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TELEWORKING AND THE CITY

MYTHS OF WORKPLACE TRANSCENDENCE AND TRAVEL REDUCTION

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INTRODUCTION

The information revolution positively abounds with myths. The starting point for most of these myths is that of "a feverish belief in transcendence; a faith that, this time round, a new technology will finally and truly deliver us from the limitations and the frustrations of this imperfect world" (Robins, 1995). One of the most potent of such myths is that of the "end of geography," in which the constraints that bind us to places and that have imposed upon us a "tyranny of distance" are becoming, or are about to become, electronically transcended.

The theme of this volume—telecommunications and the city—has been a fertile breeding ground for variants of this myth (Graham, 1997). In this chapter, we attempt to debunk three interlinked myths concerning the implications of information and communications technologies for the future nature and form of the city. These might be categorized as "myths of disappearance through redundancy," in that in each case technological advance is assumed to transcend the need for an existing, and by implication outmoded, type of activity with its particular spatial expression. The myths are:

- the unnecessary workplace
- the unnecessary city
- the unnecessary need to travel

In the first half of the chapter, we reveal the false premises upon which the first two of these myths are constructed, and argue that neither the conventional workplace nor the physically bounded city are rendered redundant through the new technologies of virtuality. Rather we attempt to demonstrate that "places of work," in the sense both of individual workplaces and of the agglomeration of such workplaces into cities, are highly functional and effective forms of human organization, and as a result are likely to prove considerably more persistent and resilient than the technological futurists would have us believe.

In the second half of the chapter, we move from the conceptual level to a more empirically informed, though still speculative, consideration of the implications of "teleworking"—broadly defined, for the spatial form of the future city and for the travel patterns that are likely to be engendered. The forms of teleworking that we consider extend beyond home-based telecommuting to encompass other forms of working associated with communications technologies and also the new forms of tele-mediated service consumption with which they go hand in hand. Drawing upon an empirical investigation of recent trends in Britain, our objective is to demonstrate that, far from reducing the need to travel and contributing to more environmentally sustainable urban forms, the new communications technologies seem, conversely, to be associated with mobility-intensive and spatially dispersed activity patterns.

UNNECESSARY PLACES?

The "end of geography" line of argument rests on the assumption that the spatial ties that bind us into particular places will be relaxed to the point of severance through the space-transcending power of technology. The particular places that concern us here are the workplace and the city. Let us first consider why some have argued that the existence of these places will be rendered unnecessary as a result of the technological revolution, before challenging the assumptions that underpin these arguments.

With respect to the workplace, Hiltz (1984) first argued that the emergence of online communities would challenge the way in which we think of an office: "Usually, one thinks of it as a place, with desks and telephones and typewriters. In thinking about the office of the future, one must instead think of it as a communications space, created by the merger of computers and telecommunications" (Hiltz, 1984, page XV). A similar line of thinking was developed by Huws, Korte, and Robinson (1990, page 208), in suggesting that "the traditional concept of the workplace as a fixed geographical space will be replaced by more abstract notions of the working context as a set of relationships, a network, an intellectual space."

The idea of an established physical place becoming redundant and replaced by a more fluid and immaterial electronic space has also been applied to the city itself. Marshall McLuhan predicted that "with instant electric technology ... (the) very nature of the city as a form of major dimensions must inevitably dissolve like a fading shot in a movie" (McLuhan, 1964, page 366, quoted in Gold, 1991), while Berry (1973) used a similar metaphor in arguing that communications technologies would act as a "solvent which would dissolve the core-oriented city." The emergence of new communications networks such as the Internet and of cyberspace technologies that have the "ability to simulate environments within which humans can interact" (Featherstone and Burrows, 1995, page 5), has led to renewed questioning of the role, indeed the very legitimacy, of the city. According to William Mitchell (1995, page 107), "the very idea of the city is challenged and must eventually be reconceived," a task that he embarks upon through his vision of a "City of Bits":

> This will be a city unrooted to any definite spot on the surface of the earth, shaped by connectivity and bandwidth constraints rather than by accessibility and land values, largely asynchronous in its operation, and inhabited by disembodied and fragmented subjects who exist as collections of aliases and agents. Its places will be constructed virtually by software instead of physically from stones and timbers, and they will be connected by logical linkages rather than by doors, passageways, and streets. (page 24)

The idea of the "loss of the city" through "the decline of physical presence in favour of an immaterial, phantom presence" (Virilio, 1996, page 45, quoted in Robins, 1996) is similar to the notion outlined above that the conventional work*place* will be displaced by the "elusive office" (Huws, et al., 1990) of shared electronic work*spaces*. The problem with both visions lies in their impoverished understanding of the rationale for, and benefits of, physical presence.

The Necessary Workplace

In the case of the workplace, the difficulties in establishing viable forms of teleworking reveal the significance of physical presence within the activity called "work." Recognizing that much work is difficult to detach from its broader working context, teleworking trials and experiments have tended to concentrate on particular kinds of work that appear to be most likely to be sustainable outside the conventional workplace (Gillespie and Li, 1994). Two broadly defined kinds of work have been identified as potentially suitable for teleworking from home: first, low level repetitive tasks such as data entry where the need for contact is assumed to be negligible; and, second, professional staff carrying out cognitive creative tasks (Kraut, 1989).

However, in practice it proves extremely difficult to identify tasks in either of these categories that are sufficiently self-contained to be sustainable in a telework environment. A survey in the United Kingdom of home-based teleworking in large and medium-sized enterprises, for example, found that "loss of face-to-face to contact" was by an overwhelming margin the most significant perceived problem with respect to the introduction of teleworking (National Computing Centre, 1992). This finding is consistent with other evaluations of teleworking trials and experiments, in which the difficulties associated with the lack of face-to-face contact are found to be the major barrier to the growth of teleworking, both from the perspective of the employees who are deprived of the social and networking aspects of work in a shared workplace, and from the perspective of managers who encounter problems of controlling, monitoring, and motivating teleworkers (Gray, et al., 1993).

The widely acknowledged skepticism of managers to teleworking is usually attributed to an out-moded conservatism (Huws, et al., 1990; Qvortrup, 1992). Yet the desire of managers to maintain face-to-face contact through direct physical presence simply acknowledges the importance of informal communications in the workplace in providing "the basis of supervision, socialization, social support, on-the-job learning by doing, and of the reproduction of corporate know-how and culture" (Kraut, 1989, page 26). Not to recognize this is to completely misunderstand the nature of what managers do, for as Boden and Molotch (1994) point out, managers spend more than half of their workday in copresence with others.

Even those jobs that are perceived to be self-contained and strongly individual, such as certain creative tasks, are found to be difficult to maintain in a teleworking environment, where the opportunity provided by the workplace for "bouncing ideas off other people" is denied or restricted (Stanworth and Stanworth, 1991). Similar findings have been established by Christiansen, Jacobsen, and Kalsdottir (1996), based on in-depth interviews with highly qualified professionals in the United States and Denmark with long-standing experience of telework. Their research stresses the importance of physical presence in much of the work that professionals do, such that frequent presence in the workplace is regarded as a necessity for viable, sustainable teleworking; they conclude that for professionals, teleworking more than two days a week seems problematic.

For "teleservices"—services where face-to-face communication with the business or consumer customer is replaced or complemented by telephone-based communications—the opportunities for the dispersal of work beyond traditional shared workplaces to the home would, from the purely technical point of view, appear to be an option (Richardson, 1997); the expertise embedded in the software often means that levels of worker expertise need not be high, while the control mechanisms in the software allow real-time monitoring by supervisors, in terms of immediately available statistical data and the ability to listen in to calls and to record conversations. Yet the dominant tendency in teleservices is to organize work into (often very) large, highly "industrialized" automated, tailorized workplaces, known as "call centers" (Richardson, 1994; Richardson and Marshall, 1996).

There are a number of reasons for this. First, the technology is generally designed on the basis that teleservice tasks will continue to be performed in call centers; that is to say, suppliers are conservative in how they design and advertise products (though most of the major suppliers of call-center technology have now developed small-office/home-office call-center technologies). Second, it may not make economic sense for a company to distribute calls to workers' homes; the cost of transmitting both voice and data traffic to a large number of workers' homes as opposed to a single central site, requiring at minimum ISDN lines, is unlikely to be cost-effective unless levels of flexibility or productivity are increased very significantly. Furthermore, investing in call-center technology for a large number of home-based agents may not make economic sense; the technology can be used only by one agent, whereas in a call-center it may be used by three or more agents covering a number of shifts, to say, an 18 to 24-hour-per-day operation; and staff turnover (in the United Kingdom) is estimated to average around 20 to 30 percent per annum and thus there is no guarantee of a return on capital investment.

Third, and crucially, although the work is routinized and in theory subject to control through output targets, as in other industries managers prefer

to have their workforce in one (or a few) places. Call-center managers interviewed in the United Kingdom by the authors and asked about call-center working from home generally greeted the question with incredulity—the process of management is seen as complex enough without introducing another layer of complexity. Why develop new training and motivational strategies for home-based workers, and spend time ensuring they don't feel marginalized and isolated, when managers have a call-center to run? In addition, managers suggested that there are definite benefits of the call-center environment, which would be hard to replicate in the home, the key benefit being teamworking, around which most call-centers are organized and performance pay calculated. There was also skepticism as to whether the kind of people who work from home would be well suited for teleservice work, the assumption being that more gregarious, outgoing people are best suited for call-center work, and that these are likely to prefer an office environment where socialization is possible.

We would conclude that for both professional and more routinized home-based teleworking, many of the problems in implementation are due to a failure to understand the significance of the workplace or the activities that take place within it. The flawed conception that underlies much of the discussion around the potential of teleworking from home is to see the workplace primarily as a physical location to which workers travel in order to undertake the individual work tasks assigned to them (Gillespie and Li, 1994). What these approaches fail to recognize is that the workplace is a highly functional device for facilitating the activities of collaborative work *groups*, which is how nearly all work is accomplished (the excessive individualism of conventional academia notwithstanding!). From this perspective:

> (p)erhaps the attainment of "the elusive office" will remain just that, elusive, and the work*place* will prove resistant to being substituted by a virtual work*space*. Perhaps, for a little while longer at least, the obstinacy of the workplace in the face of its imminent demise will ensure that location independence remains an unrealised goal. (Gillespie and Li, 1994, page 270)

The Necessary City

The reasons why the electronic dissolution of the city is not imminent are similar to, and at least as compelling, as the reasons for the persistence of the workplace. Indeed, far from undermining the role of the city, as many earlier predicted, the emerging consensus is now that telecommunications and information technologies are contributing to a *strengthening* of the role of major cities within a global "space of flows" (Castells, 1989 and 1996; Graham and Marvin, 1996).

One reason why the electronic redundancy of the city has not come about lies in the mutually reinforcing interaction between concentrations of demand for specialized telecommunications services, and the supply of those services.

Far from equalizing the supply of telecommunications services across the globe, the combination of rapid technological advance, the increasing specialization of customer demand and the liberalization of telecommunications supply has led to an increasingly differentiated geography of telecommunications provision (Gillespie and Robins, 1991). As Mitch Moss first pointed out, these developments are leading to "the creation of a new telecommunications infrastructure designed to serve the information-intensive activities of large metropolitan regions" (Moss, 1987, page 536).

Taking the example of the United Kingdom, which has one of the most liberal telecommunications regimes in the world, the "landscape" of telecommunications provision has become highly differentiated, with cities the clear beneficiaries. In the City of London, firms benefit from a host of competing suppliers (including British Telecom, Mercury, City of London Telecommunications, MFS Telecommunications, Worldcom, and Energis; see Ireland, 1994) and the most advanced service offerings. In the central business districts (CBDs) of other major cities, and in business parks and other concentrations of business activity, firms have a range of potential suppliers and access to most advanced services. In the remaining urban areas, firms have a more restricted choice of supplier, with direct connection usually available only from British Telecom (BT) and, where infrastructures have been built, from the local cable operator. In many small towns and rural areas, customers are confronted with a *de facto* monopoly supplier, while some rural customers do not even have direct access to digital exchanges capable of providing services such as basic-rate ISDN (Gillespie et al., 1994). The general pattern, then, is one of metropolitan "hot spots" of intense competition and investment, surrounded by "warm haloes" of duopolistic competition in the urban areas, giving way in turn to "cold shadows" of *de facto* monopoly in rural Britain (Gillespie and Cornford, 1995).

A second and still more significant explanation for why electronic technologies have not undermined the rationale for the city lies in the continued, indeed increasing, need for copresence in human affairs. According to Boden and Molotch (1994, page 258), "(a)lthough in some instances communication is best done by more impersonal means, modernity implies no dilution in the degree that face-to-face—or, more precisely, 'copresent'—interaction is both preferred and necessary across a wide range of tasks," leading to what they term the "compulsion of proximity." It is the enduring nature of this compulsion that continues to provide the rationale for cities. As Tony Fitzpatrick (1997, page 9, quoted in Amin and Graham, 1997, page 413), the Director of Ove Arup, puts it as follows:

> Cities reflect the economic realities of the twenty-first century. Remote working from self-sufficient farmsteads via the Internet cannot replace the powerhouses of personal interaction which drives teamwork and creativity. These are the cornerstones of how professional people add value to their work. Besides, you cannot look into someone's eyes and see that they are trustworthy over the Internet.

Indeed, it can be convincingly argued that trends such as globalization, and the increasing velocity and volatility of the economy that is attendant upon it, are serving to accentuate the role of cities as interpreters of change and managers of risk (Mitchelson and Wheeler, 1994). Telecommunications networks, of course, have contributed greatly to the process of globalization and time-space compression, and hence are part of the explanation for the accentuated role for cities. Sassen (1991, page 5) points out that it is "precisely because of the territorial dispersal facilitated by telecommunications that agglomeration of certain centralizing activities has sharply increased," while Thrift's (1996) work on the City of London has demonstrated that the growth of information from new communications technologies has presented fundamental problems of interpretation for workers in the City that have forced greater rather than less face-to-face communication. The same point is made by Boden and Molotch (1994, page 274, original emphasis):

> The scattering made possible by the new technologies may indeed intensify the need for copresence among those who coordinate dispersed activities and interpret the information pouring in from far-flung settings. The more information produced by the new technologies, the higher the premium on copresence needed to design, interpret, and implement the knowledge gained. *In other words, the only way to deal effectively with the simple communication of high technology is with the medium of highest complexity—copresence.*

In this sense, of course, the city can be interpreted as the form of human settlement that has as its purpose the maximization of copresence. We can in consequence conclude that the anticipated (by some at least) demise of the city through technological redundancy not only been has exaggerated, it is has been completely misspecified, for the role of the city is actually being *enhanced* through global telecommunications networks. Such reflections have led Castells (1996) to predict that the dominant form of urbanization in the next millennium will be that of the "megacity," huge urban agglomerations forming the nodes of the global economy:

> in spite of all their social, urban and environmental problems, megacities will continue to grow, both in their size and in their attractiveness for the location of high-level functions and for people's choice. The ecological dream of small, quasi-rural communes will be pushed away to countercultural marginality by the historical tide of megacity development. (Ibid., page 409)

We began this chapter by suggesting that there were three "myths of disappearance" associated with information and communication technologies that we intended to debunk. Having now established the continued necessity of workplaces and of cities, in the remainder of the chapter we intend to concentrate on the third myth, which concerned the "unnecessary need to travel." This will require us to consider developments in urban spatial form, from which the need to travel is in part at least derived. Our focus will be to look at various types of "teleworking" in order to open a window onto the spatial structure and travel patterns of the future "informational city."

TELEWORKING AND THE NEED TO TRAVEL

Much of the rhetoric around teleworking, particularly in the United States, has concerned its potential to substitute for travel, specifically the journey to work. Although the implications for travel would therefore at first sight appear to be obvious, in reality the outcomes can be rather complicated. Mokhtarian (1990) reminds us that there are four possible interactions between telecommunications and travel:

(i) substitution (i.e., telecommunications decreases travel);
(ii) enhancement (i.e., telecommunications directly stimulates travel);
(iii) operational efficiency (i.e., telecommunications improves travel by making the transportation system more efficient);
(iv) indirect, long-term impacts (e.g., telecommunications may affect locational and land use decisions, thereby affecting travel).

Based on an extensive review of the literature, Graham and Marvin (1994, page 269) conclude that:

> the relationship between telecommunications and the urban environment is not as simple as the substitutionist perspective would imply. Instead, electronic and physical transformation proceed in parallel, producing complex and often contradictory effects on urban flows and spaces.

As a means of illustrating the validity of this conclusion, this section will examine the travel implications of various types of teleworking, drawing upon a report undertaken for the U.K. Parliamentary Office of Science and Technology by the authors (Gillespie, Richardson, and Cornford, 1995). The findings concentrate on the U.K. and European experience and are necessarily speculative, for both the extent of teleworking and the amount of research that has been undertaken on it are very much less in the United Kingdom and (particularly) the rest of Europe when compared with the United States. Although there is well-developed U.S. literature on teleworking and its travel implications (see, for example, Nilles, 1988; Kitamura, et al., 1990; Mokhtarian, 1991; Niles, 1994; Mokhtarian, et al., 1995; Handy and Mokhtarian, 1996), the very different urban spatial contexts in the United States (particularly in California, where most of the research has been undertaken), means that little confidence could be attached to transferring U.S. results to U.K. and European urban contexts. In the absence of appropriate evidence, therefore, necessarily we will need to be speculative.

In the above-mentioned study (Gillespie, et al., 1995), we developed a five-fold classification of "telework" in the broader-than-usual sense of all forms of work organization that are based around information and communications (ICT) technologies:

1. *Electronic homework*—in which the worker undertakes paid employment from home (either as an employee or self-employed) supported by ICTs. It is this category of work that is, in the European context, usually con-

veyed by the term "telework" (in the United States it is more usually referred to as "telecommuting"), but in our analysis this was just one form of a broader category.

2. *Telecottages*—or shared facilities from which teleworking to other locations can take place. In the United Kingdom/European context, and in contrast to the United States where "neighborhood telework centres" have been established in a number of metropolitan areas, shared access teleworking facilities have been developed only in rural areas, hence our use of the term "telecottage."
3. *Nomadic or mobile workers*—these workers are mobile, use portable ICT equipment and work from a combination of locations, including home, cars/trains/planes, customers' premises and the central office (which is often reorganized and downsized to accommodate "hot-desking").
4. *Remote offices*—this category encompasses firms and organizations that have used ICTs to reorganize across space, both centralizing functions into (usually) fairly large, specialist offices, but often at the same time taking the opportunity presented by ICTs to site these offices at lower cost locations. Telephone call-centers for delivering teleservices are one particular form within the remote-office category.
5. *Group or team telework*—developments in ICTs are increasingly making possible geographically distributed teamwork, in which interconnected work tasks can be performed by workers operating from a number of locations using a shared virtual workspace.

Below we attempt to review and, given the limited empirical material to draw upon, to speculate upon the likely locational trends that will be associated with these forms of (broadly defined) teleworking and the likely travel patterns that will be associated with them. We ignore the telecottage category, as, in the U.K. context, rural shared facility centers have only a handful of teleworkers operating from them (Richardson and Gillespie, 1999).

Electronic Homeworking

From the evidence reviewed above (such as Christiansen, et al., 1996), we can surmise that the growth of electronic homeworking (EHW) will be relatively modest, and that it will in the main be part-time in nature, perhaps being undertaken for a day or two a week (this is certainly the case in the United States; see Lund and Mokhtarian, 1994). Its impact upon urban form and travel will be hardly revolutionary therefore, both because its incidence will be relatively limited and because most electronic homeworkers (except those who are self-employed) will still need to commute to their office for the majority of their working days.

Because of the latter feature, and because the incidence of electronic homeworking is higher in those professional occupations and service activities that are concentrated in cities, EHW in the United Kingdom is overrepresented in metropolitan regions, particularly London. Huws's (1993) survey of employers in the United Kingdom established that while London accounted for 16 percent of the country's total sample of employers, it accounted for 24 percent of employers with teleworkers. Although we do not yet have access to data on the residential location of teleworkers, we can assume that they are geographically constrained by the need to travel to their employer's premises and, frequently, to the premises of clients as well, for home-based teleworkers working for a single employer spend on average a quarter of their time on the employer's premises and a further quarter elsewhere (Huws, 1993). Even freelance teleworkers, who might be assumed to have the greatest degree of locational freedom and who are most usually associated with rurally based lifestyles, are often constrained by the need to be close to clients, and survey evidence reveals that more than half of such teleworkers live in the centers or suburbs of cities (Huws et al., 1996).

Even the limited impacts upon urban travel associated with the substitution of some journeys to work by electronic means need to be qualified by taking into account a number of further issues (Gillespie, et al., 1995):

- *The mode of travel of trips replaced by EHW*—the possibility arises that public transport or soft mode trips could be substituted, rather than car-driver trips, with the risk that the critical mass of commuters needed to support public transit or car pools could be reduced, leading in the longer term to greater car dependence (U.S. Department of Transportation, 1993). This risk is likely to be more significant in European cities than it would be in the already predominantly car-dependent American metropolises. Thus a study of telecommuting in the Netherlands (reported in Mokhtarian, et al., 1995) found that nearly all telecommuting occasions replaced public transport or bike trips rather than car trips. In the case of London, with many long-distance rail commuters, it has been suggested that part-time EHW may exacerbate the economic problems of rail transit if it is concentrated on certain days of the week (for instance, Fridays), reducing rail revenues on these days while the same amount of infrastructure is still needed to get people into Central London on the other days of the week (Department of Transport, 1993).
- *The impact of EHW on noncommute trips*—the incorporation of other journeys, such as dropping children at school or shopping, into the commute trip, a process of "trip chaining," could lead to additional journeys being generated (either by the teleworker or by other household members) if the commute trip is electronically substituted. Additionally, electronic homeworkers will generate substantial business travel, notably to meet clients.
- *The impact of EHW on the travel behavior of other household members*—it has been hypothesized that there may be additional trips generated by other household members. Although the limited evidence from the United States does not lend support to this hypothesis (Kitamura et al., 1990; Mokhtarian, et al., 1995), it may well be that in the United Kingdom, with much lower levels of household car ownership, journeys foregone by telecommuting will generate additional travel by making the car available for other household members (Lyons, no date).

- *The impact of improved traffic flow on latent demand*—one of the likely outcomes of EHW is to reduce peak-hour travel and hence ease road congestion. If this is so, however, then latent demand is likely to induce additional travel in much the same way that building new road capacity does. In the United States, it has been estimated that "perhaps half the potential reduction in vehicle miles traveled directly attributed to telecommuters will be replaced by new traffic, induced by lower levels of congestion and higher average speeds" (U.S. Department of Energy, 1994, page xi).
- *The longer-run impact on residential location and average commute distances*—it has been hypothesized that telecommuting will encourage residential relocation to sites further from workplaces, because longer commuting distances can be traded off for less-frequent work trips (Mokhtarian, et al., 1995). Limited U.S. evidence adds some support to this hypothesis, in that a survey of telecommuters in California who had relocated revealed that in 50 percent of the completed move cases the move was farther away from the central office, compared with 30 percent moving nearer (Nilles, 1991, cited in Lyons, undated).

So what can be concluded concerning the urban form and travel implications of EHW? First, we can conclude that the implications will be modest. Estimates derived primarily from U.S. experience suggest that with 5.8 percent of the workforce telecommuting for an average of 1.2 days per week, the associated net reduction in vehicle miles traveled in 1991 was 0.51 percent (Mokhtarian, et al., 1995). In the United Kingdom, with an appreciably lower incidence of EHW, with shorter journeys to work, and with a modal split less dominated by the private car, we can anticipate that the net substitution effect will be appreciably less than the 0.51 percent estimated for the United States. It will therefore be some appreciable time before any impacts of EHW on urban form or on urban travel patterns are likely to be discernible.

In the longer term, we might anticipate the impacts in the United Kingdom to be as follows: the main effect of any growth in EHW is likely to be the expansion of the functional metropolitan region centered on London, where most EHW is concentrated (Huws, et al., 1996). Given that the broader context of locational change in office employment in this region is that of deconcentration from central London, EHW will simply add further impetus to the process by which the nodality of the region in terms of work travel is reduced, with a more diffuse pattern of travel developing. Invariably, the new patterns of travel, both to work and to meetings, clients' premises, and so on, will be more car dependent than the centrally focused patterns of travel they replace.

Mobile Teleworking

Although there is agreement that nomadic or mobile teleworking is growing significantly, there are few reliable statistics on its incidence or rate of growth. Gray, Hodson, and Gordon (1993) estimate that there are more than 7 million nomadic desk jobs in the United States, and over 1.5 million in the United Kingdom, but the basis for their estimates is not stated. There has always been mobile work, of course, such as sales staff and field engineers; our interest is in the way some firms are starting to look strategically at how new technologies can be used to change working practices, with a view to reducing costs and improving customer service, and the locational and travel implications of such changes.

One example of a new working practice with potentially significant implications for the demand for office space, the location of office space, and the substitution/generation of travel is "hot-desking," introduced first in computer companies such as IBM and Digital, but now spreading more widely into firms with other mobile staff (Gillespie, et al., 1995). In the case of IBM, the stimulus for hot-desking was cost competition, coupled with a recognition that the was overprovided with expensive office space, given that many of the staff spent much of their working days out on the road or at customers" premises. The hot-desking scheme developed and introduced by IBM involved providing an average of one desk for two workers, with all of the desk space shared, and increasing in the amount of space for meetings. The new working practices have proved successful in terms of productivity, generating the following changes in employee time use (Young, 1992):

- travel time −13%
- time with customer + 36%
- time in office −23%
- total space saved −30%

A significant increase in nomadic working in conjunction with concepts such as hot-desking, if taken up widely, would have obvious implications for office space demand, with a significant reduction in the average space requirements of certain sectors. The increased emphasis on the mobility of the workforce is also likely to encourage firms to locate in out-of-town sites with easy access to the road network and with plentiful parking space rather than in city-center locations, thus reinforcing existing trends toward out-of-town developments.

To the authors' knowledge, no published studies have been carried out on the transport implications of this form of mobile teleworking, and there are a range of possible outcomes—some contradictory—if the practice continues to grow. Where workers have traditionally been mobile but are now being discouraged from traveling to their office base, the number of miles traveled per worker should fall, as in the IBM case reported above. However, as part of the rationale behind strategic changes in working practices such as hot-desking is to "get closer to the client," one would also expect that there would be more visits to each client than previously. If customers come to expect more site visits as a matter of course then more, rather than fewer, miles may be traveled. A further possibility is that if mobile working spreads to new areas of work, the overall travel could increase even though time traveled per worker falls (new groups of mobile workers could also have an impact on existing modal splits, with more workers having to take the car). Finally, new travel patterns may

emerge as the classic commuting trip to the office declines and workers stay at home until it is time to visit the client. We can assume that these trips are likely to be less city-center-dominated than the classic commute trip, as well as being more car-dependent.

Group or Team Teleworking

Despite the existing technological limitations on the development of team teleworking (Gillespie, et al., 1994), there can be little doubt that new forms of work organization are pulling in this direction. An increasing business focus on quality and customer service, the need for flexibility to cope with turbulent markets, and an emphasis on innovation are leading to new structures within information-based organizations in which "task-focused teams," often crossing organizational boundaries, are becoming the new paradigm of work organization (see, for example, Opper and Fersko-Weiss, 1992). Of course, not all teamworking involves spatially distributed teams, but multiple pressures are pushing in this direction. The process of globalization, the increasing need for organizations flexibly to combine and recombine their spatially dispersed specialized human resources, and the requirement to forge strategic alliances with other organizations possessing complimentary assets are all leading to the construction of task-focused teams with geographically distributed participants.

As with the other forms of telework considered above, one might assume that team telework would cut down on demand for travel. As far as we are aware, however, no detailed studies have been carried out into this aspect of team telework, so we cannot make detailed comments on the travel patterns it generates. We would, however, make the following observations. Generally speaking, computer-supported team telework not only means more tele-mediated contact with groups across space; it also means tele-mediated contact with groups with whom contact has been limited or nonexistent, as firms or networks reorganize to take advantage of distributed resources (for example, skilled labor and laboratory facilities). These new contacts also generate new travel demands as groups find that technological and organizational capacity is not (for the moment, at least) sufficiently developed to take shared tasks from inception to fruition. So, for example, it is likely that distributed R&D teams will travel for face-to-face meetings across the world, whereas previously they may have worked only locally. Even for teams working within national boundaries, more travel can be generated by teamwork. In the case of IBM, for example, distributed teams focused on business sectors, so as to get "closer to the client," mean that teamworkers may be physically further away from both their clients and their fellow teamworkers. Despite the sophisticated supporting electronic networks, face-to-face meetings are still required, both with clients and with other team members, but now instead of popping next door to meet work colleagues, or traveling a few miles to meet clients, workers now have to travel up and down the motorway on a regular basis.

We would therefore anticipate that team teleworking, in expanding the geographical spread of participants in the virtual work activity space, is likely to lead to new demands for travel and to substantial increases in the distances over which business travel takes place.

Remote Offices—The Example of Call-Centers

The locational and travel implications of call-centers are particularly complex and interesting, due to two features; first, the work concerned frequently moves between cities as well as between different types of location within cities; and second, the travel implications extend beyond work travel to also encompass travel to consume.

In the case of telebanking in the United Kingdom, for example, there are two clear locational implications with respect to employment (Marshall and Richardson, 1996). First, the possibility of separating production and consumption is allowing the relocation of substantial parts of the production process to lower-cost parts of the country, with cities such as Leeds, Edinburgh, and Glasgow gaining appreciable numbers of telebanking jobs. To an extent, therefore, travel to work to a bank branch in say, London, or to a small town in the outer Southeast of England is being replaced by a journey to work to a call center in, say, Leeds (with an appreciable degree of job downsizing en route, due to the much higher levels of labor productivity associated with tele-mediated service delivery).

Second, "in contrast to most bank branches, nearly all telebanking operations are on business parks on the edge of cities, rather than in town or city centers. There is no need for an expensive city-centre location" (Ibid., page 1855). The two locational effects are usually compounded such that jobs are in effect moving from the center or suburban high street of one city to an out-of-town business park location in another city. The shift in the type of intra-urban location is inducing a clear modal shift in that out-of-town call centers tend to have a much higher car mode share than the jobs they are replacing (Arup Economics and Planning/CURDS, 1998). The modal shift due to locational change is exacerbated by the greater incidence of shift-working in telebanking operations, militating against the use of public transport.

These work travel changes induced by implicit shifts in the location of employment are matched by changes in travel to consume, though in this case the journey is not geographically displaced but rather is electronically substituted. In the example of a bank branch in a London high street, therefore, telebanking is leading to the disappearance of both journeys to work and journeys to bank, although a portion of the journey to work is reappearing in a very different guise on a business park in a city in the north of England. The complex interplay of these production and consumption elements in traditional and tele-mediated modes of service delivery, and their different implications for urban spatial structure and for patterns of work travel and travel to consume, require further empirical investigation.

CONCLUSION

What can we conclude about the implications of teleworking, broadly defined, for urban form and for travel patterns and travel behavior? First, it might be observed that it is remarkable that so much research effort has been expended on studying the locational and travel implications associated with a handful of electronic homeworkers, when so little has been expended on studying the locational and travel implications associated with a very much larger number of workers whose working practices are being radically changed by new ICTs (for a notable exception, at least with repect to locational trends, see Office of Technology Assessment, 1995).

Second, the notion that teleworking will lead to reduced travel, and hence to more environmentally sustainable cities, is, at the very least, open to question. Even with respect to EHW, where the most obvious potential for travel substitution is to be found, we have concluded that the most likely long-term effect in the United Kingdom is that the geographical extent of the London "daily urban system" will be expanded, and the nodality of the region in terms of travel patterns will be further reduced. When we consider the likely travel impacts of the growth of mobile working and of spatially dispersed teamworking, we are at once confounded by the almost complete absence of empirical research. However, both of these significant developments in working practices appear likely to expand the daily activity spaces of individual workers and to lead to significantly increased journey distances. It also seems likely that significant modal shifts in the direction of increased car dependency will be associated with these new ways of working. Finally, the location of teleservice employment in large call centers has, within the context of the particular planning regime in the United Kingdom over the last ten years, clearly been associated with a shift from city center and high-street locations to out-of-town/edge-of-town business park locations, and will have helped fuel the growth in car dependency in the journey to work.

The "reduced demand for travel" scenario, which is usually invoked with respect to teleworking may, then, be decidedly misleading in terms of its apparently positive contribution to building more sustainable cities. Not only are communications technologies expanding the "activity spaces" within which work takes place, leading to longer distances traveled, but in addition, journey patterns associated with new ways of working are becoming more diffuse and less nodal, and hence more difficult to accomplish by public transport. This effect is exacerbated by companies adjusting their premises stock to accommodate more effectively new ways of working, leading to a reduction in demand for conventional city-center offices and an increase in demand for office space in office park environments with high levels of accessibility to the motorway system. At the same time, the substitution of tele-mediated for face-to-face banking and other services risks further undermining the role of city centers and high streets, as branch offices are closed and customers are served from large teleservice centers, themselves usually located on business parks. Far from contributing to more sustainable urban ways of life and travel behavior, therefore, teleworking and teleservices seem to be developing hand in hand with lower-density, less nodal urban forms and with travel behavior that is more car-dependent than before. Teleworking and tele-activities are, then, perhaps best understood not as developments that suppress the demand for mobility but, rather, as forms of what might best be described as "hypermobility."

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