The Environmental and Social Impacts of Telecommuting and Teleactivities

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Introduction

The effects of communication and transportation technologies on urban form and function are matters of much discourse in recent literature. In 1963 Melvin Webber, UC Berkeley Professor of City Planning, published a seminal work entitled "Order in Diversity: Community Without Propinquity". This much-discussed piece was possibly the first to argue that developments in transportation and communications technologies would produce urban settlements that are "considerably more dispersed, varied, and space-consuming than they ever were in the past" (Webber, 1963). While communication technologies have evolved faster than was envisioned by Webber, change in transportation modes and methods has occurred far slower. In fact, development in communications has occurred so rapidly that it is on the verge of dramatically altering the ways and reasons we transport ourselves from place to place.

Much of the literature since 1963 agreed that advances in computing and telecommunications technologies would fuel further urban sprawl and capital flight from central cities. Joel Garreau (1991) proposed that Edge Cities developed partially because advancing computing and communication technologies freed businesses from the need to remain in the central city. There is little doubt that the rapidly advancing technology has had, and will continue to have a strong influence on the shape and organization of American cities.

Though many pundits argue that further reductions in urban density are inevitable, others see signs that density may increase as advanced technologies become commonplace. Pressman (1987) notes that in recent studies of the effects of convergent telecommunication and computing technologies on urban form,

> "it has been neglected, more often than not, to focus also on emerging societal and human needs which may have the counter-effect of inducing greater urban concentrations and proximity – in both the employment and residential sectors – due to increasing concern with issues such as preservation of the existing social fabric, neighborhood stability, community-based interests and a life-style in which urban cultural values become paramount. These factors may, in the longer term, redirect technological forces working in the direction of urban decline. Rather than more centrifugal development, we may see a move to urban revitalization and concomitant centripetal movement."

Whether the trend is towards more dense or less dense cities, there will be significant environmental and social effects of shifting city form and function. This paper discusses some potential environmental and social consequences of increasing levels of telecommuting and other teleactivities. By combining empirical research results with reasoned arguments and plausible scenarios, this paper argues that future American cities will make gains in 'livability' through reductions in environmentally damaging impacts and increases in the social well-being.

Introduction to Telecommuting

Recent technological and organizational developments are contributing to spatial reunification of home and work activities. Modern telecommunication and computer technology allow workers to perform their duties from home, instead of requiring them to journey to and from distant workplaces; this practice is known as telecommuting. Though it is a relatively new practice, and is thus used by only a small percentage of the workforce, telecommuting will become much more common in the near future.

Telecommuting is the use of telecommunication and computer technologies to replace or reduce traditional commuting to the workplace. Telecommuters most often work in management and service jobs where there is little need for physical interactions with goods or people in the workplace. Most telecommuting occurs on a part-time basis, with part of the work week spent working in the traditional office and the other part spent working at home. Though high-tech equipment is not a necessity for telecommuting[1], it enables a much wider range of jobs to be performed outside of the traditional office.

Estimates vary on the current level of telecommuting. Quantifying telecommuters is difficult for a number of reasons. There is no single widely accepted definition of what telecommuting entails, and there are difficulties in counting telecommuters because not all telecommuters do so all the time. Some surveys do not differentiate between people that work at

1 For purposes of this examination, I am assuming that all telecommuting will utilize some form of in-home computer technology, or at the minimum an array of technologically advanced devices.

home in home-based businesses and those that telecommute from their homes. Finally, the sampling methods of some surveys are different enough to make comparison and averaging impossible. Given these limitations the estimates below vary accordingly.

Year and Source:	Estimated Values:
1992 Link Resources (Telecommuting) and Mokhtarian, 1993	6.6 million telecommuters in 4.9 million households 77% white collar 59% conventional employees, 41% contract-based 19% work 35 hours or more per week at home 18.3 hours at home per week average 81% work for businesses with less than 100 employees
1987 (Fathy, 1991)	200,000-250,000 telecommuters
1985 (Forbes, 1985)	100,000 telecommuters
1984 (Kelly, 1986)	4-5 million telecommuters, including part-time telecommuters

Telecommuting levels in California have been more carefully measured. A survey conducted by Caltrans in 1991 provides the most accurate estimates of state-wide telecommuters and telecommuting frequency. It suggests that on any given weekday 1.4 percent of workers telecommute, which translates into about 5.8 percent of the workforce telecommuting at some time. Other sources place daily telecommuting levels between 1 and 2 percent, or between 136,000 and 272,000 workers (Handy, 1994).

It is likely that the number of employees telecommuting, and the frequency with which they telecommute, will increase in the near future (Mokhtarian, 1993). In 1980 76% of the workforce was engaged in information and service activities. Currently, over 80% of newly created jobs are in the information and service sectors (Fathy, 1991). The nature of these jobs make them ideal for telecommuters. Regulations, especially in Southern California, are requiring local businesses and governments to implement programs such as telecommuting to reduce automobile emissions and congestion.

There are few technological limitations to the widespread adoption of telecommuting, while cultural and organizational barriers are legion (Telecommuting; Schuler, 1992; Monod, 1984). Management styles and practices must change to accommodate telecommuting

employees, while the employees themselves must become comfortable with working outside of the office in a more independent manner. For telecommuting arrangements to function, management by surveillance must become management by results (Buckinger, 1994).

Employers seeing the benefits of telecommuting are slowly implementing programs. Benefits to businesses include: increased worker productivity[2], increased worker morale, reduced worker turnover, reduced health care costs, reduced office facility costs, and larger applicant pools for job openings. Benefits to workers include: reduced expense and stress of commuting, increased opportunities for parents and disabled persons to enter the workplace, more flexibility in work hours, and more potential leisure time (Telecommuting; Keklikian, 1990; Mokhtarian, 1993).

Introduction to Teleactivity

The convergence of telecommunication and computing technologies that facilitate telecommuting also make possible other forms of interactions known collectively as teleactivity. "Teleactivity is socioeconomic activity based on interactive, individualized, and asynchronous telecommunication systems to connect persons, tasks, and information regardless of distance." (Fathy, 1991). Although telecommuting is likely to have the largest environmental and social impacts, other teleactivities, such as teleshopping and telesocializing, will contribute to these changes. A symbiotic relationship exists between the various teleactivities. As people gain access to one teleactivity and start using it, the likelihood of their engaging in other teleactivities increases. As familiarity with computers becomes more common, tasks that traditionally were not computer related will increasingly become so in both the workplace and the home.

[2] Increases in productivity are due to a number of reasons, including reduction in job stress, interruptions, and wasted commute time. Studies have found productivity increases of an average of 15-16% (Telecommuting). Reliable data is difficult to obtain on this topic because much of the research has been done by companies who have retained the results for market competitiveness reasons (Kitamura, 1990b)

Teleshopping

Teleshopping is the use of telecommunications and computers to shop for and purchase goods and services. If the definition is taken loosely, teleshopping has existed since the first order for goods or services was placed via telegraph. Modern mail-order catalogs, with 800-number service and sophisticated computerized order-tracking and inventory systems, are a recent step in the evolution of teleshopping. Total volume of catalog shopping has been increasingly steadily, at the expense of traditional retail shopping (Schuler, 1992). Apparently the fact that consumers cannot actually handle and visually inspect goods is outweighed by the price and convenience benefits of mail-order shopping.

Mail-order catalogs must offer a limited number of products, and can describe each only briefly. Because consumers will not read through thousands of pages of dense text, and publishers balk at the expense of producing and mailing such tomes, there is a deliberate and necessary reduction in the information conveyed via a catalog. This limitation of paper-based catalogs is overcome when the catalog is delivered in digital form by computers.

There are two main forms of computer-based catalogs; off-line and on-line. Off-line catalogs are delivered via traditional mail methods on some form of computer-readable media, usually a CD-ROM. These catalogs offer varying levels of detail of descriptions and variety of products and may still require consumers to use the telephone to place orders. Because CD-ROMs can hold such tremendous amounts of data, it is possible for publishers to include far more detail in their descriptions and representations of the products they are offering. For instance, a traditional mail- order catalog, unlike some digital catalogs, does not allow consumers to view an item in 3D, from any perspective, and in any of the available colors and config-urations. Costs of producing and distributing CD-ROMs are comparable to the costs of

producing and delivering traditional mail-order catalogs, even though the CD-ROM version may contain 1,000 times more information than the paper version[3].

On-line catalogs have the largest potential to revolutionize the way goods and services are purchased. On-line catalogs are delivered via computer networks, often linked through telephone lines. To the consumer, these catalogs may appear similar to off-line catalogs. There are some important differences however. In an on-line catalog the data itself resides on a remote server, which allows delivery of an even greater breadth and depth of information to the potential consumer. On-line catalogs are easier to keep up-to-date, and can allow consumers to place orders over the computer networks, rather than requiring an additional phone call.

The various forms of teleshopping will never totally replace traditional, location-based commerce. Some aspects of the retail environment will never be duplicated in the teleshopping environment. For instance, shopping is a social activity for many people. Malls are places of both social and economic interaction. Duplication of such social atmospheres is extremely difficult, if not impossible, in a digital environment. Humans visual acuity exceeds the resolution of digital displays, thus limiting the effectiveness of teleshopping for items that have critical visual characteristics. Physical interactions with goods are impossible for teleshoppers. Lengthy shopping processes and the sale of high value goods will continue to occur primarily in the location-based retail environment (Schuler, 1992).

Given these limitations, some future effects of teleshopping activity can be predicted with reasonable confidence. Because teleshopping establishments do not need to secure expensive retail space, and because they do not need to maintain inventories, prices for goods should decrease. Because consumers can shop from home, trips to shopping locations may decrease as well[4]. Start-up costs for teleshopping enterprises are often less than for traditional storefront

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3 It is obvious that paper catalogs are far more transportable and accessible than computer-based catalogs. Access to computer hardware and knowledge of how to use such hardware is not necessary to browse a paper catalog. However, the skills and technology necessary to engage in teleactivity may become nearly ubiquitous in the future, in a process comparable to the widespread adoption of the telephone.

4 At least trips to shopping locations without social attractions will decrease. Trips to shopping/socializing locations may actually increase, especially if increases in teleactivity contribute to increases in discretionary time, as suggested below.

retail, thus encouraging more diversity in the telemarketplace and more small business involvement. Virtual shopping environments prevent retailers from developing large physical presences and dominating retailing locations (as department stores do at shopping malls), thus leveling the field for all players to compete on selection, price, and service.

The usage and effects of teleshopping will vary depending on the population. A study of Dutch shoppers compared national averages to a group of teleshoppers who bought groceries via telephone and computer links from their homes. According to the study, elderly people and younger people with busy family and work lives were most likely to teleshop. The motivations for these two groups to teleshop are different; elderly people cited their physical condition as a principal motive, while young working people were trying to save time. These teleshoppers continued to visit stores, albeit slightly less frequently than the non-teleshopping population (Tacken, 1990). If teleshopping activity by population groups remains roughly constant in the future, communities with low numbers of elderly and young professionals may be less affected by teleshopping.

The most interesting finding of the Dutch study was that teleshopping changed the preferred modes of transportation for traditional shopping trips among the study group. Because large, bulky, and heavy orders were delivered by the teleshop[5], participants said they were more likely to walk or bike ride to shops, and less likely to drive[6]. Even if teleshopping leads to no change in the number of shopping trips, a shift to non-polluting transport would generate positive environmental benefits. Additionally, bicycle and pedestrian traffic produces more vibrant and lively street environments, which in turn may generate more bicycle and pedestrian traffic. Eventually, this process can contribute to higher urban housing densities, finer grained development patterns, and reduced automobile use and ownership.

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[5] Though delivery activities constitute new trips generated by teleshopping, logistical and scale efficiencies produced an overall reduction of both trips numbers and total vehicle miles.

[6] The cultural proclivity to bicycle riding in Holland must be considered when drawing conclusions from the results of this study. Because Americans are much less inclined to ride bicycles, and because urban structures often hamper bicycling, the effects of teleshopping on transportation mode choices may be less pronounced in the United States.

Telesocializing

Telesocializing may be defined as the use of telecommunication and computer technology to mediate social interactions. Ever since the boom in popularity of the telephone, we have conducted meaningful social exchanges via telecommunication links. Modern computers allow us to expand the breadth and depth of those interactions by facilitating the exchange of still and moving images, as well as sound and text, with the person on the other end of the line. Tele-socializing has the potential to alter our perceptions of what constitutes meaningful social interaction.

There are an estimated 10-20 million users of the world-wide computer network known as the Internet. Many of these users conduct academic, business, and social exchanges over the Internet using electronic mail, newsgroups, and the World Wide Web. Meaningful interaction has already been redefined for the growing Internet community: There have been occurrences of people who made contact in newsgroup discussions, exchanged electronic mail, met in person, and eventually got married. The fact that the Internet can mediate an interaction of sufficient quality to lead to lasting friendships and sometimes marriage speaks volumes about how tele-activity can replace some traditionally proximity-based interactions.

Some forms of socializing will not be transferable to a digital medium, at least not in the foreseeable future. Mass social gatherings, often centered around performances and sporting events, will remain popular for many people. In fact, these types of events may serve as a central-izing force in future urban change, as very low density rural populations cannot support large scale sporting and performance venues. Peoples desires to attend such events may sway their housing location decisions towards higher density urban centers, though their telecommuting jobs may allow them to live in distant rural areas.

Social interactions conducted in specific physical environments will also transfer poorly. Disco dancing, bar hopping, and Christmas window shopping are all dependent on specific physical environments populated by numerous individuals. People derive pleasure from being an anonymous member of a larger group engaged in a similar activity. Though digital environments

can roughly duplicate these arrangements, it is difficult to replicate the semi-randomness of potential interactions that may occur between participants. Additionally, it is nearly impossible using current technology to reproduce any environment to all the senses. Vision and hearing can be satisfied by virtual reality devices, but physical sensations and smells are currently impossible to transmit over telecommunication links.

Like most technological advances, teleactivities such at teleshopping, telesocializing and telecommuting will not independently bring about great changes in our society. Instead, they will remove certain constraints and allow greater freedom of action. Change will occur through choices made by those using these new technologies. The next two sections introduce how some of these choices may be motivated, and what environmental and social consequences such choices may have.

Environmental Impacts of Telecommuting and Teleactivities

Americans produce more environmental impact as a result of our daily activities than any other society in the history of humankind. These impacts have tremendous social and economic costs. Telecommuting, and to a lesser extent teleactivities, offers some hope for reducing our impacts on the planet and on each other. This section examines some of the way teleactivities may facilitate such reductions.

Reduction of Automobile Use and Non-renewable Resource Consumption

By reducing commute trips and distances, telecommuting can reduce non-renewable resource consumption. Even as low- and zero-emission cars become more common, fossil fuels will power the vast majority of transportation for the foreseeable future. Large oil corporations simply have too much invested in their infrastructure to allow a rapid switch to solar powered electric transportation. By reducing trip distances and frequencies, overall fuel use by tele-commuters will be reduced. In addition, those telecommuters will save themselves and society

the related costs of operating motor vehicles[7]. Only 60% of the $71 billion annual cost of operating the nation's roads and highways is paid by user fees; the remaining $29 billion is paid by society through property taxes, general funds, and other indirect sources (MacKenzie, 1992)

Reducing automobile use is one of the primary benefits of telecommuting. Studies of telecommuters have shown clear and dramatic reductions in all aspects of automobile usage (Handy, 1994; Kitamura, 1991, 1990; Mokhtarian 1991a, 1991b; Pendyala, 1992). Telecommuters usually eliminate two trips per day when they work at home. Elimination of automobile trips has tremendous environmental benefits, including reduced emissions and reduced non-renewable fuel use.

Motor vehicles in the United States consume one eighth of annual global oil production, at the rate of about 8.9 million barrels per day. Half of all imported oil is used by motorists (MacKenzie, 1992). Telecommuting offers some potential to reduce this consumption, and thus reduce the environmental problems associated with automobile and fossil fuel use.

A study conducted by Bell Atlantic researchers counted 12 million potential telecommuters in their service region. If just 5% (600,000 workers) telecommuted, annual savings would total 73 million gallons of gas, 6,443 tons of hydrocarbons, 38,000 tons of carbon monoxide, and 2,300 tons of nitrogen oxide. A recent study by Arthur D. Little Associates found that if 10-20% of traditional commuters switched to telecommuting, savings would total $23 billion annually. These savings would be realized by eliminating 1.8 million tons of regulated pollutants, saving 3.5 billion gallons of gas, freeing up of 3.1 billion hours of personal time from reduced congestion and automobile trips, and reducing maintenance costs for existing transportation infrastructure by $500 million (Telecommuting). A 1985 study by the Southern California Association of Governments found that a 32% reduction in freeway congestion could be achieved by just 12% of the workforce telecommuting (Fathy, 1991).

[7] For telecommuters working at home, the costs of equipping and operating a home office, if not borne by their employer, may offset some of the savings gained by driving less.

Telecommuting can reduce peak-period commuting travel, and thus help reduce congestion (Mokhtarian, 1991b). According to the Federal Highway Administration, "Congestion now affects more areas, more often, for longer periods, and with more impacts on highway users that at any time in the nation's history." Total market costs of congestion borne by drivers are at least $100 billion per year. Total costs to society may be many times that figure. (MacKenzie, 1992)

A telecommuter may only need to go into the office for a few hours each day; they may work at home in the morning, leave for the office at 10 AM, return by 3 PM, and continue to work at home in the evening. If enough people followed this pattern the traffic load on freeways would remain more constant throughout the day, thus reducing peak period congestion. However, such a practice could interrupt normal work patterns by breaking up the work day with commutes. It also would do little to reduce single occupancy vehicle use, and may in fact encourage it by making participation in car and van pools more difficult. Studies of practicing telecommuters have shown large decreases in peak-period trips, in terms of both absolute trip numbers and frequency of freeway use (Pendyala, 1992; Kitamura, 1991, 1990). By encouraging telecommuting, local agencies can reduce peak-period freeway congestion for much less money than building carpool lanes, and with much less difficulty than imposing peak-period tolls.

Telecommuters and teleshoppers may find less need for automobiles, and thus teleactivity may result in lower car ownership rates. Studies have been unable to confirm this hypotheses (Handy, 1994; Mokhtarian, 1991); however, as teleactivity reduces automobile trips, and as regulations increase the cost of automobile ownership and use, it is likely that we will see some decrease in automobile ownership rates for households that telecommute and teleshop. Though the widely quoted correlation between residential density and fuel consumption has been demonstrated to be statistically invalid, a strong correlation does exist between absolute city size and fuel consumption (Brindle, 1994). Though causality is difficult to ascertain, it is likely the relationship is at least partially driven by increases in distances between points in homogeneous residential and commercial zones as city size increases. Thus, if teleactivity contributes to a

multi-nucleated urban arrangement, where distances between homes, employment centers, shops, and services are shortened to the walkable scale (as is suggested below), fuel use and car ownership rates may decrease. Considering the high costs of simply owning a car, outside of operation and maintenance costs, reducing car ownership can be financially rewarding for former car owners[8].

There are a few ways in which telecommuting can potentially increase automobile use. These include trips made to relieve 'cabin fever', trips by household members who would not have otherwise had a car available to them, and trips to local photocopying, faxing, and office supply stores. However, empirical studies have found that the amount of travel generated by telecommuting is always significantly less than that replaced by telecommuting, and that essentially no new trips are created (Handy, 1994; Mokhtarian, 1991a, 1991b; Pendyala et al, 1992; Kitamura et al, 1991).

For telecommuting to work effectively as a traffic reduction measure, planning and policy efforts must be coordinated between various departments. It is counterproductive for one department to encourage telecommuting while another pushes for additional highway lanes. Strategies to facilitate automobile use can act as a disincentive to telecommuting. Bigger, faster highways and free workplace parking encourage people to remain in their cars. Instead, companies and governments must act to increase the cost of owning and operating an automobile, while at the same time increasing availability of alternatives like public transit and telecommuting.

Reduction of Demand for Office Space

Widespread telecommuting within a company reduces the office space needed to support employees. Because most telecommuters spend part of their week in the office and the other part

[8] Reductions in automobile use and ownership could cause financial hardships for some sectors of the economy. Revenue and taxes generated by the sales, servicing, and operation of motor vehicles provide many people with their livelihoods and many government agencies with portions of their operating budgets. There are no reliable predictions of future numbers of telecommuters, but it seems reasonable to predict that it will be a long time before telecommuting becomes widespread enough to affect incidental benefits of motor vehicle use.

at home, low levels of telecommuting will not significantly reduce business needs for office space. However, when telecommuting becomes full-time or nearly full-time, when employees share office space on the days they do drive to work, and when a large proportion of employees telecommute, the square-footage of office needed per employee drops dramatically.

Besides the obvious financial costs to businesses of securing, operating, and maintaining offices, there are numerous environmental costs, usually borne by consumers and society. HVAC (Heating, Ventilation, and Air Conditioning) equipment consumes large amounts of electricity and natural gas while exhausting waste heat to the atmosphere. Additionally, the siting and design of most offices necessitates automobile-based commuting. This is especially true when offices are relatively low density one and two story structures built on the urban and suburban fringe.

Over 90% of all commuters park for free at their workplace. Extensive literature has shown that free parking for commuters makes solo commuting almost irresistible. MacKenzie (1992) estimates the cost of free parking at $85 million annually. This cost is paid indirectly by the consumer, and represents yet another cost to society of office space and automobile-based commuting that might be reduced through telecommuting.

The parking required for automobile-based commuters may consume 60% of a given lot, thus greatly reducing the utility of dollars spent on land for office development. Parking lots are the source of many environmental problems related to office and commercial development. Paved parking lots act as giant solar collectors, decreasing the albedo of the earth's surface and increasing air temperatures in the surrounding area. This localized heating further increases air conditioning energy costs, which in turn dumps more waste heat into the local environment. This cycle can raise the average temperature of entire urban areas, a phenomenon know as the heat island effect.

Open space and agricultural land is often consumed by buildings and parking lots. More than 60,000 square miles of United States land is paved over, or about 2% of the total surface area and 10% of all arable land. In the typical American city nearly half the land is used to

accommodate motor vehicles (MacKenzie, 1992). Such paved areas are impervious to water, thus storm and snow-melt run-off from developed sites is far greater than from undeveloped sites. Rapid run-off taxes storm sewer systems, and may require expensive repairs and upgrades to the sewers that are often paid for by the community at large.

Changing Transit Infrastructure Use

If widespread telecommuting acts as a decentralizing force, existing local highways and transit systems may become chronically under-used (Schuler, 1992). Highways might eventually be torn down, thus freeing-up land. Public transport systems may cease operations for financial reasons caused by reduced tax revenues. Urban dwellers left behind by the teleactivity revolution would suffer. Manufacturing and other location-based workers, the poor, and the unemployed may be left with few options. Those with personal automobiles would be forced to use them more often, thus defeating many of the potential environmental benefits of telecommuting. Those without cars may try to move closer to their places of employment, though this will not always be physically or economically possible. The lot of the underclasses will not be directly improved by increases in telecommuting. Hopefully, however, the savings to government generated by reductions in infrastructure development and maintenance might be channeled into public transportation projects that benefit everyone. Given that each new unit of transportation capacity costs $20,000-30,000 to create and maintain for 20 years[9] (Telecommuting), the financial benefits to society of delaying the development of additional transportation infrastructure could be huge.

Transformation of Utilization and Function of Homes

Homes in America are among the largest in the world. Large homes consume proportionally large amounts of land and energy. As family structures have changed, the large

[9] Creation of space for one new worker to get to work for 20 years. This is an average figure highly dependent on many variables.

American home has become inefficient for its occupants. Working singles, single parents, and empty nesters must often live in houses larger than their lifestyles require. More than one quarter of American homes today are occupied by a single person (Ahrentzen, 1989). Telecommuting allows more efficient utilization of home space. Under-used rooms can be converted into a home offices, giving greater utility to the dollars spent on housing. Additionally, a greater utility is received from dollars spent to maintain interior climates at comfortable levels. Economies of scale suggest that heating and cooling a single large office building is less energy intensive than heating and cooling many individual homes. However, when sufficient numbers of workers are telecommuting, its evident that the environmental impact of conditioning home climate alone is less than the impact of conditioning both the home and the office building, something that is usually necessary with traditional commuting arrangements.[10]

Shifting Urban Settlement Patterns

Telecommuting may contribute to further suburbanization and urban sprawl by releasing households from locational constraints related to maximum acceptable commute time and distance (Mokhtarian, 1991b). Because telecommuting is such a relatively new activity, no studies have been able to confirm or deny this hypothesis (Handy, 1994). If this indeed occurs, the environmental costs of further sprawl could far outweigh benefits received by reduced automobile and office use. It is difficult to estimate the likelihood of this scenario because there are so many factors contributing to housing location decisions.

Findings of a 1986 survey of homeworkers, some of whom telecommuted, suggest that home-based work may induce finer-grained, higher-density urban patterns. Respondents expressed an increase in the 'spatial proximity importance' of goods and services, especially those "facilities and services instrumental to the work tasks". Convenient central downtown districts were also more highly valued after telecommuting began, suggesting a centralizing

[10] Discussion of the psychological and social impacts of bringing work into the home environment appears below.

effect of telecommuting. The telecommuters in this study wanted to be near downtown for access to professional services, business clients, and main offices. Ambient neighborhood qualities were also more highly valued, such as peace and quite, pleasant views, and pleasant pedestrian environments (Ahrentzen, 1989). Though such neighborhood qualities are available in rural settings, access to goods and services can be limited by distances and low population densities. Thoughtfully planned residential neighborhoods, located near neighborhood commercial centers and designed to ensure a pleasant environment and sufficient privacy, can satisfy the needs of homeworkers in ways that low-density suburban developments cannot.

A study of approximately 250 California state employees found that telecommuters reduced the spatial extension of their daily activities when compared to non-telecommuters. This contraction of action space took place on both telecommuting and regular commuting days (Pendyala, 1992). Thus increases in telecommuting may lead to more activity near to home, which would have a centralizing effect on household locations. Telecommuters may in fact move into closer proximity to their frequently visited locations, thus encouraging higher density, walkable residential development near small neighborhood commercial centers.

Increasing High-Tech Waste Stream

By further increasing our need to own and use computing devices, widespread telecommuting could eventually increases the volume of obsolete electronics entering the waste stream. With computers doubling in speed every 18-24 months, top-of-the-line equipment becomes dated and archaic after only a few years. While this may have the positive effect of providing a source for donations of computing equipment to schools and organizations, it may also increase the flow of non-biodegradable, sometimes toxic waste to brimming landfills.

Though this alone should not be a reason to deny support for telecommuting, it must be considered when assessing environmental impacts of teleactivities.[11]

Most of the environmental impacts discussed above are results of changes in human behavior. Such behavioral changes are motivated by shifts in personal and societal priorities, or by economic forces. The social aspects of telecommuting and other teleactivities must be considered if we are to assess the likelihood of behavioral changes. The next section examines some of the social impacts of teleactivity, both positive and negative, and presents some predictions for the future.

Social Impacts of Telecommuting and Teleactivities

Telecommuting and telesocializing require a certain acceptance of changing societal norms. Interactions that would previously have been carried out face-to-face will be mediated by computers. Social functions served by direct human contact may require alterations and modifications to fit into our increasingly digital world. The meanings of 'Home' and 'Work' will change as distinctions between the two blur. Over a century of societal and psychological constructs based on temporal and physical separations between home and work are challenged by telecommuting and other teleactivities.

Changes in the Workplace and at Home

> "When the 'home' becomes a workplace the boundaries between work and family, workplace and home, public and private space...become blurred. How the separate spheres and roles are interpreted when new circumstances are operative affect the home as a social and physical setting." (Gurstein, 1989)

11 Recent advances by German companies in Design For Disassembly (DFD) may make this point moot. German government regulations are requiring that companies make their products easy to disassemble and recycle when they have reached the end of their useful life. Companies have found that they can actually reduce their costs of manufacturing new goods by recycling their old products. In the United States volume buyers of computers and other high-tech devices are entering into agreements that require their suppliers to take back the devices at the end of their useful life. Though American companies have been slow to institute DFD, it is likely that regulations and profit motives will make this more common in the future.

Interaction with others via computer has become, for many people, a normal part of their socializing patterns. Internet newsgroups, chat rooms, and electronic mailing lists facilitate interaction between people with similar interests, regardless of physical location or socio-economic position[12]. As computer mediated communications become a larger part of normal, everyday life, people will develop new requirements for what satisfies the basic human need for social interaction, and those new requirements will not always include physical proximity.

Work activity in a traditional office setting has a major proximity-dependent social component. Workers spend some of the work day socializing with colleagues at the coffee machine and the water cooler. These opportunities to socialize are lost when the worker is at home all day. The loss of this socializing time is potentially detrimental to the mental health of the worker, and to their productivity and job satisfaction. However, the very technologies that facilitate telecommuting also facilitate telesocializing. Video conferencing, when combined with other forms of telesocializing discussed above, allows telecommuters to maintain contact with their co-workers.

Recent developments in desktop video conferencing have led to dramatic reductions in cost and increases in quality. In a few years all personal computers will likely come equipped with tiny video cameras and microphones that allow users to conduct 'VideoPhone' calls over computer networks. By reuniting the face with the voice, video conferencing and videophones allow the closest approximation of physical proximity technologically possible at a reasonable price. Most of what is currently considered necessary for social interactions is contained in either the voice or in facial expressions. As technology improves and display screens grow to wall sized (which will occur within 5-10 years), we will also be able to convey body language over digital links, thus blurring even further the distinction between face to face and computer mediated interactions.

[12] For instance, sources for this paper were recommended by readers of the alt.urban.planning Internet newsgroup by people in the United States and England, and some ideas in this paper were inspired and critiqued by electronic mail exchanges between the author and people in Santa Cruz, San Francisco, and Montreal.

The productivity based assessments of job performance that telecommuting often necessitates have some potential negative consequences for employees. Unscrupulous employers could institute a form of "electronic sweatshops" (Gurstein, 1989), where people working at home are paid strictly according to output, and productivity expectations are set unrealistically high. Worker's computers can be set to monitor keystrokes and report efficiency to the employer. Because some homeworkers would not have traditional face to face interactions with their coworkers, they may not realize that their working conditions are unfair. The lack of informal workplace interactions may hamper formation of unions or other labor groups that could campaign on behalf of the exploited workers (Antonoff, 1985; Hartz, 1985; Nilles, 1974). Baran (1985) found that telecommuting programs and decentralization of operations at insurance companies reduced the feelings of community and individual empowerment among workers. While some researchers (Kilian, 1984) have suggested that those most disenfranchised and exploited by telecommuting arrangements will be women, others (Banbury-Masland, 1985; Monod, 1984) hypothesis that women, especially those with family responsibilities, will gain greater access to higher level management and executive jobs through flexible working arrangements like telecommuting. Little current evidence exists to support either of these views (Handy, 1994), and it is likely that telecommuting will have little overall effect on the composition, compensation, and organization of the workforce in general.

Change in Work Patterns

Telecommuting has important benefits for specific population groups. Working parents benefit from reductions in commute time, which allows them to spend more time with their children. Single parents, which now comprise 9% of all households, can especially benefit. Just as some households care for children, others care for elderly parents, and some care for both. All of these households can potentially benefit from the flexibility offered by telecommuting (Handy, 1994). Teleshopping offers similar time savings, and reduces the need for often stressful trips to the grocery store with young children in tow.

That same flexibility, combined with a reduction in necessary travel, may allow a greater proportion of retirement age workers to remain in the workforce (Handy, 1994). The physical demands of traveling to, from, and about the workplace causes some people to retire at the very prime of their job knowledge. Wise companies will offer telecommuting as an alternative to retirement for productive and capable elderly employees. The company benefits by retaining a skilled employee, while the worker benefits by maintaining their position as a productive member of society. Elderly people that continue to work are often happier and healthier than non-working retirees.

For similar reasons, disabled workers often have difficulty gaining entrance to and operating in the traditional workplace. The Americans with Disabilities Act (ADA) is doing much to rectify this situation, and telecommuting offers one alternative for disabled workers. Tele-commuting involving persons with disabilities is growing in popularity, however most projects instituted to date have been facilitated by the efforts of non-profit advocacy organizations. Care must be taken in all telecommuting arrangements that the telecommuters do not feel isolated or segregated from the in-office workers, especially when the workers are disabled and already subject to much segregation in society (Jarrett, 1994).

Shifting Meanings and Perceptions of Home

Like any socially transforming technology, telecommuting has some inherent dangers. By reuniting the home and work spheres, there is a blurring of the lines between work life and home life. Some telecommuters have reported increasing their working hours in excess of savings in commute time. The lack of distinction between work and home often causes work to take spatial and temporal precedence. Living rooms may be converted into offices because they are no longer being used for entertainment (Gurstein, 1989).

Ahrentzen (1989) examined changes in homeworkers feelings about their homes after they started working mostly at home. Though some reported little change, and others found the home becoming more of a sanctuary in a positive way, many felt isolated and entrapped in their

homes (Ahrentzen, 1989; Gurstein, 1989). One woman reported, “Home used to feel like a sanctuary. Now I sometimes feel trapped because I’m here all the time.” Those that mentioned these feelings also mentioned their coping mechanisms. For some, phone calls and electronic mail provided sufficient connection to the outside world. Most of the respondents found it necessary to get out of the house at some time during the day (Ahrentzen, 1989). Walkable, pedestrian oriented environments offer relief for the homeworker that feels trapped. As does neighborly relations; interactions that previously took place in the coffee room may take place over the garden fence, or on the front porch. This will be especially so if planners and developers follow some of the guidelines in Calthorpe’s “The Next American Metropolis” or Chris Alexander’s “A Pattern Language” for creating pedestrian oriented urban structures and forms (Calthorpe, 1993; Alexander et al, 1977).

Shifts in the Spatial Extent of Socio-Economic Classes

By freeing households from spatial constraints imposed by the need to live relatively close to places of employment, commerce, and social interaction, teleactivity may induce further geographic separation between the classes. Wealthier teleactive elites may move into rural areas while the poorer underclasses have no choice but to remain in the declining cities (Tele-commuting). Capital flight into rural areas would be economically and socially detrimental to the cities left behind. Such class differences may be driven partially by access to and knowledge of computers.

There is much disturbing evidence on differences in ownership and use of computers between ethnic and socio-economic groups. A 1989 U.S. Census Bureau found that 26.9 million white people use computers at home, compared to only 1.5 million blacks. Computer use in schools shows similar disparities; 17.4 million white students but only 2.4 million black students. The same report found that nearly half of all households with annual incomes over $75,000 owned computers, compared with less than 1 in 20 households with incomes less than $15,000. Though computers are rapidly getting cheaper and more useful, they are still out of reach for

many people. However, at one time televisions showed similar penetration among ethnic and socio-economic groups; now they are present in almost every American home. (Stuart, 1995)

Telecommuting has special benefits of the poor, who spend a disproportionate percentage of their income on transportation. It is possible that teleactivities will encourage higher-density, finer-grained settlement patterns, where all socio-economic classes could live in relative proximity. As costs of hardware decrease, and as employer acceptance of telecommuting increases, the jobs available to telecommuters will broaden to include positions at all pay and experience levels.

Increases in Discretionary Time

By reducing time spent traveling to and from work, telecommuting offers workers a significant increase in discretionary time (Kitamura, 1990). Some telecommuters may use this time to do more work, thus resulting in no net gain in leisure time. Others may utilize it for recreational and social activities.

Teleshopping also offers the possibility of increasing discretionary time by eliminating travel time for traditional shopping trips, and by speeding routine purchases. Intelligent agents, or pieces of software that search computer networks, will reduce our need to comparison shop to obtain the best price. Using intelligent agents to automate routine shopping for groceries and staple goods may give households more time for other activities.

Increases in leisure activities may have far-reaching social and environmental effects. Previously mentioned reductions in activity space, combined with increases in pedestrian and bicycle travel may make neighborhood attractions more popular. Or, family ties may regain importance and discretionary time will be spent at home. Either way, increases in discretionary time will likely boost the economy as spending on leisure activities increases. If families and individuals use their new free time to go for drives in the country, we may see a reverse congestion problem, where roads are clear during the week and crowded on the weekends. Overall, the

effects of discretionary time changes are very difficult to predict. Such changes may not produce any noticeable changes in our society or environment for a very long time.

Change in Community Formation and Organization

The shape and function of community in modern American society has been influenced by a separation of work and home spheres since the Industrial revolution. Socializing and shopping have also taken place primarily outside of the home. Teleactivities brings traditionally separate work, home, social, and commerce activities under one roof. This change may precipitate change in the form and purpose of community organization.

Previous to the existence of telesocializing, social groupings were usually limited by spatial constraints. Informal and formal groups were formed by people with common interests or values, or by neighbors living near each other. There has been a decline in the sense of community felt by many Americans, brought about partially by the increasingly large distances between people in suburban areas. Telesocializing, by removing spatial constraints and broadening the range of potential group members, is allowing people to join 'virtual' communities and is reminding people of the importance of community (Barlow, 1995; Rheingold, 1995). Once the value of community is fixed in peoples minds, the likelihood of community forming on the local level increases.

Additionally, increased residential densities, combined with greater pedestrian activity, may precipitate a return to community awareness and participation. As both the number of people at home during the day and the number of short distance trips conducted by those people increases, teleactivity may increase the apparent population of neighborhoods. As people become more aware of their surroundings and their neighbors, friendships will form on the local level. Neighborhoods will regain importance in the social priorities of their residents.

Conclusion: More Livable Cities

If adopted on a larger scale, teleactivities have the potential to dramatically alter the form and function of human settlement. These alterations may increase our impact on the environment, especially if suburban sprawl accelerates. It is more likely, however, that the centralizing effects of teleactivities will prevail, producing more compact urban areas composed of many small neighborhoods linked by transit to other neighborhoods and to the central city. Such a multi-nucleated arrangement would significantly reduce our overall and per capita environmental impacts, and would foster interactions and community building between residents. Reduction in car ownership facilitated by pedestrian and transit oriented developments may lead to higher standards of living through reduced automobile related expenditures by individuals and society. With a little help from forward looking politicians, planners, and developers, inevitable increases in telecommuting and other teleactivities will lead to more livable cities.

Bibliography

Ahrentzen, Sherry (1989). “A Place of Peace, Prospect, and...a P.C.: The Home as Office”, The Journal of Architectural Planning Research, v. 6 (4), Winter 1989, p. 271-288.

Alexander, Christopher, et al (1977). “A Pattern Language–Towns, Buildings, Construction”, Oxford University Press, New York.

Antonoff, Michael (1985). “The Push for Telecommuting”, Personal Computing, v. 9 (7), July 1985, p. 82-92. Summarized in “Telecommuting: A Selective, Annotated Bibliography” by James Joseph Sanchez, 1987, Vance Bibliographies, Monticello, IL.

Banbury-Masland, Broke and Daniel J. Brass (1985). “Careers, Marriage, and Children: Are Women Changing Their Minds”, Business Horizons, v. 28 (3), May-June 1985, p. 81-86. Summarized in “Telecommuting: A Selective, Annotated Bibliography” by James Joseph Sanchez, 1987, Vance Bibliographies, Monticello, IL.

Banbury-Masland, Broke and Daniel J. Brass (1985). “Careers, Marriage, and Children: Are Women Changing Their Minds”, Business Horizons, v. 28 (3), May-June 1985, p. 81-86. Summarized in “Telecommuting: A Selective, Annotated Bibliography” by James Joseph Sanchez, 1987, Vance Bibliographies, Monticello, IL.

Baran, Barbara (1985). “Office Automation and Women’s Work: The Technological Transformation of the Insurance Industry”, in “High Technology, Space, and Society”, Manuel Castells editor, 1985, Sage Publications, Beverly Hills, CA. Summarized in “Telecommuting: A Selective, Annotated Bibliography” by James Joseph Sanchez, 1987, Vance Bibliographies, Monticello, IL.

Barlow, John Perry (1995). “Is There a There in Cyberspace?”, Utne Reader, no. 68, March-April 1995, p. 53-56.

Brindle, Ray (1994). “Lies, Damned Lies and ‘Automobile Dependence’–Some Hyperbolic Reflections”, Australasian Transport Research Forum, v. 19, 1994.

Buckinger, Carol (1994). “Picking the Participants: Guidelines for Selecting a Telecommuting Team”, Institute of Transportation Studies at The University of California, Davis.

Calthorpe, Peter (1993). “The Next American Metropolis–Ecology, Community, and the American Dream”, Princeton Architectural Press, New York.

Forbes Magazine (1984). “Working by Wire”, v. 16, February 11, 1985, p. 14. Summarized in “Telecommuting: A Selective, Annotated Bibliography” by James Joseph Sanchez, 1987, Vance Bibliographies, Monticello, IL.

Garreau, Joel (1991). “Edge City–Life on the New Frontier”, Doubleday, New York.

Gurstein, Penny (1989). “The Electronic Cottage: Implications for the Meaning of the Home”, paper presented at the symposium on The Use and Meaning of Home and Neighborhood, Alvkarleby, Sweden, September, 1989.

Handy, Susan L. and Patricia Mokhtarian (1994). “Present Status and Future Directions of Telecommuting in California”, California Energy Commission.

Hartz, Nan S. (1985). “Telecommuting. There’s No Place Like Home”, Data Management, v. 23 (6), June 1985, p. 10-11. Summarized in “Telecommuting: A Selective, Annotated Bibliography” by James Joseph Sanchez, 1987, Vance Bibliographies, Monticello, IL.

Jarrett, James E. (1994). “Exploratory Analysis of Telecommuting Projects Involving Persons with Disabilities”, Center for Transportation Research, The University of Texas at Austin.

Keklikian, Arto S. (1990). “Exploring Telework as a Long-Range Planning Strategy for Canada’s National Capital Region”, Transportation Research Record #1285.

Kelly, Marcia M. (1986). “Telecommuting: The Next Computer Revolution”, Small Business Report, v. 11 (4), April 1986, p. 73. Summarized in “Telecommuting: A Selective, Annotated Bibliography” by James Joseph Sanchez, 1987, Vance Bibliographies, Monticello, IL.

Kitamura, Ryuichi, Patricia Mokhtarian, Ram M. Pendyala, Konstadinos Goulias (1991). “An Evaluation of Telecommuting as a Trip Reduction Measure”, Institute of Transportation Studies at The University of California, Davis.

Kitamura, Ryuichi, Ram M. Pendyala, Konstadinos Goulias (1990a). “Telecommuting and Travel Demand: An Impact Assessment for State of California Telecommute Pilot Project Participants”, Transportation Research Group at The University of California, Davis.

Kitamura, Ryuichi, Jack M. Niles, Patrick Conroy, and David M. Flemming (1990b). “Telecommuting as a Transportation Planning Measure: Initial Results of California Pilot Project”, Transportation Research Record #1285.

MacKenzie, James J., Roger C. Dower, and Donald D.T. Chen (1992). “The Going Rate: What it Really Costs to Drive”, World Resources Institute.

Mokhtarian, Patricia (1993). “Telecommuting: What’s the Payoff?”, Access, #2, Spring 1993.

Mokhtarian, Patricia (1991a). “An Empirical Analysis of the Transportation Impacts of Telecommuting”, Working paper #131 of The University of California Transportation Center.

Mokhtarian, Patricia (1991b). “The Transportation Impacts of Telecommuting in Two San Diego Pilot Programs”, Institute of Transportation Studies at The University of California, Davis, paper #UCD-ITS-RR-91-12.

Monod, Elsbeth (1984). “Telecommuting–A new word, but Still the Same Old Story?”, Women, Work and Computerization Proceedings. Amsterdam, Holland. Summarized in “Telecommuting: A Selective, Annotated Bibliography” by James Joseph Sanchez, 1987, Vance Bibliographies, Monticello, IL.

Nilles, Jack M., et al (1974). “Development of Policy on the Telecommunications–Transportation Tradeoff. Final Report.” Office of Interdisciplinary Program Development, University of Southern California, Los Angeles. Summarized in “Telecommuting: A Selective, Annotated Bibliography” by James Joseph Sanchez, 1987, Vance Bibliographies, Monticello, IL.

Pendyala, Ram M., Konstadinos G. Goulias, Ryuichi Kitamura (1992). “Impacts of Telecommuting on Spatial and Temporal Patterns of Household Travel”, Working paper #111 of The University of California Transportation Center.

Pressman, Norman (1987). “Technology and Future Settlement Form–A Canadian Scenario Beyond 2001”, in Proceedings of the International Symposium on Transport, Communication and Urban Form, v. 1, William Young editor, Department of Civil Engineering, Monash University, Australia.

Rheingold, Howard (1995). “The Virtual Community”, Utne Reader, no. 68, March-April 1995, p. 61-64.

Schuler, Richard E. (1992), “Urban Infrastructure for the 21st Century”, Urban Studies, v. 29 (2), p. 297-310.

Stuart, Reginald (1995), “High-Tech Redlining”, Utne Reader, no. 68, March-April 1995, p. 73.

Tacken, M. (1990). “Effects of Teleshopping on the Use of Time and Space”, Transportation Research Record #1285.

Telecommuting: Hearing Before the Sub-Committee on Telecommunications and Finance of the Committee on Energy and Commerce, House of Representatives, One Hundred Second Congress, Second Session, on H. R. 5082.

Webber, Melvin M. (1963). “Order in Diversity: Community Without Propinquity”, in Cities and Space–The Future Use of Urban Land, John Hopkins Press, Baltimore.