

Telework - an Overview of Likely Impacts on Traffic and Settlement Patterns

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1 Introduction

Telework is being promoted as one of the most far-reaching innovations originated by the new possibilities inherent in information and communication technologies (ICT). In general, the term "telework" comprises all forms of work taking place *at a distance* from the traditional working environment (the office or factory floor) and making use of telematics (usually, a computer linked to public or private networks via modem or ISDN) to bridge this distance. In popular discourse, a narrower definition is frequently implied implicitly which focuses on telework *from home*. The great majority of today's workforce are still used to a clear separation between living space and working space and, by implication, free time and working time. Therefore, the spread of telework with its emphasis on a greater integration of these spheres can rightly be seen as a fundamental shift in the way work is organised.

A number of questions arises here: Will employees in droves move their workplaces out of the city-centre multi-storey buildings into the comfort of suburban residential areas? Will rural and peripheral regions overcome locational disadvantages and produce jobs in numbers today preserved for agglomerations? Does distance lose any relevance in determining the location of economic activity in an era of total time-space-convergence?

These questions are not only of interest to geographers and transport researchers, because they relate to some of the great challenges of today's urban systems, especially how to decrease traffic volumes and therefore reduce congestion and transport-related energy consumption and emissions. But while often taken for granted, it yet remains to be proven that telecommunications do really substitute for physical transport. The transportation-telecommunications trade-off is still one of the most debated propositions in transport theories and urban planning. Some critics argue that - quite contrary to the mainstream opinion - the greater locational flexibility that can be achieved through telematics applications might accelerate urban sprawl, increase spoliation of the countryside and lead to even more environmentally problematic individual traffic (see for example Graham & Marvin 1996).

In the following, we focus on evidence from current telework research to shed some light on the question of what kind of influences the application of ICT will have on land-use patterns and transport development. In the light of utopian assumptions about the dissolution of cities (most prominently in Alvin Toffler's "Third Wave" from 1980), it should be the role of geographers to replace speculative talk by analysis of observable reality. This paper wants to contribute to this aim. Initially, we will give an overview of current trends in settlement developments, land use patterns and transport developments (chapter 2). Afterwards, we will focus on the spatial implications of telework (chapter 3). Here, it will be necessary to differentiate between a number of individual determinants of spatial development that are influenced in one way or another by telework:

- *business locations*: What kind of (macro and micro) locations do companies which employ teleworkers chose as sites for their establishments (3.1)?
- *residential locations*: Where do teleworkers settle and what are the distances between telework place and location of the employer (3.2)?
- *business demand for office space*: How does telework affect the demand for office space from companies that employ teleworkers (3.3.1)?
- *private household demand for residential space*: How does telework affect the spatial requirements of private households which comprise one or several teleworkers (3.3.2)?
- *mobility behaviour*: What are the implications of telework for individual mobility, especially miles travelled, choice of transport medium and temporal distribution of transport demand (3.4)?

In short, will telework result in a reversal or acceleration of geographical trends (in settlement and transport patterns)? Will metropolitan agglomerations benefit or suffer from coming developments in work organisation?

Before analysing telework's spatial implications, some basic assumptions have to be made about the likely future spread of telework. There are countless differing projections of numbers of teleworkers, but some common straints can be made out:

- Telework can potentially enable companies and employees to increase the spatial and temporal flexibility of work. Only those organisational modes of telework that exploit this potential will gain considerable significance in the future.
- Hence **permanent telework** in which employees work exclusively from home will remain an exception in the years to come. Mostly, home-based work does take the form of **alternating**

telework¹, where the teleworking individual divides his or her working time between days spent in the office and days spent teleworking from home.

- Without enjoying in the least as much media coverage as home-based teleworking, **mobile telework** is of equal, if not greater importance. A large share of employees who work in the field will successively be equipped with mobile devices (usually a laptop and a mobile phone) with which to access corporate information systems from outside of the company's premises. This way traditional field staff turn into teleworkers simply by means of a change of work tools. The number of mobile workers itself is not stagnant but increasing steadily as the production process moves closer to the customer (not only with regard to his or her integration in the value added process, but also geographically). As mobile telework shows a number of characteristics that differ considerably from other forms of telework, likely impacts on transport and land use developments are outlined in a separate chapter (3.5).
- **Centre-based telework** in so-called telecottages or neighbourhood telecentres continues to play only a minor role in Germany as well as in other countries (see Fig. 1). Mostly, they are subsidised by the state in one way or another and hardly manage to survive once this lifeline is cut (Korte 1998).

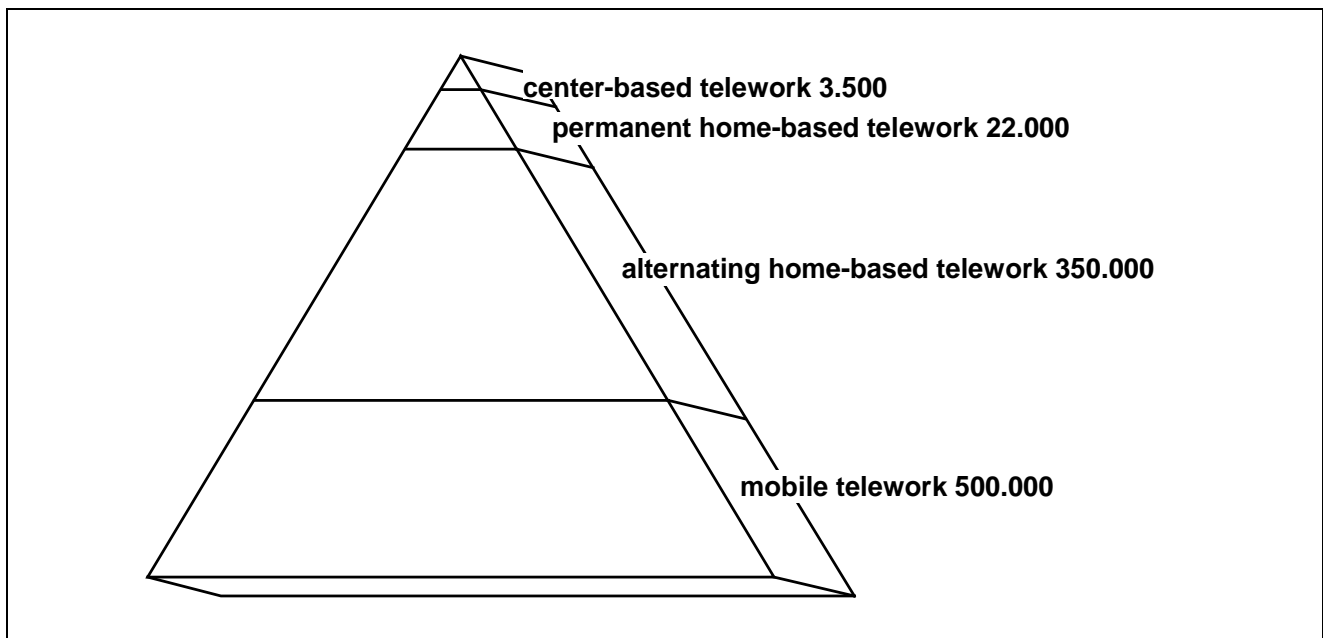


Fig. 1: Penetration of different types of telework in Germany, statistical base: Freudenreich et al. 1997 (middle scenario projection)

¹ sometimes referred to as "part-time telework". We prefer the use of "alternating telework" to avoid confusion with teleworkers who have part-time work contracts.

- Outside of the limelight, much of the growth in telework does take place in the field of **self-employed teleworkers**. Dostal (1999), a leading figure in German labour market research, states that telework in the form of permanent employees working part-time at home may prove to be only a transitional state. In the long run he expects that moving work from the company's premises to where the individual wants to work will go hand in hand with contractual flexibilisation. The outcome might be a workforce comprised of wired freelancers who get paid for their performance, not for the length of time spend sitting in office buildings.
- Although some critics have claimed that the diffusion of telework has ground to a halt, all available empirical data suggest that overall telework practice (as measured in a) the share of individuals teleworking at least one day per week or b) in total working hours spent teleworking) continues to grow strongly (see empirica 1999).

2 Trends in land use and transport development - an overview

In the following the main trends in settlement and transport development in Germany are highlighted.

2.1 Trends in settlement development

Developments in settlement structures (Henckel et al. 1993, Stiens 1993, Irmen & Blach 1994, Brake 1994) can be analysed at different spatial dimensions. For our purpose, the two most appropriate dimensions are the inter-regional as well as the intra-regional perspective (regions indicating functional units, usually agglomeration cores together with their hinterland).

At the inter-regional dimension, deconcentration to the benefit of smaller cities could be observed in the 1980s. In the 1990s a number of developments, one of which being the influx of asylum-seekers and foreigners with German heritage, has caused population in agglomerations to grow again. This reversal of long term trends in population distribution has even effected some of the city centres.

At the same time control functions (business headquarters) as well as supportive, advanced business services (consultancy, finance, insurance and real estate, advertising etc.) continue to concentrate in only a few advantaged metropolitan areas, and here at very central locations. We can also observe a growing degree of specialisation of individual regions leading to organisations clustering together according to their industry affiliation.

Looking at the intra-regional dimension, the process of suburbanisation that began in large scale in the 1960s is undiminished. New residential and business areas are developed especially at the fringes of conurbations and adjacent locations. Ongoing urban sprawl results in growing consumption of land, high transport volumes, increasing dependency on private car transport and high costs for supplying infrastructure. In the new German "Länder" in the East suburbanisation began with delay in 1990 (planned economy in the GDR meant that urban sprawl was all but unknown) and is now spreading with great speed.

There is increasing functional specialisation of parts of the urban cityscape. This kind of functional separation is most eminent in the city centres, where residential functions are pushed out towards the urban fringe.

2.2 Trends in residential and commercial land-use

Against stagnant, in some years even falling overall employment in 1990's Germany, the number of employees in the service sector has been increasing steadily. The share of information workers, i.e. those who are involved in the production, transmission and processing of information, has already jumped the 50%-mark even in Germany.

Consumption of office space per member of staff increased considerably until the beginning of the 1990s (von Einem & Tonndorf 1990). This was largely due to the space requirements of the computer technology, which found its way into the average office in the 1980s. Since then it has stagnated or even fallen slightly because of widespread efforts to cut overheads and increase office utilization (Aring 1996).

Geographically, office functions are concentrated either in the city centres or in commercial districts at the urban fringe which are favourably situated as regards traffic connections, such as sites at arterial streets or with close access to motorways or an international airport.

Growth in demand for residential living space continues to be strong. The number of residential units grows in the face of a rising share of older people and the trend to smaller households. There is a strong correlation between average size of living space per capita and household incomes; both have been increasing steadily for a long time.

2.3 Trends in transport development

Motor car traffic, individual as well as freight transport, is on the rise. The number of car owners is growing not only in the new "Länder" but also in the West. In Germany, every second person does

call a motor car their own. In 2010 Germany will have roughly 50 Mio. cars travelling on its roads (Hopf 1994).

More than half of all ways and 3/4 of overall passenger traffic, i.e. the total length of trips made including pedestrian traffic, fall to the private car. The share of public transport is accordingly small.

Commuter traffic accounts for only 20% of all passenger traffic. In the last two decades increased motorization and prolonged average distances between place of residence and workplace have resulted in a considerable change in the shares of individual transport media in commuter traffic to the benefit of private car traffic.

Analysing the development of overall passenger traffic one finds an interesting and somewhat surprising relationship: The average number of trips as well as the average time spent on individual transport tend to stay roughly the same, the only variable increasing being the average miles travelled. Transport researchers suggest that each individual has a kind of time budget they are ready to spend on transport. If technological progress enables us to travel farther in the same amount of time, we tend to not use the time saved on other activities, but travel further (or more often) instead (Kloas & Kuhfeld 1996).

3 Implications of telework for urban and regional development

These developmental trends form the backbone against which spatial effects of telework will exert themselves. In the following these effects are outlined. Statements are based on research by the authors as well as others. Due to limited empirical evidence, most of the findings are still based on theoretical considerations and are therefore presented here as hypotheses, waiting for (further) verification. Existing research is often based on teleworking trials involving employees who form only a small share of their respective organisation's staff. As these are early adopters (and therefore can be expected to behave systematically different to subsequent adopters), findings do not lend themselves easily to generalization (Lyons & Hickford 1998).

3.1 Locations of organisations applying telework

A first guess at the regional categories that will benefit most from decentralised work organisation can be obtained by looking at the business locations of organisations that currently practice telework. In spite of a number of state-funded projects that have succeeded in creating job opportunities in rural and peripheral regions through telework, anecdotal evidence suggests that

telework does predominantly take place in urban regions. The majority of well-known organisations that employ teleworkers (as well as the teleworkers themselves) are indeed located in agglomerations.

However, empirical research to prove these hypotheses is still scarce. A study in the UK by Huws (1993) came to the conclusion that teleworking companies were concentrating in the Greater London area. A representative survey of decision makers in organisations in Europe conducted by empirica found telework to be overrepresented in large cities compared to smaller cities and rural regions (Kordey & Gareis 1997).

A number of explanations for this are available. Firstly, organisations employing staff with occupations that are suitable for telework are most likely to be found in larger agglomerations. Secondly, high qualified persons are overrepresented in metropolitan regions. Because of their greater bargaining power on the labour market highly qualified employees are in a better position to demand telework from their employer. Moreover, the costs of equipping and maintaining a teleworkplace can be amortized more quickly if the employee in question produces a high added value (resulting in a greater nominal value of the productivity increase that usually results from telework). Thirdly, savings achieved through reductions in office space (i.e. the economic feasibility of telework) are greater at high-price locations, e.g. sites at central locations in large cities. Fourthly, traffic congestion and car parking problems that push the demand for telework are a typically urban phenomenon.

Moreover, telework fosters the degree of economic specialisation of a region simply because the catchment area of each company increases through the possibility to employ highly qualified staff at great distances. No longer is it necessary to run several offices in different cities just to tap into regional labour market resources.

3.2 Locational behaviour of teleworkers

In order to determine the spatial distribution of teleworking practice, we have to consider not only the location of organisations who practice telework but also the locational behaviour of teleworkers themselves. Here it is necessary to distinguish between employed and self-employed teleworkers. We will look at mobile teleworking separately.

3.2.1 Telework by employees

In theory, teleworkers should be free to choose their place of residence irrespective of the distance to their employer's premises. Therefore, peripheral locations e.g. in rural regions that offer higher quality of living and cost less are made feasible for teleworkers. Until now, however, telework across longer distances is only rarely practiced, for a number of reasons:

Currently, most teleworkers do not spend their whole working time, but only a few days per week at home. This implicates that some commuting continues to occur. Moreover, many teleworkers must be able to visit the central office at short notice when the necessity arises, so they should not locate too far away from their employer's premises. Therefore, peripheral regions do not benefit considerably, because a location at a remote place does only allow for permanent but not for alternating telework. Additionally, Germany's peripheral regions do not offer enough locational advantages in the form of low wages or a more flexible labour force that could make companies want to employ staff from a distance on a greater scale. However, instead of transferring jobs to disadvantaged regions in Germany, employers start to do so across the border to low-cost countries in Eastern Europe and Asia. This so-called offshore office work (Floeting & Henckel 1994) affects not only simple clerical tasks but also high-qualified jobs e.g. in software development and IT management.

Until now, telework over long distances has been hampered by the distance dependency of telecommunication rates. In spite of the recent deregulation of German telecommunications and a subsequent price slump, distance dependency is still an issue. Telework over great distances (especially if requiring a permanent online connection) is still very costly and therefore hardly proven to be profitable. This was one of the main reasons why several companies set as a precondition for applicants for a tele-workplace that the distance between business site and place of residence should not exceed 50km (Gareis & Kordey 1997).

3.2.2 Telework by self-employed and freelancers

Telework by self-employed individuals takes place predominantly in or in direct proximity to the place of residence of the person(s) concerned. Here, the choice of business location is usually not based on an explicit analysis of options available, but often predetermined by the place of residence at the time of finishing education (Grabow et al. 1995). Thus the question arises what types of regions are most likely to produce start-ups by entrepreneurs and subsequently properly support their development into self-standing business establishments.

Because of the origin of high qualified entrepreneurs in the university milieu, proximity to public research institutions is of vital importance. Apart from that, successful start-ups need a high degree of integration in social networks from which business opportunities spring. Therefore, preferential locations are the nodes of interregional (or even international) knowledge networks, i.e. central locations of metropolitan areas - in particular those with important universities, a favourable economic structure and high innovation potential - and their catchment areas.

That is not to say that self-employed individuals do not sometimes relocate after the initial start-up phase to locations which are more in line with their personal preferences, e.g. rural areas offering a high quality of living, if telework frees them of the obligation to locate close to their customers. Self-employed individuals, however, differ from employees in that they have to stay in close contact with not only one employer, but a multitude of business partners. Face-to-face meetings are often an integral part of customer service and are therefore not easily substituted for by telemediated communication. A location in too great a distance to the main traffic routes increases the expense for these face-to-face contacts to such a degree that maintaining customer contacts can prove difficult. The majority of self-employed teleworkers are not in a position to afford such strains. Therefore, most of them will stay in close proximity to central agglomerations.

3.3 Effects on land-use patterns

3.3.1 Demand for office space

Actual utilization rates of office space and workplace infrastructure are low. The average work desk is used for only 14% of the time it is available (Fuchs 1997). This observation together with the burden of extremely high square meter prices at central locations has led to efforts to find more efficient ways to manage office space. Quite obviously, great savings can be achieved by allocating available space more innovatively. Telework can work as a catalyst here. Often, strategies like desk sharing, hot desking or hotelling (Mazzi 1996) are introduced together with telework. In some cases, complete buildings have been vacated and replaced by small, multi-functional offices that almost exclusively act as meeting points for communication with colleagues and business partners. Workdesks are provided on a "first come first served" basis. Most of the work which does not require interacting with managers and colleagues is done at home. This way, some companies have already cut overheads substantially (Borsuk 1996): In the service sector, occupancy costs is the second largest corporate expense.

Until now, the introduction of such strategies is hampered by the wish of teleworking employees to keep their workdesk at the office for exclusive use. In some teleworking pilots, teleworkers obviously felt expelled and marginalized from the team after they had lost their working desk. Even more than in other countries, German employees view their work desk as something of an entitlement.

Apart from psychological problems, sharing desks might turn out to be impracticable because of the need to coordinate times of presence. In other cases, a stress on teamwork means that on specific days all members of staff should be present which poses problems when the number of desks is limited due to desk sharing. Mostly, however, desk sharing is feasible and can be efficiently managed (see Kordey 1998).

High demand for office space at central locations has exerted strong pressure on the city centres of large agglomerations. It has resulted in sky-high rents and the displacement of residential population. Teleworking can work against this trend, as jobs are shifted from the central office buildings out of town into employees' dwellings or to suburban telecentres. If this happened on a more than minor scale, demand for inner city locations would dwindle and become less profitable, but socially more desirable land uses would be made feasible again.

3.3.2 Demand for residential land-use

If workplaces are moved into the private homes of employees, demand for residential space will be affected, too. Households that include teleworkers will need more space. The lack of appropriate space already constrains the individual's ability to telework, as many German companies require a separate, dedicated room for setting up the tele-workplace as a prerequisite for potential participants in a teleworking scheme. Moreover, individuals whose lives revolve around their home in a way typical for teleworkers might wish to live in a more spacy dwelling.

Increasing demand for living space can more readily be satisfied at decentral locations at the fringes of agglomerations. For this reason urban sprawl and suburbanisation are likely not only to continue, but accelerate as a result of widespread adoption of telework. Disperse settlement structures in general imply high traffic volumes with a preference for private car traffic rather than public transport (Bergmann et al. 1994).

While suburban residential areas have until now been characterised by an almost total lack of commercial functions, telework will result in a re-integration of living and working. Telework by employed persons will act as a "Trojan horse" with which small enterprises will infiltrate today's

residential areas, if - as can be expected - a considerable number of employed teleworkers will turn entrepreneurs and build up their own businesses. Working at home also implies an increasing demand for retail outlets at least for short term supply (e.g. groceries). Overall economic activity in today's dormant residential areas will experience a boost, while retail trade in the city centres might be weakened (further).

3.4 Transport effects

The discussion about travel demand impacts of telework often suffers from a too narrow point of view. Niles (1994) has shown in his excellent analysis of traffic-telecommunication interrelationships that it is questionable from a scientific point of view to analyse traffic effects of telework in separation from more general developments in telematics applications and the social as well as economic framework. ICT play a crucial (but in no way deterministic) role in the current process of economic restructuring and this process in its turn has led to increasing travel demand. Even if reductions in travel demand were to be expected one has to bear in mind the problem of latent demand only waiting to exert itself once roads become less congested. Only against this background is it possible to arrive at sound conclusions about the so-called traffic-telecommunications trade-off.

On the individual level, the possibility to remove commute trips is one of the most highly valued attributes of teleworking. This applies especially, of course, to employees with long commuting distances and those who have to travel into the central city for work, where they are affected not only by traffic congestion, but also by lack of parking availability. Employees with a longer than average journey time to work are much more likely to show an interest in teleworking than others (empirica 1999).

A number of empirical studies in the USA and the Netherlands have found evidence of substitution processes through reduction in traffic activity when teleworking (Lyons & Hickford 1998, Harmsen & König 1994, Niles 1994, Nilles 1994, Hamer et al. 1991). A study in the course of the Californian Telecommuting Pilot Project found that the "radius of activity" of teleworkers as well as non-teleworking members of their households shrank (Pendyala et al. 1991). To the knowledge of the authors, there have been no results published from empirical research on this subject in Germany.

Apart from saving commute trips, telework does potentially have complementary effects: **Firstly**, it might cause non-work related tripmaking to increase for mainly two reasons:

- if previously, travelling to work and other personal matters, e.g. school-runs or shopping, were chained into the commute trip, new non work-related trips might be necessary;
- because the vehicle is available during working hours, other household members might want to use it.

Secondly, telework might make residential relocation to more distant areas possible. Recent research in the UK (Lyons and Hickford 1998) found that telework is quite likely to cause individuals to choose a location further away from their employer's premises when moving house.

For example, telework can make it possible to keep a job although moving - for private reasons like marriage - to another part of the country, simply by switching to telecommuting (a great advantage from the employee's point of view). When teleworking alternately, the remaining days working in the office can result in very great commuting distances.

Thirdly, it might induce a shift in travel-to-work mode as a result of altered mobility requirements (Köhler 1993, Niles 1994, Lund & Mokhtarian 1994). More flexible working times can make individual traffic (even) more attractive, as they become less plannable in advance and individual commuting hours are not in line with the operation times of public transport links (Harvey et al. 1997).

Because of the short-term duration of most evaluation studies, empirical evidence for complementary effects is scarce. Whether further diffusion of telework will actually result in a decrease of car traffic volumes will have to be seen. Today, nobody can say that for sure. On the one hand, more widespread application of telework could lead to a more even distribution of traffic volumes, improving the situation at peak times. On the other hand, telework favours disperse settlement structures as well as irregular traffic behaviour. Both effects are to the disadvantage of public transport.

To summarize, there are strong reasons to believe that telework will *ceteris paribus* lead to an increase in private car traffic in the middle to long run rather than reduce traffic volumes wholesale. If, however, political attempts to make transport pricing reflect transport's real external costs bear fruit, telework can be used to offset the negative effect of rising transport costs on household incomes. With that telework might make it politically viable to increase the cost of private car traffic to a socially and economically reasonable level. It would then have contributed more than its share to environmental protection (EC 1995).

3.5 Mobile telework

Mobile telework means that the place of work is not the private residence, but other locations apart from home and office. Since this type of telework affects in particular individuals working in the field, prominent locations of customers determine the actual places where the work takes place.

Mobile teleworkers are distinguished by - as their label implies - their mobility, i.e. the distance they cover in the course of their work. As a direct consequence of this, growth of mobile telework will increase the total traffic load. The imperative behind the growth of mobile telework is similar to developments in markets for intermediate goods, where just-in-time delivery is used to remove inefficiencies in inter-company production chains. Just as just-in-time production transfers the warehouse onto the roads, mobile telework transfers work onto the streets so to better respond to the demands of the customer ("just-in-time-working").

Mobile telework also results in more demand for office space and accommodation facilities at the nodes of the traffic system, i.e. central locations in cities as well as close to airports.

4 Conclusions

Let us return to the initial question: Are the days numbered for the urban metropolis? Do peripheral regions benefit from "death of distance" through the application of telematics? Or more generally speaking: What type of regions are the winners and what type are the losers in the processes underlying the move towards an information society?

All available evidence suggests that telework will not diminish the relative importance of urban agglomerations. Central locations are on the contrary likely to benefit from the growing flexibilisation of place and time of work. Face-to-face interaction will not be substituted completely by even the most sophisticated technology to come. People will continue to come together and talk at "real" places in "real" time. There are even some indicators that telework - together with other ICT applications like traffic management systems - might be able to improve the efficiency of metropolitan regions and the quality of living they offer, thus increasing their ability to pull in inhabitants and establishments.

At the other end of the spectrum, we do not foresee that prospects of remote regions are improving. There is at least no inherent automatism. Although shedding some of the traditional locational disadvantages is a precondition for peripheral regions, if they want to regain some of their

developmental dynamism, it may prove not to be sufficient for catching up with the locations favoured by economic restructuring. Only those regions that are endowed with enough of the pull-factors that actually make people want to live there can expect to benefit from technologically enabled decentralisation. Regions that offer a high quality of living as well as desirable residential areas do qualify. Most of the peripheral regions, however, do not fall into this category.

<i>General Trends in Spatial and Transport Development</i>	<i>Effects of Telework</i>	
	<i>trend-supporting</i>	<i>trend-counteracting</i>
Inter-regional: Deconcentration to the benefit of smaller cities; highly specialized functions concentrate in cores of big agglomerations	<ul style="list-style-type: none"> Reduction of locational disadvantages means better chances to create sustainable employment in peripheral regions 	<ul style="list-style-type: none"> Contributing towards greater efficiency of urban systems
Intra-regional: Dispersion of population and employment	<ul style="list-style-type: none"> The displacement of workplaces from inner city establishments to suburban residential areas boosts the demand for suburban property 	<ul style="list-style-type: none"> none
Separation of individual land use functions	<ul style="list-style-type: none"> Selective relocation of office functions that do not depend on face-to-face contacts strengthens the functional specialisation of city centres 	<ul style="list-style-type: none"> displacement of workplaces into the dwellings of employees or to suburban telework centres teleworkers exert a larger part of their spending power in their neighbourhood
Growth of office space in city centres	<ul style="list-style-type: none"> higher demand for communication facilities (training and conference rooms) for regular meetings of teleworkers 	<ul style="list-style-type: none"> higher utilization of office space due to new office management methods like desk sharing, hoteling
Rising spatial demands for residential use, especially in the suburban fringe	<ul style="list-style-type: none"> increasing demand for living space for integration of workplaces in dwellings 	<ul style="list-style-type: none"> none
Increasing overall traffic volumes	<ul style="list-style-type: none"> longer commuting distances as a result of relocation of teleworker's dwellings mobile telework transfers work from the office to the streets (just-in-time working) 	<ul style="list-style-type: none"> removal of commute trips reduction of activity radius
Increasing traffic volumes at peak periods	<ul style="list-style-type: none"> mobile telework increases traffic volumes throughout the day 	<ul style="list-style-type: none"> reduction of peak period traffic due to greater asynchronicity of working hours
Growth of individual at the cost of public transport	<ul style="list-style-type: none"> disperse settlement structures and irregular transport behaviour favour individual transport 	<ul style="list-style-type: none"> none

Tab. 1: *Spatial effects of telework*

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These general statements should not, however, distract from the possibilities that still exist to create employment even in remote regions. Political initiative can make very good use of regional teleworking schemes. Recent examples (see for example Bertin & Denbigh 1998) show that even being located in the extreme periphery does not preclude inhabitants from tapping into global markets. There is, however, a strong need for political initiative and focused support if telework is to contribute towards spatially more balanced growth (CoSD 1999).

As this paper should have made clear, we have only started to come to grips with the spatial implications of tele-mediated new ways of working. Insofar as we cannot possibly aim at giving a last word on the subject, we will in the following suggest 10 hypotheses which summarize the current state of the debate. We suppose that these hypotheses should form the basis of future research in this field.

1. Current trends in spatial development, namely the intra-regional dispersal of population in form of a continuous suburbanisation and the inter-regional counterurbanisation with increasing differentiation between favoured and structurally disadvantaged regions, will be underlined by the widespread adoption and diffusion of telework because telework increases the number of locational options of companies as well as employees.
2. In general, teleworking is an urban phenomenon. Both, organisations that practice telework as well as the bulk of teleworkers will prefer locations within urban agglomerations. Not only that, telework also enhances the efficiency and therefore the attractiveness of big cities from the inhabitants' as well as local establishments' viewpoint.
3. Only a small number of rural regions, namely those that are characterised by desirable landscapes and a high quality of living, but are at the same time not too far away from the main traffic pathways, are in a position to attract teleworkers in more than neglectable numbers.
4. Peripheral locations which do not fall into this category will find it extremely difficult to benefit from the spread of telework. Nevertheless, there is a case to be made for telework as a political means to boost the economic development of remote regions, even if results from existing projects are mixed.
5. More flexible and efficient allocation of office space at central locations will result in the number of *workplaces* in city centres decreasing, although the number of *jobs* will stay much the same. This uncoupling of the number of the persons employed and the number of workplaces will considerably affect property and real estate markets.
6. In the case of home-based teleworking, this reduction in central office space will be compensated for by the expansion of space for residential use due to growing demand by teleworker households. As this increase takes place in the areas of primary residential land use, office space is delocated from the city centres to the city fringes as well as the surrounding countryside. Land consumption in these areas will increase, which runs counter to current attempts in regional planning to contain urban sprawl.

7. While working at home means a re-introduction of commercial functions in today's suburban residential areas (and therefore a decrease of functional specialisation here), the selective relocation of office functions which do not require a high density of information and face-to-face contacts (e.g. traditional back office activities that are found to be very suitable for teleworking) strengthens the functional specialisation of city centres.
8. Locational preferences of private households will gain in influence on the spatial distribution of employment, while locational preferences of enterprises become relatively less important. This results in a (further) strengthening of so-called soft locational factors at the expense of old-fashioned "hard" factors like infrastructure provision and distance to markets.
9. Teleworking will - together with parallel developments that point in the same direction - contribute to a greater asynchronicity of urban life. Traffic volumes at peak periods might fall, but overall traffic volumes will not.
10. If - through residential relocation to more remote areas - telework results in more disperse settlement structures, the economic viability of providing public transport services might be threatened. A rising number of employees will have no access to public transport. This will most likely lead to a further shift of the mode split in favour of individual transport (i.e. private car traffic), if no appropriate political countermeasures are taken.

Again, it is of greatest importance to stress the fact that telework as a technology does not automatically have a set of social implications. Things are not determined to happen because of certain qualities of new technologies (Floeting & Grabow 1998). Societies can make use of telework to reach their goals. The hypotheses mentioned above do not vie for describing the logical outcome of telework application, but they describe what kind of pressure we think the spread of telework will exert, if political and economical conditions remain largely unchanged.

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Zusammenfassung

”Telearbeit” umfaßt alle Organisationsformen der Arbeit, die in Distanz von der herkömmlichen Arbeitsumgebung, also in der Regel dem Büro bzw. der Fabrik, stattfinden und zur Überbrückung dieser Entfernung Informations- und Kommunikationstechniken (üblicherweise einen Computer, der über ein Modem oder ISDN mit öffentlichen oder privaten Netzwerken verbunden ist) nutzen. Telearbeit wird von vielen als eine Telematikanwendung betrachtet, die sehr weitreichende Auswirkungen auf wirtschaftliche und gesellschaftliche Strukturen haben wird. Der Einsatz der Telearbeit kann potentiell Verkehrsaufkommens reduzieren, die Umwelt entlasten und somit zur Behebung von aktuellen Problemen von Stadträumen beitragen. Jedoch werden auch Stimmen laut, nach denen Telearbeit bestehende raumstrukturelle Trends wie Suburbanisierung und zunehmender Flächenverbrauch verstärken könnte. Dieser Beitrag zieht Erkenntnisse aus der Telearbeitsforschung heran, um die wahrscheinlichen räumlichen Auswirkungen einer weiteren Verbreitung von Telearbeit darzustellen.

Summary

”Telework” comprises all forms of work taking place at a distance from the traditional working environment (the office or factory floor) and making use of telematics (usually, a computer linked to public or private networks via modem or ISDN) to bridge this distance. It is being promoted as one of the most far-reaching innovations originated by the new possibilities inherent in information and communication technologies (ICT). Potentially, telework can have beneficial impacts on today’s urban systems, because it might decrease traffic volumes and therefore reduce congestion and transport-related emissions. However, some critics argue that the greater locational flexibility that can be achieved through telematics applications might accelerate urban sprawl, increase spoliation of the countryside and lead to even more environmentally problematic individual traffic. This paper looks into results from current telework research to find evidence for likely spatial impacts of telework.

Résumé

«Télétravail» comprend toutes les formes organisationnelles du travail qui sont effectuées à distance des lieux d'emploi traditionnels comme, en première ligne, le bureau ou l'usine et qui, pour franchir cette distance, se servent des nouvelles technologies de la communication (en général d'un

ordinateur lié par modem ou par numéris aux systèmes publics ou privés). Beaucoup de personnes considèrent le télétravail comme une application télématique qui aura des effets de grande portée sur les structures socio-économiques. L'implantation du télétravail peut potentiellement réduire la densité du trafic, diminuer la pollution de l'environnement et contribuer ainsi à la solution des problèmes actuels des agglomérations urbaines. Pourtant, certaines voix se font de plus en plus entendre qui constatent que le télétravail pourrait renforcer des tendances spatiales déjà existantes telles que la suburbanisation et le besoin augmentant en superficie. Cet article se sert des connaissances dans le domaine de la recherche du télétravail pour dépendre les probables effets spatiaux d'une diffusion plus étendue du télétravail.