terms, would require a continuous upgrading of labour skills in order to survive.

A major impact is expected on *business organization*, applied both at the intra and the inter-organization level. Location independence, introduced by the technological advances and teleworking, is potentially affecting business organization along two major axes, associated with: the enhancement of the firm's capability to enable activities to be undertaken at a distance; the strengthening of the capability to enable new activities, which were previously refrained due to either the costs or the efforts involved (Holm et al. [9]).

ICTs, by enabling activities at a distance, enhance the flexibility of businesses to relocate their activities on the basis of decreasing operating costs and increasing profitability. This consequently leads into a remarkable restructuring of the geography of employment. At a first glance, it seems that relocation addresses to white-collar 'information' work. Many

research efforts, though, show that relocation is also associated with work in general, especially information processing work, since digitization of data and sophisticated international communication links have increased enormously the possibilities for 'offshore' information processing (Bibby [2]). An example is the service provision through the development of call centers, operating across national borders, which are activated in tele-sales, tele-service enquiries, etc.

Another major trend appearing during the last decade is the *downsizing* of businesses and the rise of small and very small businesses. This trend, as Nilles [14] claims, is based on the need of large firms to reduce operating costs and increase profitability, which results into a reduction of the number of levels in organizational hierarchies and provides them with a much broader range of options in terms of outsourcing certain tasks. Subcontractors, in such a context, undertake the task to accomplish specific parts of their production, while the focus of their efforts shifts on their own core business areas. As a result, businesses are downsized, while at the same time, they are outsourcing parts of their production either locally or at a distance, depending on where the job or skill needed for the specific work can be found at a reasonable cost.

The growing trend towards downsizing of businesses has left skilled labour force with no job (Nilles [14]). The rapid growth of information technology and the location flexibility it entails, together with the growing demand for specialists to deal with the rapid changes in the nature and composition of markets, have given rise to a growing number of teleworkers, who are running small or very small (one person's) businesses, searching for work opportunities around the world. In such a context, new types of self-employment working structures are emerging during the last years in many places in the world, taking full advantage of network capabilities (EC [5], Nilles, [14]).

ICTs, in their function to diffuse information, are 'enabling technologies', supporting business cooperation. The diminishing importance of physical location has led to a certain organizational flexibility in spatial terms. Based on network technologies and teleworking potential, *new business models* have been developed, which offer the opportunity for businesses to adjust their policies in order to: increase productivity and competitiveness; develop opportunities for creativity and new forms of expression; adjust to the rapidly evolving markets; remove boundaries between them and suppliers or customers; enable the undertaking of new activities, which were previously not accessible due to either costs or effort involved (Skyrme [19]). Actually, business organization has been handled as the 'tool', via which specific tasks or opportunities can be successfully dealt with.

In order to meet the requirements of the new era, new forms of businesses' organization are rising, being the outcome of the potential offered by technological evolutions. Virtual organization (Lockett and Holland [12]), strategic web (Lorenzoni and Baden-Fuller [13]) network organization (Powell [16]), strategic/co-operative alliances (Holm et al. [9]) are such examples.

Old traditional organizational schemes, like strategic alliances, value-adding partnerships etc., have been gradually abandoned. These are replaced by networks of firms, located anywhere and communicating through the network for the whole range of their activities (production, selling, marketing, contacting with customers and co-operators etc.) (Dembski [3]). New forms of cooperation are defined by their product-market strategy, network structure, information systems and business communication patterns (Schwarzer and Kremar [18], Holland [7]). These are also characterized by their temporary nature, serving the purpose of a specific task or opportunity.

In conclusion, teleworking goes far beyond being an application of network technology. It introduces profound transformations in the society, driven by technological evolution, which are clearly 'affecting individuals at work and at home, in production and consumption, in commercial and social interactions' (EU, 2001). It consists of a key variable in the Information Society, 'breaking down barriers between people, places, roles and activities' (EC [5]).

As a counter argument appears the need to focus on the *threats* introduced by teleworking. Two major streams of negative impacts can be identified. The first is related to the impacts from the adjustment of labour force to the new working conditions and their social implications. Old traditional working schemes, characterized by discrete units of time and space of work, are dramatically altered. Security, exhaled from those structures, is swiped away, and is replaced by work uncertainty

and a continuous effort to correspond to a rapidly changing and very demanding working environment (Bibby [2], EC [5], EU [6]). The second stream is associated with the gradually *disappearing of boundaries* between work and private life, individual and community structures both in time and space, particularly in relation to work. Many authors have argued that the blurring of boundaries under the new conditions may lead to psychological and identity problems (Hodson [7]), experienced under the new circumstances.

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