TRANSPORTATION AND TELECOMMUNICATIONS PHASE II

SUMMARY REPORT

May 2000

State and Local Policy Program, Humphrey Institute of Public Affairs,
The University of Minnesota
Claremont Graduate University Research Institute

The Humphrey Institute of the University of Minnesota is hospitable to a diversity of opinions and aspirations. The Institute does not itself take positions on issues of public policy.
PROJECT TEAM

State and Local Policy Program

Lee Munnich Jr., Senior Fellow and Director
Cynthia Pasing, Transportation Research Manager
Barbara Rohde, Research Fellow
Frank Douma, Research Fellow
Don Koski, Research Assistant
Hannes Loimer, Research Assistant
Marnie Werner, Research Assistant

Humphrey Institute

Milda Hedblom, Director, Telecommunications Information Society Policy Forum, and Adjunct Faculty

Claremont Graduate School

Tom Horan, Executive Director
Darrene Hackler, Research Assistant
Kimberly Wells, Research Assistant
ACKNOWLEDGMENTS

The project team wishes to thank Congressman Martin Olav Sabo for his great interest in telecommunication and transportation issues and the Minnesota Department of Transportation, whose financial support made this study possible. We wish to acknowledge the work of our advisory committee members. Their contributions to the project team proved invaluable.

Finally, we wish to thank all of the individuals who participated in the project and the Minnesota officials, planners and community organizers for their continued efforts to recognize the increased impact that telecommunications will have on transportation.

The State and Local Policy Program Project Team
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EXECUTIVE SUMMARY

This report represents the findings of several investigations in the realm of telecommunications that constitute the second phase of an ongoing research project. Increased and widespread interest in telecommunications and information services policy is a new wrinkle in the policy landscape. State agencies and individual actors now understand that the quality and character of their services depends more and more on telecommunications and information technology options and investment.

This study conducted an analysis on three different levels. In working with a real community, a planning process for IT implementation and its stakeholders and problems could be identified. In surveying the attitudes, behavior and characteristics of teleworkers, this study was able to profile and compare future work alternatives based on information technologies to the status quo and thus outline possible policy changes and opportunities. Finally, in relating technological infrastructure to economic growth this report tried to address the question as to what degree information infrastructure can be or has been an economic advantage for second-tier cities.

Not all of the conclusions in this report are final. Some findings seem to be more certain than others, and some common knowledge assumptions seem to be supported by our analysis, while others could not be relied upon with sufficient confidence. However, the findings from this research all agree upon the magnitude and the rapidity of change brought to us through this technological and economic leap forward facilitated by information and communication technologies. This is also reflected by the broad interest in such topics from all sides of the spectrum as could be shown in the summary of events and activities. Whether such a trend can be translated into transportation, economic and social opportunities for a region remains to be seen and depends, as we have pointed out, on the presence of supportive policies and partnerships as well as the focus of analysis.

Unlike the transportation infrastructure, which is controlled by the public sector, telecommunications infrastructure is unfolding and being driven by private markets - high speed lines to businesses and telecommuters choosing or encouraged to stay at home. This means that there is not a single proactive agency that controls or plans for these businesses and consumer behavior. In reality there is a need for a cross agency approach to understanding and facilitating the direction of impact. For MnDOT this means working with appropriate agencies and businesses to plan telecommunications and telework programs which will reduce travel, to enhance local-outstate-community value from new infrastructure (Connecting Minnesota) and locate with IT companies to locate in areas that are consistent with desired land use plans.

Therefore, it seems essential that stakeholders, such as private developers, citizens, local jurisdictions and public agencies are aware of the complex of issues and opportunities as hand as networked telecommunications has more impact than other present trends on transportation, the economy, society and potentially the environment combined. In light of these present trends, telecommunications as a mode of accessing goods and services and as a mode of travel holds promise as the one most likely to be embraced by the public and most flexibly meet their way-of-life needs.
Recommendations

These recommendations emerged from the second phase of an ongoing research project. Overarching recommendations and findings are outlined below:

1. Planning for information infrastructure support and technology use in transportation and economic development should be at least as comprehensive as traditional transportation planning and economic development analysis. This requires a coordinated approach among state agencies, especially, economic development, transportation and information technology.

2. Mn/DOT needs to enter working partnerships with other agencies, accepting that information infrastructure and information technology use will entail a variety of issues beyond transportation.

3. Mn/DOT should continue to promote telecommunications use and telecommuting as one of several approaches to successful transportation planning and management.

4. As employers, all state agencies, including Mn/DOT, need to be more aggressive in promoting uses of information technology, offering flexible work schemes, telework and multiple travel options.

5. Mn/DOT should seek innovative ways to support the opportunities and benefits of decentralized office work arrangements.

6. Mn/DOT should promote the telecommuting agenda through workplace support of employee demands for flexibility in telecommuting and furthering the positive attitudes toward new work behavior and new management relations between employers and employees.

7. Mn/DOT should continue exploration of demonstration projects to show the technical and institutional feasibility as well as the highest possible benefits from successful use of interconnected advanced telecommunications and information infrastructure as a tool for communities.

8. Mn/DOT should work with other state agencies and supportive business and non-profit groups to propose appropriate tax benefits for those who are telecommuters/home office workers.

9. State agencies, especially Mn/DOT, the Department of Administration and the Department of Economic Development should pursue partnerships with telecommunications providers serving specific areas to assist the expansion of telecommunications as a mode of transportation.

10. Mn/DOT should cooperate with other state agencies and innovative private and non-profit partners to suggest policies which encourage building or retrofitting housing for telecommuting and home office use as well as providing benefits to home buyers whose work relies on telecommunications as a viable transportation alternative.

11. Mn/DOT, the Department of Administration and other state agencies should assist rural Minnesota communities to take advantage of existing and upcoming networks such as the "Connecting Minnesota" project.

INTRODUCTION

Transportation infrastructure has played a key role in attracting economic growth to Minnesota while retaining other important qualities of life amenities. Recognizing this, the Minnesota Department of Transportation, Mn/DOT, has pursued strategies to enhance the role of various transportation modes in meeting the economic and community goals of the state. Recently, Mn/DOT has endorsed telecommunications as a mode; this recognition has multiple implications. It necessitates a better understanding of the telecommunications infrastructure and how it relates to the goals and policies of the transportation infrastructure. It also necessitates a better understanding of the telecommunication impact on business and residents as these impacts come to affect travel demand, including telecommunications induced trip substitution and trip generation.

Telecommunications infrastructure development is a heavily debated question at all levels of policy. The Minnesota Department of Transportation along with others such as the Department of Administration, the Department of Economic Development, and the Department of Children, Families and Learning have an important stake in the development and implementation of infrastructure services in a way that brings benefits to all Minnesotans. The interest of the Minnesota Department of Transportation & other state agencies in telecommunications and information infrastructure development comes at the same time as interest has burgeoned in all other sectors as well, including business embracing the Web for electronic presence and for the conduct of electronic commerce, the significant migration of intermediary service industries to the Internet, and the continuing surge in individual use of the Internet. It is inevitable that the new centrality of telecommunications and information would lead to more scrutiny of the public policies and industry developments shaping them.

Significant service gaps and pricing issues also exist, including residential service gaps, even with the advent of DSL and cable modem service. There are geographic service gaps between rural and urban areas especially for advanced services. This proliferation of options and service combined with service gaps additionally complicates the job of motivated agencies such as Mn/DOT when it sets out to deepen its understanding of the connections between transportation needs, telecommunications infrastructure development and information services provision.

In September 1997 Mn/DOT sponsored an initial scoping study as a first phase to developing a set of research questions on the telecommunications/transportation relationship. This project implements the research recommendations developed through the initial scoping effort. The preliminary study contained several tasks including investigation of information infrastructure capacity issues, analysis of possible incentives to encourage electronic commerce (e-commerce), review of potential tax and regulatory barriers, analysis of factors surrounding telework, and identification of transportation system impacts of telecommunications developments. Since work on this project began and individual scopes of all project tasks have been outlined in a more detailed fashion, specific cases were expanded from what originally was proposed in the agreement scope of work. The research elements outlined were developed as a consequence of these research scoping activities, and reflect the input of an advisory panel.
composed of representatives from MnDOT, Met Council, Office of Technology, the Office of Administration and the private sector. The objectives of this study are to:

1. Empirically assess the impact of telecommunications vis-à-vis transportation infrastructure in attracting and retaining (high-technology) business, with special attention to the spatial (land-use) implications

2. Evaluate the feasibility of a local demonstration of an electronically-enriched (e-enriched) community as a means to better understand both the community and policy implications of this new infrastructure

3. Devise an empirically-based methodology for ascertaining community electronic travel (e.g., telework) readiness and progress, including scenarios of transportation impacts.

Parallel to this summary report, individual task reports (Comparative Assessment of Telecommunications, Finger hut Telecommuting Report, Hennepin County Telecommuting Report) are available, which contain a higher level of detail and cartographic information about spatial distribution, travel behavior, infrastructure provision, and show more of the outcomes presented in this study.

1. A COMPARATIVE ASSESSMENT OF THE ROLE OF TELECOMMUNICATIONS IN REGIONAL ECONOMIC DEVELOPMENT

BACKGROUND

The impact of physical infrastructures such as transportation on the economic vitality of regions has been assessed by many studies. What is not known is the role that the new “invisible” infrastructure plays in promoting economic development. A related unknown is how this infrastructure and co-associated development relates to other regional elements such as transportation and land use plans. This article begins to explore these linkages through a comparative assessment of four second-tier cities, Minneapolis-St. Paul, Minnesota, Phoenix, Arizona, Austin, Texas, and Tampa, Florida in both high tech industrial location and telecommunications infrastructure. It will try to assess the impact of telecommunications vis-à-vis transportation infrastructure in attracting and retaining high-technology business, with special attention to the spatial and land-use implications.

Across these areas, the analysis found that while telecommunication infrastructure varied, industrial location of high tech firms was not directly affected. However, there were spatial differences in their availability. Moreover, key stakeholders interviewed suggested that the provision of telecommunications infrastructure was a “necessary but not sufficient condition” to encourage economic development of “wired cities”—indeed, the entire package of telecom, educational systems, transport, and cultural amenities were all important in attracting and retaining high-tech/high wage businesses and employees. In terms of policy linkages, the connection between telecommunications and other sectoral plans is mostly unexplored but could have powerful impacts. For example, the spatial location of high tech firms could affect both land use and transportation demand, but little is known about developing an integrated policy. Several policy recommendations are made for achieving closer linkages between economic development and land use plans. 1

FOCUS OF STUDY

The focus of the study was to explore the spatial movement of Information Technology (IT) businesses and the potential role that IT plays in affecting this spatial movement. With the high technology industry being the fastest growing segment of the economy, it is important to understand where these businesses are located—both across and within metropolitan areas. A related interest is how the provision, or lack thereof, of telecommunication infrastructure, is affecting this location. Is the telecommunication infrastructure affecting how and where businesses locate in a manner similar to the effect that the transportation infrastructure has had?

The four second-tier cities were selected for this comparative analysis on the basis of their reputation as high tech industry cities. The comparative analysis will explore each area’s

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advantages as well as disadvantages in IT industry and telecommunications infrastructure. This study does not statistically determine why IT industry is present in an area and what role economic development and telecommunications infrastructure played in that process. The study does, however, provide a detailed assessment of IT industrial location and telecommunications infrastructure in the region and cities analyzed in order to explore possible trends and relationships. For a detailed county comparison of the Twin cities metropolitan area please refer to the more detailed individual report of the ‘Comparative Assessment of the Role of Telecommunications in Regional Economic Development’.

HIGH TECH, SECOND-TIER CITIES

The following provides some background on the four second-tier cities and demonstrates their high-tech reputation. A recent study by the American Electronics Association (AEA) and Business Facilities ranked states on the growth of high tech industry and its importance to each state’s economy. Each one of the four cities’ states was in the top fifteen with Texas and Florida coming in first and second, respectively. Minnesota’s rank was eleventh while Arizona finished fourteenth. 1

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<th>Rank</th>
<th>1990-97 Growth</th>
<th>Rank</th>
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<td>6</td>
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<td>7.7%</td>
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* MSA refers to the metropolitan statistical areas established by U.S. Census Bureau. While the Minneapolis-St. Paul MSA includes 13 counties, this study focuses on the seven counties included in the Twin Cities Metropolitan Council region.

Source: U.S. Census Bureau

Table 1: Characteristics of Second Tier Cities

- **Austin** is home to a cluster of industries that support the high tech sectors such as tool, die and machinery, office supplies, and specialized components. In addition, the University of Texas Austin’s presence provides the area with superior educational, research and development, and training opportunities.

- **Florida** is known for its aerospace industry on the eastern coast and telecommunications on the western coast around the Tampa Bay area. This area is the tenth largest consumer and the fourteenth largest media market while also being the home of the 1-4 High Tech Corridor.

- The 1970s and 1980s saw the **Twin Cities** and the state of Minnesota as a high tech hardware sector haven. After structural changes in the economy Minnesota’s high tech industry suffered but a new surge of employment in software and services has brought both the Twin Cities and Minnesota back on the high tech map such that it appeared consistently in all of the AEA’s category rankings.

- Arizona has been a high tech state for sometime with Phoenix and surrounding Maricopa county accounting for the majority of the state’s high tech industry. The educational foundation is also a factor in Phoenix, with Arizona State University minutes away in Tempe.

SIC CODES AND IT INDUSTRY

The study utilizes a list of Standard Industrial Classification (SIC) codes that were identified as related to IT industry by several methods. A report by the State and Local Policy Program at the Hubert H. Humphrey Institute of the University of Minnesota, entitled “Industry Clusters. An Economic Development Strategy for Minnesota,” identifies 11 clusters for the state of Minnesota. In addition, several other reports were sought to refine a complete IT industry list of SIC codes that were applicable beyond the State of Minnesota. For example, the Department of Commerce’s “The Emerging Digital Economy” report listed the SIC codes that the Information Technology Institute and American Electronics Association (AEA) as well as the new North American Industrial Classification System (NAICS) consider to be the IT industry. 2 The IT industry was further refined into five sectors so that the analysis was more varied than a general analysis of the IT industry. The list of IT industry SIC codes were divided into the following sectors: Hardware, Software, Services, Networking, and Telecom services.

IT Trends 1992 to 1995

To give each city’s IT industry some point of comparison the national economy’s IT industry growth as well as its individual sectors of hardware, software, services, network services, and telecom services were analyzed. Overall, the IT industry grew in the three year period between 1992 and 1995. Employment increased 10.27% while establishments grew 24.78%. Each of the five sectors also grew with telecom services and hardware growing the least in both employment and establishments. The following associates the sectoral growth percentages with each sector’s share of the US IT industry.

The hardware sector posted the second lowest growth results while its share of the IT industry decreased from 1992 to 1995 in both employment and establishments. Both findings, to some degree, support the popular contention that hardware is not as important to the IT industry as before the Internet age. As expected, services and software sectors posted the highest and second highest growth of all sectors in employment and establishment. 3 The service sector, followed by software, also increased their share of the IT industry. While the networking sector was composed of only one SIC code in this study, it still experienced growth in the time period. The sector also increased its share, but its small numbers has limited influence in the IT industry. The final sector, telecom services, performed the worst in terms of growth and had a decreasing share of the IT industry’s employment and establishments.

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3 Given that some SIC codes are double counted in different sectors, sector share percentages to not add up to 100%. For example, 1992 employment in each sector adds up to 104.49% because SIC 5045, 7371, and 3732 fall in a total of three separate sectors.
Leading Counties in IT Industry

Each county's IT industry and sectors were analyzed as a percentage of the United States totals. Five of the total twenty-one counties analyzed continually ranked highest in all sectors. These were Hennepin County in Minnesota, Travis County in Texas, Maricopa County in Arizona, and Hillsborough and Pinellas counties in Florida. For the employment percentages of the US IT industry overall, Maricopa had the largest share of US employment for 1992 and 1995 followed by Travis, Hennepin, Hillsborough, and Pinellas. For establishments, Maricopa led in 1992 followed by Hennepin, Travis, Hillsborough, and Pinellas while in 1995, Hennepin reversed positions with Maricopa. Maricopa dominates in three of the four years for IT industry.

As the following tables show, five counties that accounted for the largest percentages of US employment or establishments for 1992 and 1995 were also central counties. Ramsey County is the one other county that is considered central since St. Paul the other half of the Twin Cities is within its boundaries. Ramsey was the sixth ranked county in nineteen of the twenty-four possible categories (IT industry and sector employment and establishments for 1992 and 1995). Thus, central counties fared the best in this analysis. However, some differences within this group of counties is warranted. Maricopa was the first ranked county in at least three categories in the industry overall, hardware, and telecommunication services. Hennepin was the same for software, services, and networking sectors. Both counties exhibit strength in certain areas, but their strength in entirety is notable since in only eight of the twenty-four categories did Maricopa or Hennepin fall out of the top two ranked counties for employment and establishments. Thus, Hennepin County and the Twin Cities should be considered as IT industry-intensive as the other second-tier cities in this study. In addition, policy lessons from economic development to land use and infrastructure can be learned from such a comparison when the industrial location information is combined with the telecommunications infrastructure analysis below.

The analysis of IT trends from 1992 to 1995 reveals interesting results for both employment and establishment trends. Historically, employment has been the most studied unit of analysis in industrial location given the effect that employment growth can have on a local economy. However, employment data suffers from frequent data suppression in geographical areas that have too few firms in any SIC code. The Census suppresses employment data for confidentiality reasons so that the employment and payroll information cannot be directly traced back to one or two firms in an area (see detailed report for further information). Given that regions and metropolitan areas are of primary interest to the study, the level of analysis is the county. Trends in the IT industry were analyzed at the county level so that an accurate map of IT industrial location could be drawn. Growth in each county's IT industry as well as the individual sectors of hardware, software, services, networking, and telecom services is the most notable trend in our analysis. To enhance the growth statistics, each county's IT industry and sectors are analyzed as a percentage of the United States totals. Finally, each sector's share of a county's total IT industry is explored to determine its relative importance to the county's IT industry. Both employment and establishment data was used for the analysis. To facilitate the inter-metropolitan comparison between counties in each second-tier city, GIS maps were created to depict the growth in employment and establishments for the IT industry and sectors from 1992 to 1995.
### Hennepin County, MN (Minneapolis)

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### Ramsey County, MN (Saint Paul)

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### Williamson County, TX (Georgetown - Austin region)

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IT INDUSTRY IN MINNESOTA REGIONS AND SECOND-TIER CITIES

Minneapolis - Saint Paul

Software was found to be the second most consistent high tech performer in the Twin Cities next to services. As of 1995, software accounted for a third or more of either IT employment and establishments in all seven counties. Noting the hardware sector’s decline in the Twin Cities, growth in IT services may be seen as the Twin Cities’ IT industry of revival since it was the most consistent high tech performer. All counties had positive establishment growth, and Scott and Ramsey claimed the first and third highest employment growth of all twenty-one counties in the study, respectively. Overall, the services sector contributed greatly to each county’s IT industry. In both IT employment and establishments, services increased its share over the period accounting for over 40% of both in all counties.

The analysis of IT location support other findings that the hardware sector is declining while services and software were found to be increasingly important to the IT industry in the Twin Cities metro area. Hennepin’s leadership in services and software in the national percentages are reinforced with those sectors strong growth and shares versus the surrounding counties. However, hardware, while on the decline in some counties, still accounted for moderate shares of the IT industry in those counties.

Telecommunications infrastructure in the Twin Cities metro area was found to be less pervasive than in Phoenix and Tampa. MediaOne’s cable modem service started in late 1998 and only covers the eastern and northern parts of the Twin Cities. Another Cable Company, Time Warner, has plans to serve Hennepin County (western) but has yet to roll out any services even for trial. Thus, in comparing the four second-tier cities, Austin and the Twin Cities have the lowest cable modem coverage. As for ISDN, all four major telephone companies offered ISDN, generating coverage of all but the far southwestern suburbs of the metropolitan area. For xDSL, West was the only telecom providing the service to the Twin Cities.

Intrametropolitan Industrial Location in Twin Cities

Given that the Twin Cities is the only second-tier city in this study with more than two counties, the Twin Cities case presents an excellent opportunity to further understand the spatial location of IT industry sectors at an intra-metropolitan level. In general, IT growth, to some extent, differed for employment and establishments. Metro counties to the south (Dakota and Scott) and east (Washington) along with Ramsey were strong in IT employment. Washington also led IT establishments growth but was followed by Anoka and Scott, which are counties around the metro downtown to east, north, and south. By sector, the intra-metropolitan location patterns of IT industry became more interesting. In the hardware sector, the two central counties of Ramsey and Hennepin had the highest employment growth, as did Dakota in the southeast. In terms of IT establishments growth, Washington to the east and Scott in the south had the highest results followed by Hennepin, Ramsey, and Dakota. New, smaller firm growth in hardware seemed to be occurring in the outer counties of Washington, Scott, and Dakota, and the central counties were experiencing both employment and establishment growth.

These intra-metropolitan results suggested several trends. First, the Twin Cities as a whole competed favorably with Austin and outperformed Phoenix and Tampa for this period in most sectors. Second, growth occurred outside of the central counties of Hennepin and Ramsey in all sectors but hardware. Third, the eastern portion (less Hennepin and Carver) of the Twin Cities seemed to have stronger IT sector growth such that Ramsey is having greater success in attracting IT industry than Hennepin. Three counties in particular contributed heavily to this trend. Anoka’s overall growth in software and networking as well as its service establishments growth accounted for its strong IT establishments showing. Scott’s growth in services and hardware establishments were also indicative of the county’s IT growth. Finally, Washington had strong establishment growth in all sectors verifying its strong IT industry growth. The strong showing of these three counties and even Dakota in hardware, software, and services show that the expansion of the IT industry is occurring outside of the central downtown area of Minneapolis and St. Paul. In addition, the impressive establishment gains in Anoka, Scott, and Washington were not met with similar employment figures. Most likely, IT growth in these counties increased the number of firms relative to its base but were small employers of labor. However, such growth will indeed be beneficial since any start-up activity often generates further growth. The outer counties of the Twin Cities may be another source of IT revival for the economy as a whole.

Phoenix, Arizona

Phoenix is located in the heart of Maricopa County. Given Maricopa’s sheer geographical size, most of the high tech industry located in Arizona is located in Maricopa County. While IT growth in employment and establishments did not rank high among all twenty-one counties, Maricopa continued its consistent performance across all sectors. In comparison with all other counties, notable sector employment growth was found in hardware, networking, and telecom services, while IT establishments growth was strong in networking and telecom services.

The composition of Maricopa’s IT industry is also interesting. The hardware sector accounts for a large portion of IT employment and establishments in Phoenix. However, the sector’s share had decreased but not as great as that found in the Twin Cities (below). Telecom services employment also contributes greatly to the IT industry. As for establishments, telecom services are the most dominate sectors in Maricopa’s IT industry. These two sectors also had increases in their share of employment and seem to be becoming stronger sectors in Maricopa. The location analysis indicates Maricopa’s strength in hardware as well as services, software, and telecom services.

In terms of telecommunications infrastructure, Phoenix seem to have abundant availability of the three high-speed data services analyzed. Cox Communications has provided cable modern service since May 1997 to both residential and business users. As for ISDN and xDSL, US West has offered both in the Phoenix Valley. The suitable presence of telecom services in Phoenix has most likely increased the likelihood of high-speed data services from telecom companies in the area.

Austin, Texas

Often lauded by pundits as the up-and-coming high tech city Austin is home of large computer manufacturers and other high tech industry. The Greater Austin area encompasses the counties of Travis and Williamson. The city of Austin is in Travis while a suburb city of Round
Rock (home of Dell) is in Williamson. IT employment and establishment growth was present in both Travis and Williamson counties, but Williamson out-performed Travis on both.

Travis County had strong growth in employment in the sectors of hardware, software, networking, and telecom services. Establishment growth in comparison was notable in only telecom services. As far as the sectors that contribute the most to IT industry in Travis, IT employment was captured predominantly by hardware at 74% with services and software accounting for only 12% each. However, in share of IT establishments, services and software accounted for approximately half to all IT establishments, and hardware was only a quarter of IT establishments. Thus, individual hardware firms in Travis most likely employ large amounts of labor.

Williamson County has a strong presence of hardware, software, and services. Sector employment growth in each ranked first or second when compared to all other counties. Only services and networking establishment growth was notable. Of these three strong sectors, only services increased its share of the county’s employment and establishments from 1992 to 1995. The sector share of hardware also indicated that hardware establishments were large employers.

These two counties indeed represented a high tech region. Their growth in hardware employment and establishments was quite different from the Twin Cities situation. In addition, these establishments were most likely large employers. Austin has seen the services sector increase its contribution to the IT industry in the area. Austin also has an increasing presence of networking firms. While not accounting for a large portion of the IT industry, the sector’s presence has been supported by Austin’s large hardware industry.

Telecommunications infrastructure in Austin was not as robust as Phoenix’s. Cable service in has been introduced to only the residential market by Time-Warner. In comparison to the other cities, Austin has lowest cable modem provision. This finding was of interest given that Time Warner holds the franchise in Austin as well as Tampa, yet Tampa has had cable modems for some time. As for the other high-speed data services, ISDN was readily available through Southwestern Bell at all central offices. But, Austin lacked complete coverage of xDSL since Southwestern Bell has made ADSL available as a commercial offering to customers located only in downtown, north, and west of Austin at only four of seventeen contiguous central offices. For a high tech region, the benchmarked telecommunications infrastructure in this study was not as abundant as in Phoenix.

**Tampa, Florida**

Tampa, located in Hillsborough County, has been successful in attracting high tech industry through Tampa Bay regional efforts such as the I-4 high tech corridor. Thus, Pinellas County, part of the Tampa Bay area, was also included in the analysis. Unlike the Austin counties, Hillsborough and Pinellas performed somewhat closely to one another with fewer extremes. Both counties had solid IT employment and establishments growth.

Hillsborough and Pinellas saw declines in two sectors’ employment. Both lost networking while Hillsborough lost software and Pinellas services. IT employment in Hillsborough was greatest in services and telecom services—ranked first among all counties and is home to GTE. For Pinellas, IT employment was notable in hardware and software. Neither county had greater than average growth in IT establishments. As for how each sector contributed to the IT industry in each county, Hillsborough’s IT employment were dominated by services and telecom services while its establishments were mainly services and software. The sectors contributing the most to IT employment in Pinellas were hardware, software, and telecom services. In IT establishments, the service, software, and hardware sectors were strongest.

These two counties represent the most diverse base of IT industry so far. While services and software are found to be contributing to both counties, Pinellas’ strength in hardware and Hillsborough’s strength in telecom services seems to indicate that IT industry agglomeration as a whole and not just for sectors may be occurring in Tampa Bay. Tampa Bay’s wholehearted approach may concentrate on particular type of IT firms, but the foundations that exist in the area are attractive to a range of IT firms.

In terms of telecommunications infrastructure, cable service in Tampa was prevalent with Time-Warner’s Road Runner Internet interface providing cable modem service to approximately ten percent of current cable customers in the Tampa Bay area. With the presence of GTE in Tampa, both ISDN and xDSL service were available to residential and business customers in Tampa Bay. As in Phoenix, the presence of a large telecom company has led to abundant telecom high-speed data services. Phoenix’s and Tampa’s xDSL coverage is superior to that found in Austin and the Twin Cities.

**Conclusion to IT Industry Analysis**

How each region or city fared in IT and the IT sectors is of the most relevance to the study. The Twin City’s strength seemed to be in services, Austin fared well in software, services, and hardware although each sector had differing levels of importance to each region. Phoenix had supremacy in hardware joined by software and services while nixing telecom services as an important contributor. The final mix was that found in Tampa Bay with strength in hardware, services, and telecom services. The shares of these leading sectors in each of these regions were not equivalent but demonstrated the specialty that each region has developed.

**Implication of findings**

Even though the individual cities showed quite different patterns in IT industry diversification within the above-mentioned clusters, most counties experienced significant growth in the last years. Some counties showed extraordinary growth in establishments and jobs whereas other counties were also declining in certain sectors (i.e. Hardware). The overall picture for the IT industry, though, turned out to be a positive one. Consequently it has to be assessed to which degree the community and its economic development units can enhance and steer these developments with the provision of electronic infrastructure. In fact, it is shown in the following chapters that communities must go well beyond the simple provision of IT infrastructure if they want to be successful in attracting future industries in a growth sector.

**Telecommunications Infrastructure Analysis**

The spatial impact of IT industry is compared with the telecom infrastructure of the area it is located in. While the relationship between telecommunications infrastructure and IT locational pattern of firms may not be causal, the existence of both is important to economic development of a region. Three types of high-speed data services served as benchmarks of telecommunications
infrastructure: ISDN and xDSL, available through the local telephone provider, and cable modern service, available through the local cable company.

**HIGH SPEED DATA SERVICES**

**HIGH SPEED DATA PROVISION SUMMARY**

Of the three services, cable modem seems to be the most aggressive in all studied areas. It is available now in MediaOne’s areas, in the eastern and northern parts of the Twin Cities, while Time Warner promises to have it soon in Hennepin County. Bresnan (which now has TCI’s former territory) has just started up cable modem service in the other population centers of the state, namely Duluth, Rochester, St. Cloud, Mankato and Marshall. Presently, of the other three cities, Austin has lowest cable modem provision. Time Warner holds the franchise in Austin as well as Tampa, yet Tampa has had cable modems for some time. In comparing the four second tier cities Austin and the Twin Cities have the lowest coverage.

Within the State of Minnesota, ISDN appears to be widely available in the population concentrations of Minnesota, namely the Twin Cities, St. Cloud, Duluth and Rochester, which are largely US West territory. US West’s ISDN is also spotted around the state in areas to the southeast of the Twin Cities, possibly because of their proximity to the Twin Cities and Rochester, and down the I-35 corridor to the south. ISDN’s availability also extends out to the west of the Twin Cities into frontier, Sprint and GTE territory. The other three second-tier cities have complete ISDN coverage.

xDSL is still fairly new and expanding technology. In Minnesota, even in exchanges where xDSL is available, it is not available to every home because of physical restrictions on the distance from stations. xDSL is concentrated in the Twin Cities with only US West offering it at the present. Sprint is also considering xDSL, and there are likely other small independent telecommunications companies that are considering it, including at least one that is choosing to skip over the ISDN stage and go straight to xDSL for the faster speed. Austin lacks complete coverage of xDSL while both Phoenix and Tampa are well covered.

As for telecommunications infrastructure, at least one high-speed data service appears to be within reach of those who want it. Cable modem service appears to offer the highest speeds at consistently lower prices, and it also appears to be the fastest growing service in each city. ISDN is available in all four cities. xDSL, on the other hand, is still quite limited. Overall, Phoenix and Tampa offer the complete range of these high-speed data services, while both Austin and the Twin Cities lack complete cable modem coverage, and Austin has only limited availability of xDSL.

Generally the study shows that the most sophisticated infrastructure at competitive market prices can be found in the dense, metropolitan areas of the selected cities. It reflects the “cherry picking” approach of the private enterprises that supply the telecommunication infrastructure. This raises the question of equity. It leaves enterprises or private users, who are not located within the prime service areas—as they already made their location choice before it infrastructure provision changes—in a situation of disadvantage. It has been stated in numerous studies however, that the telecommunication market is not a market of equity. Communities can attempt to balance these developments within their investment and policy frameworks. The success of these attempts is naturally limited, due to financial and political constraints of municipalities and will be more successful in industry sectors that cannot be directly connected to telecommunication infrastructure.

**INDUSTRY AND TELECOMMUNICATIONS INFRASTRUCTURE**

To supplement the high-speed data service analysis, other indicators of telecommunications infrastructure were investigated. Studies proclaiming the “most wired,” “best Internet access,” and the “fastest web connectivity” are quickly finding their places among the headlines of many magazines and newspapers. In examining whether each of these four cities appeared in such studies, it was found that Phoenix and Tampa seem to be lagging and Minneapolis and Austin were at the top of the four second-tier cities in terms of connectivity and other Internet statistics.

Another interesting rating of cities was conducted by PC World in which three hundred cities were rated on various qualities and amenities, such as a city’s friendliness toward telecommuting. The Tampa Bay area ranked the highest at number seven, followed by Phoenix at nineteen, Austin at thirty-six, and the Twin Cities at thirty-eight. In summary, Tampa and Phoenix rank higher in the telecommuting survey but lower in Internet connectivity. This trend holds interesting implications for whether an area’s inclination toward telecommuting is predicated on a higher measure of Internet performance and other possible infrastructure enhancements. Such a finding seems to be opposite what is conjectured.

Integrating the inter-metropolitan spatial analysis of industry and infrastructure, some results are worthy of further explanation. While Austin and Twin Cities rank high in Internet statistics, they do not have the best provision of high-speed services, lacking cable in both and xDSL in Austin. Yet, the presence of ISDN in these two cities gave them top fifty results in the telecommuting rankings. Given that the analysis of telecommunications infrastructure showed Tampa and Phoenix as having complete coverage in all three high-speed data services, high telecommuting rankings should have been somewhat expected. In addition, these two cities were the only ones in which the telecom services sector had a positive, somewhat larger impact on their economies. The investment of GTE in Tampa and US West in Phoenix has been quite supportive of telecommunications infrastructure. As a leading sector in the IT industry of both cities, telecommuting seems to be a benefit of such investment.
IMPLICATIONS AND RECOMMENDATIONS

"Telecom Necessary but not sufficient"

Each second-tier city in this study was found to be an agglomeration of specific IT sectors. The tie of individual sectors to telecommunications infrastructure was not found to be prevalent. Only in the case of the telecom services sector were the growth and share of the sector indirectly linked to full coverage of the benchmarked telecommunications infrastructure, as in Phoenix and Tampa. Even in the intra-metropolitan analysis of the Twin Cities where telecommunications infrastructure varied, the predominant trend seemed more associated with a county’s geographical placement than the existence of telecommunications infrastructure. Such findings seem to indicate that while the telecommunications infrastructure is important, the type of high-speed data service benchmarked is not the most important location factor.

Consequently, the existence of the telecommunications infrastructure may not necessarily mean that IT industry and economic development will follow. In fact, the benchmarking of actual telecommunications infrastructure may not be a main indicator of IT industrial location. As Don Upton, the Director of Public Affairs and Economic Development for GTE in Tampa stated, "benchmarking is easier than you think since ‘where the fiber is’ is not the main concern of industry; instead ‘how to excess the pipeline’ is the information that should be used to attract and grow business.” The presence of telecommunications infrastructure is useless if the locating firm does not have access to it. To make this link, coordinated planning of telecom companies and economic development officials would assist communities in understanding how this variegated amenity can be used to a community’s benefit.

Package of Infrastructure Needed for Economic Development

A transportation network contributes to productivity by providing the capacity for people and goods to move at a competitive cost. The transportation network links people with jobs, goods and services, entertainment, and cultural activities and businesses with suppliers and customers. Similarly, the telecommunications network can contribute to productivity by allowing personal and business activities to occur at competitive costs. In this sense, telecommunications is both a substitute for and complement to the transportation network. A robust telecommunications network with ubiquitous bandwidth capacity at competitive cost is likely to be a necessary requirement for the development of an IT industry within a community. Planning and investment in telecommunications infrastructure will require a similar level of planning as for transportation infrastructure.

Because telecommunications has been viewed as largely a private sector activity, telecommunications infrastructure has not been given the same attention within government, as has transportation infrastructure. In the future, transportation planning, economic development, and community development activities will need to account for and incorporate telecommunications planning as a necessary component. The study’s findings make such coordinated planning even more necessary with the amount of growth occurring in outer counties and cities where planning systems may not be adequate to handle such growth. Likewise, central cities and inner-ring suburbs need to incorporate telecommunications planning into their community and economic development efforts if they hope to remain competitive in the emerging IT industry and to reduce urban sprawl.

Coordinated Telecommunications Planning

Through integrating telecommunications infrastructure planning into the overall economic development package (education, transportation, fiscal incentives, etc.), communities will be able to attract a fuller range of locating industry. Communities and economic development officials should understand how most industry judges a community’s telecommunications capabilities and plan accordingly in future infrastructure plans, focusing on availability, accessibility, reliability, quality, and cost of such infrastructure. Creation of a public-private partnership between the city and the local telecommunications companies would allow fuller understanding of the process and role of telecommunications.

For this to occur, an open line of communication must exist between a city’s economic development department and the telecommunications company serving the area. Enlisting the telecommunications companies support of economic development leaders at all levels will lead to a coordinated planning effort. This will enable the policies to attract new high tech industry to be comprehensive and based on up-to-date information. A city’s desire to deploy an advanced telecommunications infrastructure to attract industry may be more successful if the local telecommunications company is aware of the desired infrastructure and can request allocations from the parent company to make the upgrade possible.

Future Research

Also revealing in this analysis is that while some cities have IT strengths, all of the second-tier cities were endowed with some IT industry that did not vary directly with telecommunications infrastructure. This relationship may be better captured at a finer detail of industry and telecommunications infrastructure. If the intra-metropolitan decisions of IT industry are immensely affected by the presence of telecommunications infrastructure (necessary but not sufficient), how do the intra-metropolitan patterns diverge or mimic these findings under more developed criteria for benchmarking telecommunications infrastructure?

Surveyed IT industry, with the possible exception of Hardware, locates primarily in metropolitan areas, including if not especially, the suburban areas. This means that, if with increasing ubiquity of telecommunications infrastructure it matters less where you locate on a macro scale (Austin, Phoenix or Twin Cities etc.) but more where within a given metropolitan a firm locates, then it will be important to assess on a more detailed level and with a higher resolution how the level of IT infrastructure supports this fluidity of movement among industries within a city. A step towards a more detailed assessment of IT location will be its study within a given metropolitan area. Also developing a better understanding of the role of amenities and regional investments in corporate location decisions would give greater insight into the awareness of corporate executives on how the location of high tech industry has cross cutting impacts on both economic development and regional quality.
REFERENCES


II. REPORT ON ELECTRONICALLY ENRICHED COMMUNITY DEMONSTRATION PROJECTS

INTRODUCTION

It is now clear that we are collectively experiencing a fundamental change affecting almost all environments and transactions including work, learning and leisure. Without risking hyperbole, it is right to call this an information age revolution related to telecommunications, information technology, electronic networks and information services. This change began several decades ago and left its imprint first in business and education, but was understood rather narrowly as a management or administrative tool.

In the early 1990's several events converged which irrevocably launched the information age revolution including the widespread acceptance of the Internet Protocol for communications across public and private networks, the creation of the World Wide Web system for organizing access to the resources and capabilities of the Internet, and the dissemination of Windows/mouse user tools. In essence, the common language of the Internet Protocol married to Web information access system suddenly altered and multiplied the reasons for investment in computers and networks. Furthermore the introduction of windows/mouse user tools made computers and networks vastly more accessible beyond the small circle of digital serbiles who had been controlling the keys to the electronic kingdom. These factors, inter alia, laid the basis for the explosion of demand for access and bandwidth capacity which are defining features of the information age society as we approach the turn of the century.

Contemporary potential of the information age bears little relation to even the recent past. Creative invention abounds and in every sector the search is on to identify how best to realize the potential benefits of the information age environment. The transportation sector is engaged in that quest and the Minnesota Department of Transportation has been at the forefront of state agencies with its attempts to understand the links between information and communications technologies and transportation. An oft-cited but still powerful analogy likens the development of contemporary telecommunications infrastructure to the build-out of the surface transportation infrastructure earlier in this century. It was correctly observed in the Telecommunications Project Interim Report that the information age changes “can be seen as representing (1) a social/economic trend that will affect the nature and distribution of travel, (2) a new mode of transport for delivering and accessing goods and services, and (3) a new infrastructure that includes not only transportation activities, but a plethora of other public-and private-sector activities as well.”

DEVELOPMENT OF A DEMONSTRATION PROJECT

The concept of a demonstration project evolved from several recurrent themes in transportation, design and telecommunications policy domains. Transportation study and practice have gradually come to recognize that transit via telecommunications should be regarded as a valid form of transportation. This in turn has created a sustained interest to better understand
both enabling and limiting factors in telecommuting options. Telecommunications infrastructure development and options for information services number among these critical factors. Community design issues play a role in setting the parameters of either factor in a given setting, particularly through the development or re-development of specific sites, which may be amenable to enhanced telecommunications, infrastructure development.

The discussion has already pointed to the process by which the key issues and goals for the demonstration project emerged. Extrapolating from that discussion and restating the goals at a slightly higher level of generality, the following set of template goals are suggested:

A. To test the feasibility of coordinated consideration of telecommunications & information infrastructure needs and services in demonstration sites.
B. To connect transit, travel reduction and telecommuting gains to coordinated telecommunications and information analysis and planning.
C. To support telecommunication/information and transit/telecommuting coordination with community design considerations.

DEMONSTRATION PROJECTS: KEY PHASES

In all important respects, the plan for development of this demonstration project concept unfolded gradually but three phases suggested themselves initially. The first phase focused on identification of potential partners, the second on seeking support and the third on critical decisions.

Phase One: Identification of Potential Partners

It was clear from the outset that potential partners would be needed on both the public sector and the private sector side. Ideally, the project team was looking for a project which would already have both public and private commitment and would also be amenable to testing the coordinated telecommunications infrastructure, transportation/transit and design considerations. The search for potential partners for this project followed several different paths but thinking on this point should be open. Furthermore, the search for potential partners is in many ways a simultaneous search for support, particularly financial support. The template suggestions offered here include those which were taken in this project as well as some which were identified and would have been followed had others failed:

: The network path
As implied by the title, this path makes use of crucial connections known to project principals. In this project the Advisory Committee provided critical suggestions.

: The public platform path
As implied by the title project members made the project invitation known to potential partners at various public conferences and gatherings where such partners were likely

: The request partners path
This path would have been the next followed if needed. It involves a circulation of concept and request for partnership discussion. This device is commonly used in ordinary networking and telecommunications projects as Requests for Information and Requests for Proposal. It would have been novel to use it for the combined substantive purposes represented in this project.

Project Invitation and Response

The invitation to consider a partnership project was necessarily broad in its terms of reference. As indicated above there was no single path to locating potential partners nor was there a single presentation. However, the template goals and activities were always identified as follows:

: The overarching goal of this project was to demonstrate the highest potential uses and benefits which would relate directly to transportation planning and the potential role of telecommuting in the planning, investment, and service roll-out decisions of advanced telecommunications infrastructure and information services applications. This project was to explore with various partners how to integrate telecommunication infrastructure, real estate considerations, telecommuting capacity, transportation options, and community design factors to foster new forms of development and re-development. Its aim is to set a new standard in Minnesota for sustainable, livable, economically competitive communities based on an electronically enriched environment.

Response to the project invitation came from half a dozen communities in the Twin Cities metro area. Meetings or follow-up discussions were held to clarify possible synergy between community needs and the project purposes. Various elements needed to be simultaneously present in any given community including active or nearly active work on a development site, an identified developer willing to discuss telecommunications infrastructure and information applications as a leading element in development planning, and city or municipal leadership whose understanding of community needs included a commitment to systematic incorporation of information infrastructure in the planning and development process. From the expressions of interest the two communities of Richfield and St. Paul decided to engage in fuller exploration including Phases Two and Three.

Another significant outreach activity in Phase One of the project was to hold a joint public program with the Telecommunications and Information Society Policy Forum, a forum for
exchange and focused discussion on critical telecommunications and information issues. Since participation is drawn from diverse sectors, it offered an opportunity to both present the essential ideas to a broader public audience and to gather further ideas for developing a common agenda in working with communities.

The Forum discussion was the first opportunity to bring together key participants with a common focus on the potential of the project. The public discussion was quite favorable with the most intense interest focused on the new role of the developer as envisioned in the project.

**POTENTIAL PROJECT SITES: SAINT PAUL**

The Lowertown area of the City of St. Paul presented a strong opportunity for creation of a demonstration project in an inner city urban setting. Lowertown with its fringes along the Mississippi River had been a vibrant area of the city in its early history but became a place that time and commerce seemed to have bypassed. However, the nineteenth and early twentieth century buildings were remarkably preserved. A new initiative was launched about twenty years ago with McKnight Foundation support to revitalize the Lowertown area.

As Lowertown was revitalized, working artists and entrepreneurial companies involved in advanced technology were attracted there, bringing a growing demand for superior technology infrastructure. This was the catalyst for the concept of a Cyber Village in the Lowertown area. This project has a number of features including a fiber optic network run to specific buildings to support information businesses. An originally envisioned but unrealized element was to extend high-speed services to residential buildings.

The project was proposed to build upon the Cyber Village achievements but extend them with some innovative telecommunications and data elements. The proposal that was eventually developed for this area included a number of distinctive elements:

- completion of the unrealized aim of bringing the residents and artist studios into the high speed network
- creation of cyber century work/live units through extension of high speed network features into vacant and underutilized historic buildings as part of the re-development plan
- contribute to economic development by bringing high bandwidth the last mile to existing as well as new business/housing construction
- attract information businesses through the magnet of a fully e-enriched Lowertown community

The first contact about a possible project in St. Paul took place through the Planning and Economic Development division of the St. Paul City Government. St. Paul had suggested itself to the project team for a number of reasons. These included pre-existing contacts as well as the fact that a couple of other projects were underway in St. Paul and worth exploring for possible synergy with this project.

1 Refer to Section IV of this report for a full description of TISP activities for the year.

For example, there was an effort to showcase the development of the St. Paul Cyber Village, a concentration of a number of Web-based, networking and information applications companies in the Lowertown area of St. Paul. In addition, there was a larger ongoing Lowertown redevelopment project financed with a combination mainly of foundation and public money.

Two things quickly became clear from the initial discussion with St. Paul officials: first, there was definite interest in working together to develop a project in an appropriate site in St. Paul; and second, the decision about an appropriate site was going to be largely conditioned by a complicated set of relations to other development entities active in St. Paul (such as the Lowertown development) and to the political track where development decisions inevitably mix with other considerations. With that context in mind, discussions were held about a couple of potential sites with the staff from St. Paul Planning and Economic Development, as well as with principals from the Cyber Village and the larger Lowertown Redevelopment Corporation.

The site (the North Quadrant of the Lowertown redevelopment area) that became the proposed demonstration project site for St. Paul was a site that met many of the criteria for the project including that a property development group had been selected as the primary manager of the re-development of the whole area. It was intended to include mixed residential and business use with a high proportion of rehabilitation. From the vantage of telecommunications infrastructure and information applications, it would involve retrofitting existing premises. While all the goals of the project were appealing to the St. Paul Planning and Economic Development staff, the potential for sizeable numbers of telecommuters was particularly compelling.

It also became clear in the early work in the St. Paul project that the hoped-for synergy with other digital efforts and with the larger Lowertown Redevelopment Corporation project was unlikely to unfold for various reasons. Two factors led the project efforts away from an intensive pursuit of linkage with the Cyber Village initiative: on the one hand, the Cyber Village initiative itself was oriented less toward specific projects than toward network and showcase activity; and on the other hand, the telecommunications and information project work became closely linked to the municipal development strategy. In regard to the Lowertown Development Corporation discussions, it became evident that their agenda was already set.

**POTENTIAL PROJECTS SITES: RICHLAND**

The City of Richfield is an inner-ring suburb that has had an unusually strong sense of local community. A majority of the residents live in older vintage, single family homes. Some of its boundaries lie at the junction of major highway arteries for the Twin Cities, and in addition, it is adjacent to the airport. In consequence, Richfield is experiencing pressure to diversify its housing for younger and single residents and to accommodate the higher end mobile workers who are drawn to the location due to the airport and transport accessibility. At the same time, there is a strong need to improve community infrastructure and services to meet the needs of the older population and families with children. All of that depends on greater success in developing the economic base of the community. Therefore, due to its location and to the changes underway throughout the community, there is fairly robust development activity in Richfield at any one time.

The initial contact with Richfield was made with then-City Manager, Jim Prosser. It was a highly productive first meeting because, as it turned out, the City Manager's views about the need for systematic information infrastructure analysis in the planning and redevelopment process more than matched the views of the project team. It was subsequently discovered that this City
Manager in particular was widely regarded as one of the most far-sighted and thoughtful in the metropolitan area.

One of the most useful results of the demonstration projects was the development of a digital design plan, which might be used by any community with digital goals. The plan is included here as a template for other community planning efforts.

Template: Developing A Digital Design Plan

Developing a Digital Design Plan

A. Analysis
   Level I: Identify stakeholders and components of community
   Level II: Identify potential telecommunications applicationsstreams of services generated by components

B. Design Solutions
   Level III: Identify spatial, infrastructure, and business solutions to deliver desired applications and services

C. Conclusion
   Level IV: Develop the Design Program and Business Plan

A. Analysis
   Level I: Identify components of community

HOUSING SECTOR
   - Who will be living in the community? What needs and opportunities will they have?

Level II: Applications and Services
   - Could a local area network support community events, special services, special connections with other local and regional amenities?
   - Are there special resident groups such as seniors, live/work residents, artists, computer-oriented home businesses, children, etc. who might especially benefit from high-level internet services?
   - Are there issues about ensuring digital access for all residents?

COMMERCIAL SECTOR
   - What type and scale of commercial presence is desirable?

RETAIL
   - Identify potential retail sponsors anchors (HomeDepot, supermarkets, even WalMart?)
   - Identify desired mix and scale: (convenience foods v. regional supermarket; convenience hardware v. Home Depot...sporting goods if located near recreational amenities...etc.)

Level II: Applications and Services
   - Are there innovative electronic opportunities to attract and enhance local businesses?
   - Are there possible connections between electronic and local retailing?
   - Could a local area network connect with local business for convenience purchasing and home delivery, for example?
   - Could local commercial branches be connected electronically with regional/national businesses?
   - Are there advertising opportunities provided by a local area network?
   - What are the fiscal/tax implications of retail e-commerce on local resources?

HEALTHCARE
   - What kinds of physical and digital connections will there be between the homes, offices, healthcare centers and hospitals? (Physical resource in the community? Information/education? Telemedicine? Seniors' special needs? etc.)

HOTEL AND CONVENTION
   - Will there be a hotel? A convention center? Guest house?
   - Will there be internet and teleconferencing facilities? What facilities can be shared with other community uses?
   - Could a local area network enhance community resources for travelers?

INDUSTRIAL SECTOR
   - What industrial uses would complement the economic goals of the community? What are the industrial needs of the region? Are there implications for innovative digital live-work arrangements?

Level II: Applications and Services
   - Could the public and private sectors partner to develop a high-tech economic cluster?

CIVIC SECTOR

EDUCATION AND LIBRARY
   - Will there be a school(s) in the community? In the region? Will there be continuing education opportunities? Will there be special needs groups such as seniors? Could daycare facilities help support adult learning opportunities for residents and/or regional visitors?

Level II: Applications and Services
   - Could a distance-learning center offer special opportunities to residents and/or regional visitors? Should the facility be a separate building, or share space with other facilities such as a library, school, civic-access center, conference/hotel facility, or "home-business" center?
   - What intra-net and extra-net opportunities might help support scheduling, communications, homework, and advertising needs associated with education?

SOCIAL
   - Will there be round-the-clock residents: mothers, work-at-home professionals, evening visitors from the region, weekend visitors, hotel/convention guests?
   - Transportation: Could innovative telework programs be developed to enhance ease of access while reducing transportation system burden?
it presents an opportunity for the city and the developer together to include telecommunications and information infrastructure in a development plan. The city is bearing proactive demand for information age home/home-office units.

- **Diversification of the economic base:** In the decades ahead, the City of Richfield is looking for a way to diversify the in-city economy. The development of more information age home/home office facilities represents a sound strategy.

- **Transportation & location:** Richfield is located at a junction of major transportation routes including major freeways and large arterial roadways. Flow across the area. It is near the airport and is an access point both for the Minneapolis city area and for the next rings of settlement. Large new roadway systems in the city are not possible. At the same time new development such as office towers and multi-unit dwellings shall be chosen for both land use and economic development reasons. Consequently alternative transit and trip reduction should be a conscious strategy in advance of development. Telecommunications development and telecommuting is one of the more promising strategies.

**Phase Two: Seeking Support**

The search for support involved several interrelated considerations. One of the crucial questions in the potential partnership discussions was about the readiness of communities to make some sort of investment in time, money or both in order to engage in telecommunications and information infrastructure as an integral part of the community planning process. The support provided by the communities was not intended to be evaluated on a prior matching formula relative to the support the project received through the Minnesota Department of Transportation, the (then) Office of Technology and the Department of Administration. Nevertheless it was important that leadership in both Richfield and St. Paul communities stood ready to invest in advanced information infrastructure development planning on their own behalf.

At this stage in the project, there was considerable anticipation among all the project principals that a series of high-level conversations at the Met Council signaling strong interest in the innovative nature of the approach would translate into significant support under one or another of the Met Council development programs. On the strength of that interest the planning staff in each city and the project staff developed two grant proposals seeking support from the Livable Communities grant process for further planning funds for a site in St. Paul and a site in Richfield. Those applications are attached as appendices. Preparation of the grant proposal documents was very time-consuming and represented a considerable commitment on the part of each community to the goals of the project. The decision to develop grant proposals under the Metro Council Livable Communities Initiative was important. In the end, neither of the applications were funded but several valuable lessons were learned from that effort.

**Grant Process Lessons**

- First, it made the project itself hostage to the timetable of the Metro Council grant process. That timetable requires months—sometimes many months—between steps. It highlighted the disadvantage of organizing around grant application environments with long timelines and large grant application packages. Cities or municipalities...
who really want to move forward on these matters should probably concentrate on alternative sources of funding.

- Second, on the positive side it did clarify common understanding among all the grant process participants about the potential benefits of approaching telecommunications and information infrastructure development planning in a coherent fashion at the beginning of a development project. The benefits are quite varied including a number with specific transit and transportation dimensions.

- Third, it should be noted on the positive side that greater understanding among planning staff principals in both cities remains as a legacy which can be applied as befitting to the next project.

- Fourth, it became clear to the project principals that the Met Council decision-makers on Livable Community grants did not have sufficient background or information to understand either the needs driving the project, or the benefits that would flow to a community site possessing advanced telecommunications and information infrastructure applications.

The experience with the Met Council Advisory Committee on Livable Communities in particular underscored the strong need for future outreach efforts in order to link the many concerns about metro development to the development of telecommunications and information infrastructure. Making decisions about sites and other services—such as the Met Council does now—without some coherent understanding of the potential benefits conferred from advance thinking in regard to telecommunications infrastructure and information applications is to sell short a newly vital public interest.

**St. Paul Events:**

The demonstration project development work in St. Paul created a particularly rich consideration of the close connection between virtual space enabled by high-speed network in home/work/life settings and actual physical space. The project was intended to create a number of physical environments accessible to and responsive to the needs of residents engaged in intensive day long use of home/work/life spaces.

The goals of the St. Paul project were deeply affected by events with the intended developer in the St. Paul project, however. It was learned that the city had decided to reconsider the selection of the developer or the North Quadrant Lowertown redevelopment work and to defer another selection for an unknown time period while doing other types of preparatory work on the site. The inability to work with a specific developer and the unknown time frame for selecting a new developer altered the scenario for the St. Paul project considerably. Despite the fact that the commitment to the site remained firm and that the rationale for forward planning on telecommunications and information infrastructure remained, the absence of a timetable and a developer inevitably affected the project viability.

**Richfield Decisions:**

Richfield had identified a development site for the purposes of this project very early in the project life. This site was known as the Interchange West development project, since it was bounded on two sides by Highways 494 and 35W. The area had already been selected as a redevelopment area and most of the critical decisions relating to the buy-out or movement of property holders had been taken though many remained to be implemented. The site would be redeveloped from ground zero into a mixed commercial and residential site with two office towers, a hotel and numerous low-rise multiple tenant residences.

The City of Richfield had been working for months with the site developer so the partners in a demonstration telecommunications and information infrastructure project were clear. As the discussion evolved a decision was taken to proceed with a telecommunications development work program so that project principals could put together a small team to immediately begin work with the developer. However, it remained an open question, which needed to be resolved, whether or not the developer would be responsive to the concept and to the joint work it would require.

The developer was CSM Corporation and the principal on the Richfield site at Interchange West is Murray Kornberg. Previous research had shown that developers by and large were still not attuned to the possibility or the need for this type of analysis or integration in their project plans. This was true for CSM. However, Mr. Kornberg was personally interested in digital developments and was receptive enough to contract for the work on the Interchange West site. It was a particularly promising site because the site would involve all new building development in a campus type area of office towers, hotel complex and multiple dwellings with a small retail component. It provided the opportunity to envision integrating a network for both commercial and residential users in ways that could bring more advanced services to residences than is usually provided and also serve as a leading edge office and hotel service environment.

It is useful to recall that it was not at all clear to the demonstration project team, to the City of Richfield planners or to the developer what the role should be for providing development advice on the incorporation of leading edge information infrastructure at the earliest stages of site development decision-making. It was highly innovative and unusual to bring those elements all together in order to explore the possibility that the developer would take as much initiative to provide telecommunications infrastructure in his site and buildings as he takes for conventional means such as water, sewer and electrical infrastructure. From that perspective the development of an acceptable work program was a research question which was put to an immediate field test.

The proposal for a work program for the telecommunications and information infrastructure development project at Interchange West for the City of Richfield and the CSM Corporation reflects the needs of those partners given their place in the re-development cycle at the time the partnership for the demonstration project was struck. However, the work proposal addresses core issues which are directly relevant to almost any community and to many specific development sites. Therefore, the work program is presented here as a template which could be used in any community with similar needs and goals.

**Phase three: critical decisions**

Several critical decisions presented themselves in Phase Three. In the earlier phases a significant amount of work had been completed but carrying out the full agenda of analysis depended upon further support which had been sought for both projects under the Livable Communities grant. Once that possibility was clearly eliminated, both communities faced critical decisions whether or not to continue work on the demonstration projects. In the case of St. Paul
the project was given a red light. In the case of Richfield it was given a green light. What helps
to account for the different decision and what was learned from the process up to this point?

The St. Paul decision was directly affected by reconsideration of the choice for the site
developer. Without the need to engage in specific decisions about the site the impetus behind the
project was blunted. This site and its prospects fell into competition with consideration on other
development priorities and options. It was also the case that political uncertainty surrounding
the mayor's office created a sluggish atmosphere of decision-making while higher level staff waited
for the air to clear on that point.

For Richfield there were several factors: the development process for the specific site
was well underway, development of this site was at or near the top of the City Planning priority
list for action, and the developer was receptive to working with the project team.

Some broader lessons can be taken from this process and applied to other communities
attempting to bring telecommunications, information applications, transit/transportation and
design considerations together. From the St. Paul experience, the project team has learned that
success will be elusive where the city environment is highly bureaucratic, politically constrained
and rather indefinite in its own intent. From the Richfield experience, the project team has learned
that success is more likely where there is a high-level champion of the concept, where rapid
response is part of the culture of administration, including tutorials by key staff to develop
understanding of the project, and where the developer is both open to new ideas and active in
pushing the agenda. This process also highlighted another basic lesson: the need to engage in
strategically selected outreach efforts and inform key constituencies such as planning bodies, city
councils, Metro Council bodies, legislative staffers and committees, as well as the broader public.

DEMONSTRATION PROJECT EXPERIENCE

The decision by Richfield to carry out the demonstration project work meant that a process
required inventing which could meet expectations of the both City Planning and developer teams.
Everyone agreed upon the general purpose of the project and everyone understood the specific
project site to which that purpose would apply. But the project purpose needed to be developed
into specifics that would be appropriate for Interchange West site.

Assembling the team

The first step after the City and the developer gave them common consent to continue
was to assemble the team.

The requirements of a project as innovative as this are not immediately self-evident
because the usual boundaries for sector work (transport but not telecommunications,
telecommunications but not information applications, etc.) or technical expertise were less
important than the ability to work and think across boundaries. It is very important to have a
project coordinator who exemplifies this ability, and almost as important for the network design
and information application consultants because their normal work scenario may inhibit or even
prohibit boundary crossing. Another requirement of the work team is that each one has some
tolerance for uncertainty because as team members they would need to help the developer and the
City understand enough about network capabilities and information services capabilities to make
reasonably informed choices about the work they wanted brought back to them from the design

From this experience there is a template for team assembly and for the work process which
should be considered a starting point for other communities with similar goals.

Team Assembly Template
Ability to invent a process to
take innovative ideas to practice
Show expertise across boundaries
Skilled in process

Work Process Template
Identify layers of network and
applications relevant to site
Propose menu of relevant work
topics, adapt & repeat

For this project the team members included: Milda K. Hedblom, J.D., Ph.D., Dain
International Services (and member of the HHH Telecommunications and Transportation Project
Team); Wendy Christan, Senior Consultant, Elert & Associates; Stephen Fiorella & Dominic
Hand, Technically Speaking, Inc.; Christopher Sandberg, J.D., Lockridge, Grindal, Nauen &
Holstein.

Developing relevant scenarios

The unknown factor in this scenario turned on the extent to which the community interest
to integrate advanced infrastructure and services into the development plans and costs of the site
developer would coincide with the interests of the developer. This was the central question for the
project team. It quickly became clear that evaluation of the developer's interest included a
number of factors in addition to the obvious interest that the total development project be
profitable. These included:

- Can a telecommunications and information infrastructure project produce additional
  revenues streams under relevant scenarios?
- Can the market appeal of the electronically enriched facilities be assessed?
- Can the value of being a market leader in the builder community be assessed?
- Can the value of a high profile project with advanced electronic facilities be assessed
  for its positive impact on the next project?

The work of the project team to date has concentrated on the first question and will likely
turn next to the second in subsequent research.

The approach taken by the work team to the first key question was to establish a basis of
understanding with the developer about the essential choices in configuration of a service
network using the features and benefits of a centralized or non-centralized approach. The second
level of analysis was to construct a set of scenarios encompassing outside plant options, internal
cabling or wiring options and necessary electronics. The third level of analysis constructed
scenarios for technology services based on the network and electronics options. The fourth level of
analysis constructed revenue stream scenarios for the varied network scenarios. An additional
dimension of analysis presented a preliminary review regarding options for owning, operating or
leasing network capacity for voice service since entering that service arena still entails significant
regulatory and legal costs. The appendix contains examples of the work carried out for the
project at each level of analysis.
WILL THE SCRIPT PLAY?

At this juncture the demonstration projects leave a number of questions unresolved. For example, the City of St. Paul is likely to return in the near future to the re-development of the North Quadrant of the Lowertown project and may once again wish to bring the demonstration project analysis to that renewed effort. In the City of Richfield site, the developer has a report under advisement and the City of Richfield representative to the project indicates that the City remains committed to the goals of the project. However, the City Manager who was so critical in launching the demonstration project partnership has since left the City of Richfield.

New Interest in the Script:

In addition to the work that has been carried out to date for Richfield and St. Paul projects, two other sites have begun steps to engage in a similar process. The first of these is the Sears Tower site along Lake Street in Minneapolis. This site has already received significant public investment in order to help revitalize a languishing area of the inner city. The goal of the developer is to incorporate a significant component of information and telecommunications infrastructure in the remaining re-development work on the site. A proposal for further work on that site is under advisement.

The City of Lino Lakes has also spent some time investigating the demonstration project approach for an e-enriched community. The general objective for Lino Lakes is to enhance its economic and community attractiveness through the aggressive use of digital technology in civic, residential, and commercial zones. The City of Lino Lakes is in the midst of growth, building and re-development and they have approached this largely through the lens of an urban design consultancy.

At the same time, with the help of the Humphrey Institute team they have carried out preliminary analysis of their technology planning needs in order to create an e-enriched community. These needs include an understanding of the vision, a process to develop a master technology plan, and a plan for uses and applications throughout the community taking both services and physical design into account. A proposal for further work on Lino Lakes community development is under advisement.

The most significant missing piece from the demonstration project perspective is the opportunity to work in an out-state community. Some projects that looked very promising a few years ago for moving ahead with advanced infrastructure on a community-wide basis such as Grand Rapids seem to have floundered. Other more selected approaches have been successful. The most innovative among these is the work in St. Cloud where a city/college partnership for a fiber network has had a major impact in re-defining the market interest in investment in the St. Cloud area. It remains to be seen, however, what impact might be achieved in a smaller outstate setting that look toward creating a major initiative with combined sectoral interests like the one envisioned in the projects which are the subject of this report.

IMPLICATIONS AND RECOMMENDATIONS

One of the implications from the demonstration project work is the importance of asking the right questions in order to get useful answers. The impulse behind the demonstration project idea grew from the question whether significant transit/telecommunications benefits would flow from a general site deployment of advanced network and services, if slow growth and patchy distribution of both demand and capacity could be overcome. This project is an example of posing the right question, and the challenge is to carry through to the full proof of the concept. Even the interim results to date illustrate that it is possible to elicit serious attention from the developer and city planning worlds in addressing both the question and the answer.

One potential policy recommendation stemming from the completion of the demonstration project is for the Department of Transportation to take a direct investment interest in the installation of advanced infrastructure in the residential units of the Richfield project. In the analysis completed thus far, under most scenarios the portion of investment that has the longest timeline for return is for the residential units and will be the hardest for the private developer to build into his cost structure. It is precisely in those units that a direct transit benefit can be seen from the perspective of the Department of Transportation. Advanced infrastructure would be the essential magnet for home business and other telecommuting applications. A second potential policy recommendation that would support the magnet concept is for Mn/DOT to cultivate a working partnership with the housing developer and bring expertise from relevant state agencies to bear on the identification and recruitment of the home/home office and telecommuter occupant until a significant market is reached (such as 60% occupancy with a commitment home/home office or telecommuter transit mode).

A more general policy recommendation would be for Mn/DOT to explore working partnerships with other state agencies that can encourage telecommunications as a form of travel substitute as well as home/home-office options. One such option would be in the housing policies where various kinds of incentives are attached to the development of one kind of housing or another. Mn/DOT could take the lead in suggesting policies which could provide incentives to build or retrofit—especially at the mid and lower price range—housing for telecommuting and home/home office use. Mn/DOT might also carry its interest in telecommunications as a form of transportation into the home lender market. There, it might provide suggestions to innovative banking interests who wish to advance this type of work in their respective communities in order to explore potential, incremental benefits to home buyers who can demonstrate their intended home use of telecommunications as a viable transportation alternative.

A different direction for potential policy development points in the direction of the individual worker who is fast creating a whole new worklife pattern blurring the distinction between home and office. The underlying motive for a strong Department of Transportation interest in telecommunications and information infrastructure networks is that it represents another tool for better managing surface transportation demands as the new worklife pattern merges with the public policy interest in telecommunications as transportation. One form of support, which should be considered for this new worklife pattern, is some appropriate type of tax benefit for those who are telecommuters/home/home office workers.

At a more fundamental level, more intensive policy outreach needs to take place from Mn/DOT to other areas of state government and to the public at large in regard to the Mn/DOT stake in telecommunications and information infrastructure policy.

A major step in that direction is the participation of the Department of Administration in the Connecting Minnesota project. While the project itself remains controversial, it has precipitated needed attention in both public and private sectors on advanced information infrastructure questions in Minnesota. On the assumption that the project will be seen through to completion, the next policy step is for the Departments of Transportation and Administration to clarify how they might assist outstate communities in taking advantage of the opportunities that
the new network will represent. The template suggested in this report that community assistance would be a useful starting point for that thinking.

Another initiative is for Mn/DOT to further focus state government attention as an employer on the telecommuting/home/home office option. Some efforts have been made in that direction and regular monitoring of those developments are important as a baseline of information for decision-making. Mn/DOT should take more leadership in carrying those efforts further.

Realizing the potential of the information age and the benefits of a strong telecommunication infrastructure is not exclusively the job of the Minnesota Department of Transportation. The Minnesota Department of Transportation should move aggressively to develop cross agency partnerships in its approach to telecommunication and information development. Various findings throughout this report underscore the need for a functional approach rather than an agency approach.

It is generally recognized that there is a broad societal transformation as well as a specific business life transformation underway. In business life this includes the appearance of the digital office, the migration of core business and services onto the Internet and the desire to reduce the maintenance of real estate. All of these depend more and more upon interconnected, evenly and widely dispersed telecommunication networks and services. The Department of Transportation in cooperation with other government interests and private sector partners has a strong public interest in that development.

The need for enlightened top level leadership is critical, especially in defining the appropriate public sector responsibility for future development. As these recommendations imply a creative mix of incentives needs to be developed and partners found from new areas of both the public and private landscape. It is not too soon. Mn/DOT and all of state government needs to fully accept that networked telecommunications and computers will absolutely have more impact than anything else we can imagine in the next twenty-five years short of nuclear explosion or economic implosion. Of all the ways currently being promoted for alternative transit—light rail, bicycles, walking—the telecommunications mode is the one most likely to be embraced by the public and meet their way-of-life needs. Is Mn/DOT doing enough to effectively advance the telecommunications agenda?

REFERENCES


Giuseppe Mantovani, New Communication Environments: From Everyday to Virtual, Taylor and Francis, 1996.


Mark T. Maybury and Wolfgang Wahlster, eds, Readings in Intelligent User Interfaces, Morgan Kaufmann, 1998.


III. THE ASSESSMENT OF ELECTRONIC TRAVEL READINESS AND SCENARIOS IN MINNESOTA

INTRODUCTION

Telecommuting program implementation has increased nationwide as both private and public sectors continue to correlate telecommuting with a broad spectrum of advantageous outcomes. The term "telecommuting," created more than 20 years ago, describes a rapidly growing phenomenon that substitutes the normal work commute as employees and workers choose to work at home or in an office close to home. The establishment of flexible workforce arrangements in the corporate world is driven by efforts to improve employee productivity, increase worker morale, reduce worker turnover and decrease office facility costs. Benefits to workers are the reduced expense and stress of commuting and the increased flexibility and productivity hours offering potentially more leisure time for friends and family. In the public sector, telecommuting is being promoted as a tool to reduce traffic congestion, improve air quality and conserve energy resources.

Scholars generally agree that the concept of telecommuting, though expanding rapidly in its use, is still an underutilized work and travel option. Following the 1996 National Telecommuting Initiative Action Plan, governments are required to make telecommuting part of their overall strategy to improve services and working conditions. The Minnesota Department of Transportation (Mn/DOT) is generally providing project leadership, assistance or set forth examples for a functioning telecommuting policy.

Predictions and projections about the increase and the percentage of telecommuting are numerous. Estimates also vary on the current level of telecommuting. 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. In fact, telecommuting is overwhelmingly a part-time phenomenon. Some surveys do not differentiate between people who work at home in home-based businesses and those that telecommute from their homes. Given these limitations, estimates vary accordingly.

A growing body of research suggests that telecommuting results in individual and organizational benefits, such as reduced stress and improved productivity, as well as broader social consequences, for example, decreased traffic congestion and reductions in environmental pollution. Encouraged by such reports, policy developed in 1996 provides strong support for the implementation of telecommuting programs in state agencies throughout Minnesota. Similarly, Mn/DOT is an avid promoter of alternative travel behavior including telecommuting. The rationale for this endorsement has been captured in a series of goals including improve employee well-being, increase productivity with available resources, and address the growing problems of

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1 President’s Management Council: National Telecommuting Initiative Action Plan, January 1996
3 Minnesota Department of Administration: State of Minnesota Telecommuting Programs, St. Paul, Minnesota: Minnesota Department of Administration, 1996
roadway congestion and environmental pollution employing telecommuting as a traffic management tool.\textsuperscript{11} Policy reflecting public support is also increasingly incorporated in the strategic plans of private organizations statewide.

MinDOT has launched several research initiatives in an effort to understand the implications of telecommuting for individual well-being, and organization and transportation system development. The study presented here continues such efforts and represents the collaborative work of the University of Minnesota’s Humphrey Institute and the Claremont Graduate University Research Institute. Research questions guiding this exploratory work include:

- What factors are involved in the decision to telecommute?
- How does telecommuting affect individual travel behavior?
- How does it affect individual quality of life?
- How might telecommuting program implementation impact organizational effectiveness and productivity?

Guided by such questions, an exploratory survey was developed and administered in two large organizations in the Twin Cities area. This exploratory research relates findings to describe both micro and macro contextual elements striving to at once examine telecommuting implications for individual well-being and transportation systems.

Suggested Implications on Congestion

Despite the awareness that telecommuting is as a congestion-mitigation tool most effective when bundled with other strategies, it has nonetheless been the sole focus of a growing body of research. The reason for this emphasis seems to be that it provides a manageable perspective on an extensive discussion in the literature targeting the implications of changing communication modes for transportation system development. Researchers increasingly ask whether or not advanced telecommunication can make a difference to travel behavior—particularly with respect to congestion mitigation.

In particular, commuting has been described as the primary contributor to roadway congestion during peak periods of travel in urban areas. And because commuting represents routine, discrete travel behavior, it is generally viewed as potentially more amenable to substitution by telecommuting than other travel. Forecasts made assuming telecommuting will substitute for commuting often describe definite reductions in congestion and related pollutants in the near future.\textsuperscript{11} Several studies support the notion that transportation and telecommunication interact in a complementary fashion. That is, the use of telecommunications encourages the use of transportation (enhancements) or the use of telecommunications leads to more efficient use of travel. Questions exploring both substitution and complementary effects have been included in the Minnesota surveys. Even assuming telecommunications will substitute for travel, it is unclear whether or not such behavior will occur with the frequency necessary to produce a significant reduction in congestion or its associated pollutants.

\textsuperscript{11} MnDOT. Policy Position Statement, Administration No. 93-A-4-G/1 Telecommuting Policy, March 4, 1996.

Suggested Implications on Productivity

There are also several other reasons. People may choose to live further from the city center if they do not have to travel in to work every day. This could lead to longer journeys to work on the days when they visit the office, but might also mean longer journeys for other purposes (such as shopping, taking children to school, social travel, etc.). There may also be a modal shift towards travel by more energy-consuming private cars and away from more environmentally friendly mass transit systems. Finally, the prospect of emptier roads during rush hours might attract onto the roads people who would otherwise have stayed at some or used other forms of transport. Thus, the existing body of literature suggests a more complex relationship between telecommuting and transportation systems than previously supposed—telecommuting, as a stand-alone program is unlikely to be the panacea sought for the congestion crisis. Nonetheless, it continues to be supported by public policy due to its potential for affecting a complex of important, system-wide benefits. Beyond congestion mitigation, telecommuting is arguably important in addressing other areas touched by the revolution in telecommunications—individual and family well being, organizational productivity, and community and economic development.

Suggested Implications for Individual and Family well being

Studies indicate this mode choice may moderate the stress of increasing conflict between work and family demands while at the same providing benefits, such as increased productivity and effectiveness. The 1997 National Study of the Changing Workforce\textsuperscript{14} compared findings from a 1997 survey with results from a similar 1977 study with the objective of exploring the intertwined nature of home and work in the United States. Results agree with the experience of many people today—work demands have increased over the past two decades and employees increasingly experience negative spillover from work to the family domain. Two salary families have become the rule rather than the exception and, as a result, childcare and household pressures have increased for both men and women. Many people report they work longer hours, take work home, and engage in business travel significantly more frequently than their counterparts 20 years ago. With increasingly demanding jobs, individuals often experience negative spillover from work into the family domain with negative implications for both personal and family well-being. Note that research findings suggest the perceived aversive nature of the commute to and from work may be a significant culprit in the negative work-life outcomes. Proposed models characterize telecommuting as a potentially important moderator between commuting and stress-related outcomes.\textsuperscript{15}

Suggested Organizational Implications

Although the benefits of telecommuting at the individual level are very important, it is the business benefits that are most likely to drive its future development. Unless a clear business case can be made for telecommuting, employers will be understandably reluctant to adopt it. In fact, there are a range of different benefits which accrue to employers who adopt telecommuting, including:

- increased efficiency and motivation of nomadic staff

\textsuperscript{14} Plaut, P. D. Telecommunication Vs. Transportation. Access, Summer, No. 10, 1997, pp. 21-25

\textsuperscript{15} Novaco, R. W., Stokols, D., & Milavetz, L. (91998). Objective and subjective dimensions of travel impedance as determinants of commuting stress. American Journal of Community Psychology, 10, 231-257

higher productivity (It is difficult to quantify white-collar productivity at any but the crudest quantitative level, but telemarketing appears to be associated with an increase ranging from 0% to 45% depending on the circumstances. There appears to be no evidence of any negative effect in this area.)

the ability to decentralize activities to get closer to the customer in both time and space and/or to take advantage of lower costs or more appropriate sites

the ability to form, and re-form ‘virtual teams’ at short notice

easier recruitment and retention of valued personnel

savings on office overheads

savings on travel costs

Findings from the Changing Workforce already suggest job attitudes can be negatively affected in a reciprocal fashion by spillover from personal problems—for example, job satisfaction and organizational commitment are demonstrably reduced. Note that empirical studies demonstrate job satisfaction and commitment are linked to employee turnover. More committed and satisfied employees are less likely to leave their jobs. This relationship is particularly relevant for the Twin Cities where 56% of executive respondents to a 1998 survey noted that attraction and retention of respondents was the most significant issue for their company. Research findings from the Changing Workforce reveal that, assuming competitive pay and fringe benefits, the most effective way to improve employee attitudes, performance, and retention is to create more supportive workplaces, while keeping job demands at reasonable levels. Presumably, telecommuting is one attractive method available for balancing the often-conflicting demands of work and home while at the same time improving employee commitment and job satisfaction.

TELECOMMUTING AND CONGESTION IN THE TWIN CITIES

Even though estimates of the US Department of Transportation indicate that as much as 30% of the American labor force works at home, telecommuters are only a small part of that number excluding for example farmers or family businesses. Following the 1990 Census, almost 118,000 people worked from home full time in the State of Minnesota. Since more than half of them were considered farmers and the majority of the remainder were included under professional home-based occupations such as lawyers or doctors, the number of potential telecommuters seems quite small (approximately 20,000). As most telecommuters only work from home part-time, however, the actual numbers are significantly higher.

A study from 1992 and other various studies by Mokhtarian et al. estimated that by about 1995 about 9% of the adult workforce in the US would telecommute. This projection seems to be accurate for Minnesota, where it is estimated that, based on 1997 data, on any given day 8.9% of the workforce currently telecommute. Increasingly, transportation managers in Minneapolis-Saint Paul are confronted with a growing problem—roadway congestion. In the recent Texas Transportation Institute Mobility Study, the roadway congestion index calculated for the Twin Cities placed it 16th among 70 of the largest urban areas nationwide in 1996. The annual cost of congestion to residents (in terms of the amount of travel time delay and per-gallon estimates of fuel wasted in congested travel) was $1.02 billion and ranked Minneapolis-St. Paul 20th among areas studied. Such findings reflect a decided increase in regional congestion over the preceding decade—in 1980 roadway congestion index calculations placed the Twin Cities 31 out of 50 urban areas and 23 out of 50 in congestion cost. According to Mn/DOT Commissioner James N. Denn the “congestion crisis” confronting the Twin Cities area is projected to worsen over the next twenty years. An estimated 100 miles of the region’s 250 miles were congested during peak traffic hours in 1992—a number projected to double over the next twenty years. Estimated budgets will be unequal to keep pace with projected system demands.

Mode choice behavior contributes significantly to congestion. The 1990 census showed that 76% of commuters in Minneapolis-St. Paul chose to drive alone in their journeys to and from work. Assuming continuation of current travel behavior, projected population expansion in the Twin Cities area will be accompanied with an additional 2.4 million automobile trips on regional highways. Consequently, since 1991, Mn/DOT has joined with other state and county agencies to encourage commuters to choose alternatives to driving alone. Efforts have increasingly focused on bundled solutions such as public transportation, biking, carpooling and telecommuting. Mn/DOT developed a telecommuting policy in 1994 based on a report to the State Legislature, having surveyed about 800 households identifying public policy initiatives that the State could undertake to encourage telecommuting.

In a 1998 Commuter Survey by the Downtown Minneapolis Transportation Management Organization the overwhelming majority of Hennepin County respondents indicated they drive alone to work (72%). Among those respondents who live outside of the downtown area, the rate is 92% even. The reasons for driving alone are, according to the participants, the inadequate bus service, the longer commuting time and the long waiting times. Most of the participants selected “convenience” as the most important reason for the transportation mode of their choice. According to the study the interest in switching to acceptable bus service and telecommuting is strong. The survey calls for an improvement of bus services and bus information.

STUDY METHOD

The survey was designed with broad goals in mind—to explore and assess the implications of telecommuting for travel behavior, individual well-being, and organizational effectiveness and productivity in the Minneapolis-St. Paul area. The survey was administered to a cross-section of respondents in two large organizations (Fingerhut Companies and Hennepin County Government Agencies)—each representing a different sector of the economy. The private sector was represented by a large marketing organization employing approximately 8,000 people. The public sector was represented by local government and encompasses some thirty organizations employing approximately 10,500 individuals (excluding contractors and temporary employees).

18 Minnesota Department of Transportation (30 October 1997) Speech. Mn/DOT Commissioner James N. Denn selling the congestion crisis. October 30, 1997
21 Mn/DOT. Statewide Survey Information Memorandum, Office of Advanced Transportation Systems, March 1998
22 Mn/DOT. Statewide Survey Information Memorandum, Office of Advanced Transportation Systems, March 1998
The private firm, Fingerhat Companies, initiated a formal telecommuting program in 1996. In general, written guidelines exist (e.g., an employee must have been employed in the company for at least one year before he/she would be considered a potential candidate for telecommuting), but the program’s success rests primarily upon agreements between individual managers and employees. Such agreements clarify expectations in terms of work accomplishments, deadlines, and maintenance of suitable remote workspace. This private-sector organization is committed to enlarging the existing telecommuting program, but plans to do so slowly and methodically and with respect to job and task suitability. Currently approximately 200 employees are involved in formal telecommuting agreements (although management estimates hundreds more telecommute on an informal basis). At the time of the survey, formal telecommuting was restricted to two departments. Every member of both departments, including the 200 telecommuters, was invited to participate in the survey. Responses were encouraged through a gift certificate raffle. Surveys were provided to 550 employees on November 17 with a deadline for return of December 2, 1998. A follow-up email was sent to encourage participation mid-way through the administration period. Altogether, 276 (170 non-telecommuters, 106 telecommuters) of the 550 surveys were returned providing a response rate of 50%.

Hennepin County government initiated a formal policy supporting telecommuting in 1995. Initial guidelines were rather broad, and recent efforts have focused on the development of more detailed, uniform criteria for telecommuting (e.g., guidelines for employee performance evaluation). For the most part, goals of this local government organization reflect state targets, including cost savings, increased productivity, and improved individual, family and community well being. Presently, 293 public sector respondents are officially identified as telecommuters. Estimates suggest a greater rate of informal telecommuting—over a thousand employees currently work at home on a regular basis. Lacking methods to accurately identify informal telecommuters, only officially-designated telecommuters were invited to participate in the survey. A control group of 287 non-telecommuters were also asked to participate. These were identified through simple random sampling of a list of non-telecommuters stratified on job types matched to the telecommuter profile.

The survey was delivered via inter-office mail to employees on January 29 with a return deadline of February 19, 1999. Participation in this survey was also encouraged by a combination of four follow-up mailings, including a second mailing of the survey, plus entry into a gift certificate raffle for all participants. Of the 800 mailed surveys, 520 were returned, providing a response rate of 65%. The majority (80%) of the 293 identified telecommuters responded to the survey. For a more detailed analysis than presented here please refer to the individual survey reports of Fingerhat and Hennepin County.

Participant Demographics

Respondent demographics reveal more similarities than dissimilarities between the two participating organizations. Most respondents are married (public 63%, private 68%) and have children (public 56%, private 60%). In both groups, survey participants are primarily Caucasian (public 87%, private 97%) and between the ages of 35 and 54 (public 72%, private 69%).

On several key variables, however, responses reveal fundamental differences between the two samples. For example, public participants are primarily female (77%), while private organization participants show a more equal division between men (53%) and women (47%). Respondents from the public agency also tend to hold more advanced degrees—30% hold graduate degrees versus 8% in the private company. Respondents of private sector organizations, on the other hand, are more likely to have an associate or technical degree than those engaged in public sector work (31% versus 15%). Finally, individual income categories tend to be higher among private sector respondents—39% report annual incomes of more than $20,000 but less than $50,000, while 41% receive more than $50,000 but less than $80,000. In contrast, 63% of public sector respondents earn more than $20,000 but less than $50,000 annually, while 21% show an income of more than $50,000 but less than $80,000. Thus, income, education, and gender were routinely incorporated as covariates in analyses.

Note findings suggest that while the individual samples diverge from one another on key characteristics, they seem to fairly represent source organizational demographics. For example, similar to survey findings most of the public sector respondents are female and Caucasian. Likewise, private organization demographics demonstrate a near equal division between men and women with and most members are Caucasian matching the sample distribution for ethnicity.

RESULTS

Telecommuters - Incentives to Telecommuting

To advance effective policies for both organizational and transportation system development, it is important to understand the reasoning behind the decision to participate in telecommuting. In the literature, factors that function to both facilitate and constrain choice have been proposed and described including a host of financial considerations, commute characteristics, family obligations, and work related factors such as job suitability, and organizational climate. Agreeing with previous studies, survey results suggest person/situation characteristics that may predispose one to seek opportunities to telecommute.

Telecommuters in the present sample are more likely to have a high degree of formal education (Pearson chi square (6, N = 771) = 22.47, p = .001).

They are also more likely to be married (Pearson chi square (6, N = 765) = 18.22, p = .006) women (Pearson chi square (1, N = 767) = 4.33, p = .037) with children (Pearson chi square (1, N = 768) = 17.05 p < .001).

It may be that telecommuting provides a way for career-oriented women to balance desires to fulfill both work and family roles. In the survey, telecommuters were also presented with a list of ten of the most frequently reported arguments for telecommuting. They were asked to choose as many as three. Among public sector telecommuters, the number one choice was I can get more work done away from my usual workplace (30%), second was It saves me money (13%), and the third most frequently choice was I have a long commute (10%). The same three were chosen among private organization participants, but in reverse order. Cost savings was still number two (17%), while a long commute moved to number one (23%), and personal productivity fell to third (16%).

Survey findings indicate surveyed private sector respondents have a substantially longer commute than do public sector respondents—50% of private sector respondents survey travel more than 20 miles to work, while only 19% of public respondents travel more than 20 miles to and from work. This finding may explain the differential emphasis placed on the commute distance factor by private versus public sector respondents in reaching the decision to telecommute. In this survey sample this also shows that respondents of Fingerhut Companies do have to travel longer to their only workplace in Plymouth, MN whereas Hennepin County respondents tend to live closer to work, as there are several workplaces in the Twin Cities Metro Area.

<table>
<thead>
<tr>
<th>Profile of Hennepin County and Fingerhut Companies Telecommuters - Statistical and Survey Summary</th>
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<tbody>
<tr>
<td>Married (&gt;60%), and children (&lt; 60%)</td>
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<tr>
<td>Middle-aged between 35 and 54 (65% between 35,000 and 65,000 annually)</td>
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<tr>
<td>Higher Incomes than non telecommuters, slightly higher income among private sector respondents</td>
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<tr>
<td>Full time employees (&gt;80%, 40 hrs / week)</td>
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<tr>
<td>Telecommute part time (10% - 2 days week)</td>
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<td>Fixed schedule and set telecommuting days (Fridays and Wednesdays)</td>
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<tr>
<td>Longer mean commuting trip length</td>
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<td>Longer commuting time</td>
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<td>Telecommuting for one year or less (&lt;40%)</td>
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<td>Less stressed (&lt;70%)</td>
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Non-Telecommuters - Constraints to Telecommuting

Reflecting prior studies, survey results suggest many more respondents are interested in telecommuting than actually participate. For example, among private sector respondents, 38% currently telecommute, while 66% of non-telecommuters express an interest in participating. As for public sector respondents 46% currently telecommute, and 64% of non-telecommuters also express interest in joining the telecommuting program.

Survey queries explored constraints that might potentially prohibit interested employees from telecommuting. From a public policy perspective, it is important to understand constraining factors to more accurately anticipate potential telecommuting participation. Prior research has found that, in general, constraints tend to revolve around individual personality (e.g. need for the social milieu of work), particular job-related factors (e.g. duties that necessitate face-to-face interaction with clients or coworkers), or organizational climate (e.g. management style and/or support). Again, participants were presented with a list of the ten most commonly reported constraints. Among private sector respondents, the top three reasons are ordered as follows: Work tasks require face-to-face interactions with clients (23%), concerns that he/she would miss important work-related information (16%), and he/she would feel lonely/isolated (11%). As for public respondents, the three most commonly chosen factors constraining telecommuting included: “Work tasks require face-to-face interaction with clients” (25%), “Tasks require face-to-face interaction with coworkers” (20%), and “My manager will not allow me to telecommute” (11%). Findings agree with other studies that suggest job suitability is an important characteristic affecting an individual’s ability to choose telecommuting.

Travel Behavior

Agreeing with findings in the literature, respondents tend to drive alone as their primary mode of travel to and from work—with somewhat greater frequency in winter (74%) than in summer months (71%). Results agree with both the 1990 Census findings for Minnesota and a recent Mn/DOT survey of the Twin Cities area—both reported 74% of respondent’s drive alone in their travels to work.

In an effort to decrease roadway congestion, public policy efforts in Minnesota have increased campaign efforts encouraging the use of alternative strategies to driving alone— including carpooling, bus use, walking, bicycling and telecommuting. Comparison of survey findings to 1990 Census results suggest mixed success of such efforts. In the survey, 17% of respondents report they carpool (census 11%), while 11% choose to bus and from work (in the census 16% choose public transit). Only 4% of respondents reported full time (5 days per week) use of either carpool or bus. Despite speculation to the contrary, mode choice seems to remain consistent across seasons. In the survey respondents were asked to differentiate between summer and winter travel—differences were no greater than one percent.

Over half (54%) of surveyed respondents travel to and from work five days each week. Another 31% make the trip to and from work either three or four days per week. 12% during 1 to 2 days, while 2% indicate they do not travel to and from work during the course of an average week. Agreeing with the literature, respondents primarily commute during peak travel periods—78% of public sector respondents’ travel to work between 6:00 and 9:00 AM and 74% return during the hours of 3:00 to 6:00 PM. Somewhat more of the private sector respondents report traveling during morning (80%) and afternoon (88%) peak hours of travel.

The average length of trips for the entire sample is 34.4 minutes, with trip time of 20 minutes or less for 33% of respondents, between 21 and 40 minutes for 37%, while 30% report that their travel to work each day takes longer 40 minutes.

The literature suggests the return home is usually longer, perhaps to allow time for errands. Findings provide some support with the return home for 27% lasting 20 minutes or fewer, and for 35% of respondents reporting travel times of more than 40 minutes for the typical trip home.

In terms of distance to work, the average one-way trip length reported is 19.6 miles. Note that, in this sample, miles traveled to work are significantly shorter ($t (379) = 9.53, p < .001$) for

the public sector (M = 28.39, SD = 22.28) when compared to private sector respondents (M = 14.44, SD = 12.44).

Confidence intervals indicate that 95% of the time the difference between the one-way trip lengths reported by the private and public respondents will fall between 11.07 and 16.83 miles. Nearly identical findings were made for the return trip home.

Telecommuters

Of the 797 surveyed, 43% engage in telecommuting while 57% do not. Most respondent telecommuters work from home while 3% travel to a remote work center. In an average week over half (53%) of participants claim to telecommute 3 to 4 days, 38% 1 to 2 days, while only 7% engage full time or five days in the average week. Participation rates differ significantly in a comparison of private (M = 1.92 days, SD = 1.45) versus public sector (M = 2.99 days, SD = 3.18) respondents (t (337) = -4.23, p < .001) with public agency respondents reporting more frequent telecommuting than noted among private sector respondents.

When asked to indicate the day(s) of the week they usually choose to telecommute, private company respondents tend to select Friday (30%) and to a lesser degree, Monday (18%). Public agency respondents, on the other, do not seem to select any one day with strikingly greater frequency.

Although lacking corroborative longitudinal data, survey findings suggest many participants engage in telecommuting as a long-term solution. Previous findings suggest telecommuters often discontinue their involvement after participating for a short period—six months to a year. In this sample, the mean length for participation is 2 years. Thirty-eight percent of the sample has engaged in telecommuting for a period of less than 1 year, 39% from 1 to 2 years and 22% indicate length of participation longer than 2 years.

Non-Telecommuters

According to the literature, telecommuter and non-telecommuter travel behavior tends to differ in terms of trip length—typically telecommuters travel more miles to and from work. Findings from the survey agree and non-telecommuters do report significantly longer distances (M = 15.99, SD = 14.07) in their travel to work than do telecommuters (M = 25.06, SD = 21.71). Not surprisingly, time spent in travel to and from work is also significantly shorter (M = 5.63, p < .001) for non-telecommuters (M = 31.01, SD = 17.67) than for telecommuters (M = 39.56, SD = 21.71). Findings related to trip distance and time serve to strengthen arguments that perhaps an aversive commute is one of the primary drivers in the choice to telecommute.31

Remote workers also differ from their counterparts in average departure time for the trip to work. The mean departure time for non-telecommuters is 7:30 AM—much later than the average of 6:10 AM reported by telecommuters. Mean time at which telecommuters choose to begin the return trip home (4:31 PM) also differs from non-telecommuters (4:25 PM), but not in a particularly meaningful manner.

Assessing Emission Reduction Potential for Remote Work

As suggested by prior research, telecommuting is often viewed as a substitute for commuting with resultant reductions in Vehicle Miles Traveled (VMT). Studies by Mokhtarian and Varma35 and the US Department of Transportation36 show that in specific instances telecommuting cuts VMT in half. Remote work, accordingly, is increasingly declared a potentially effective tool for strategic's targeting reductions in roadway congestion. Reductions in congestion are also linked with reduction in nitrogen oxides, volatile organic compounds and carbon monoxide—criteria pollutants for reduction through the National Ambient Air Quality Standards.34

Given the nature of the survey questions, only commute-related vehicle trips (VT) and VMT could be estimated, which accounts for approximately one-third of total trips based upon the national average. To estimate commute-related travel mode and emissions impacts, an approach was employed that has been discussed in various studies, primarily from California.37 First, telecommuter VT and VMT were discounted by mode of travel during regular workdays and telecommuting days. More specifically, telecommuter VT and VMT per week were weighted with mode occupancy factors to reflect the mode of transportation used on work and telecommuting days and thus to more accurately estimate reductions in VT and VMT. The travel mode impact estimates also took into account travel to and from remote work centers where some telecommuters worked on telecommuting days. The emissions generated and reduced were estimated by using three primary data sources: average vehicle speed estimated from trip length and travel time responses in the respective surveys, VMT estimated using the above approach, and emissions factors from MOBILE 5A, the model employed by the Metropolitan Council, the MPO for the Twin Cities. To calculate total pounds of emissions produced and/or reduced, this formula was used: Emissions factor x annual VMT x 2.2/1000 = total pounds of specific pollutant emissions.

To calculate emissions, the average speed was determined by averaging trip length and mileage to and from work. The average vehicle speed for public respondents was calculated to be 26 miles per hour with an average two-way trip length of 28 miles. For private organization respondents, the average speed is remarkably greater, at 43.8 miles per hour, as is the average two-way trip length of 56.8 miles. Increasing trip speed according to length, this study suggests relatively less reliance upon secondary roadways for the commute. Effects are calculated assuming two scenarios—one with excluding telecommuting and the other including remote work behavior.

Calculations excluding telecommuting indicate VMT per annum for public sector respondents is 2,664,010. Higher VMT is apparent for respondents in the private sector with a total of 3,072,303. Findings reflect survey data indicating that mean commute distances are significantly greater for private than public sector respondents. Assuming telecommuting has a direct, substitutive effect, calculations for both VMT and emissions are estimated to be reduced under a scenario inclusive of home and remote center work. Among county respondents, for example, declines to 1,788,274 and, for those in the private sector, to 2,667,600, which suggest a reduction of 32% for the Hennepin County respondents and a reduction of 12.5% for the Fingerhut employees. Two actors can account for this difference. The lower percentage of telecommuters surveyed at Fingerhut companies and the use of telecenters (i.e. Saint Cloud) which respondents drove to on their telecommuting days affected the VMT reduction. From an overall perspective, however, it seems that the role of telecommuting might be more a congestion reduction tool than a pollution reduction tool.

The same applies to vehicle emission where telecommuting, reported among Fingerhut respondents, is estimated to have reduced emissions from 109,490.9 pounds to 95,073.3 pounds of total emissions (14,423 lbs.) and from 133,014.9 pounds to 89,856.5 pounds of total emissions (43,118 lbs.) among Hennepin County respondents.

The reduction from 2.6 million VMT to 1.8 million VT equals a rough 30%-commuting travel reduction, which is consistent with a variety of studies prior to this one. When focusing solely on commute trips, the current emission reductions through telecommuting among respondents are considerable. Though the absolute numbers also reflect the number of survey respondents, the greatest emission potential seems to lie in carbon monoxide with reductions of 35,000 pounds annually. This seems to be relevant, as CO is a criterion pollutant of concern in Minnesota because the state has not yet been reclassified by EPA as attaining standards established for this pollutant under the NAAQS.38 The VMT (vehicle miles traveled) and emissions saved through the surveyed telecommuters are only a small percentage of overall VT and emissions in Minnesota. The reduction from 2.6 million VMT to 1.8 million VT among surveyed employees is contrasted with an overall 46 billion VMT in the state of Minnesota in 1997. Thus the reduction of emissions must be seen in relative terms. The reduction of CO of 34,000 pounds (from 106,000 pounds to 72,000) has to be contrasted with overall CO emissions from on road vehicles of 2.2 billion pounds in the state of Minnesota in 1995.

It would be misleading to link telecommuting automatically with an overall pollution and emission reduction in the face of various uncertainties and unmeasured trips. This research merely provides information sufficient to calculate VT and emissions saved through commuting trips replaced by surveyed telecommuting employees. No predictions can be made for additional trips and induced or latent travel demand. However survey results indicate that there are fewer additional trips undertaken by telecommuters. Other studies also agree (Pudget Sound, State of California, San Diego etc.) that the impacts on the amount of additional non-commute travel remain relatively insignificant.39

Implications for Individuals: Quality of Life and Telecommuting

Findings from the literature indicate telecommuting has the potential to greatly benefit individuals, for example, by reducing stress, and negative job-to-home spillover. Other studies, however, suggest telecommuting has potentially negative implications for individual well-being through, for example, increasing social isolation, jeopardizing coworker relations and promotion potential, transference of the cost of business to individual employees, and encouraging work-aholism tendencies.

Telecommuting and Stress

Respondents were asked to respond, using a one-to-five scale from never to very often, to the question: “In the past three months have you felt nervous or stressed?” Results of an independent samples t-test, where \( t(564) = 2.14, p = .033 \), indicate non-telemcommuters (\( M = 3.05, SD = 1.02 \)) on average are significantly more nervous or stressed than telecommuters (\( M = 2.87, SD = .99 \)). Note, however, that the effect size (\( d = .09 \)) is small and indicates only 9% of the variance for the stress variable can be accounted for by whether the respondent was a telecommuter or not. Nevertheless, telecommuters do perceive that their stress has reduced with telecommuting. When presented with the statement “Since I began telecommuting, in general, I feel less stressed,” the majority of telecommuters either agreed (39%) or strongly agreed (46%).

Telecommuting and Work to home Spillover

The survey administered to public respondents was modified to include a scale from the Changing Workforce report designed to capture negative work-to-home spillover. Using a one-to-five scale of never to very often, responses were requested to seven questions. These explored the extent to which time spent engaged in the work role reduced, or had negative consequences for, family and/or other important personal relations, personal task completion, and time for obligations beyond work. The scale has a reliability coefficient of .90. Averaged responses suggest non-telemcommuters (\( M = 2.74, SD = .84 \)) experience more negative work-to-home spillover than do telecommuters (\( M = 2.65, SD = .73 \)), but this slight difference is not statistically significant (\( t(506) = 1.30, p = .193 \)). Therefore, results of this assessment do not support the work-to-home spillover reducing capacity of telecommuting noted in previous research.

Personal Costs

Recurrent themes in the literature suggest possible personal costs that might be associated with telecommuting—e.g., social isolation, negative career implications, increased household expenses and work-life-holism. Each of these potential costs was explored in the current survey. Presented with “I feel isolated on days I telecommute,” most telecommuters in this sample disagreed (66%), while only 11% agreed. Likewise, many telecommuters (59%) disagreed with “coworkers resent my telecommuting” with few agreeing (10%). Reactions to “I am not as likely to be promoted” were mixed—39% disagreed, 41% expressed neutrality, and 20% agreed.

Accordingly, findings from this Minnesota sample do not agree with other studies that suggest a link between telecommuting and concerns that it may jeopardize promotions. Also mixed were reactions elicited by: “Since I began telecommuting, my job utility expenses are higher.” Many telecommuters chose “neither disagree nor agree” (41%) perhaps suggesting that utility expenses are unchanged.

However, 34% agreed that home utility expenses are higher—information that suggests arguments for further cost-benefit analysis of telecommuting with respect to individual participants (as well as organizations) are not unwarranted. Finally, results from the survey suggest non-telemcommuters (\( M = 39.32, SD = 7.02 \)) do not devote as many hours weekly to work as do telecommuters (\( M = 40.28, SD = 5.49 \)). While the results of a t-test are significant, however, \( t(782) = 2.16, p = .031 \), the effect size is very small (\( d = .07 \)) with only 7% of the variance in work hours attributable to telecommuting.

Organizational Implications of Telecommuting

A portion of the survey was devoted to capturing information illustrative of important attitudes and behavior within the work setting. Research indicates that the eventual success of any organizational change program ultimately depends upon its potential to positively affect organizational performance. Consequently, telecommuting initiatives will succeed and expand only to the extent they have clear bottom line benefits for sponsoring organizations. In fact, research does suggest a positive relationship between important bottom-line related job behaviors such as productivity, and attitudes such as job satisfaction and organizational commitment.

The frequently reported connection between increased employee productivity and telecommuting is intriguing. Previous studies suggest telecommuters are more productive when compared with non-telemcommuters. While such work behavior is best measured using a combination of methods—performance appraisal, work portfolios and other such items that allow specific, concrete comparisons to be made upon specific performance indicators—survey data can provide a useful first step in productivity assessment. In the survey, two questions were asked to gauge work performance. One measured self-perception and the second provided a combined telecommuter/coworker perception of telecommuter productivity.

Telecommuter Productivity: Self Assessment of Respondents

Respondents were asked to rate themselves in terms of productivity and work location. To do so, they were presented with two statements, the first stating that the employee could complete more work away from the workplace, and the second suggested he/she could complete more work tasks at work. A cross-tabulation comparing telecommuters and non-telemcommuters on these two elements indicate significant and perhaps not surprising differences. Telecommuting and self-assessment of remote location productivity were significantly relate--telecommuters (72%) were more likely to agree that they are more productive away from work than were non-telecommuters (31%). On the other hand, non-telemcommuters (42%) compared with telecommuters (20%) were more likely to provide a self-assessment suggesting greater productivity at the workplace (Pearson chi square (3, \( N = 776 \)) = 100.71, p < .001).

Telecommuter Productivity: Employee Assessment

Respondents were presented with the following statement and choices: Telecommuters, when working outside the office, are (1) less productive than at the office, (2) more productive than at the office, (3) equally as productive as at the office. Results indicate non-telemcommuters tend to perceive telecommuter productivity outside the office as equal to in the office (56% non-telemcommuters versus 33% of telecommuters). Telecommuters, on the other hand, are more likely to characterize themselves and their colleagues as more productive when working away from the office (64% versus 29%). Few participants assessed telecommuter productivity outside the office as lower than at the office—although more non-telemcommuters (15%) than telecommuters (3%) made this assessment. Again, overall analysis of responses indicate telecommuting and productivity are significantly related (Pearson chi square (3, \( N = 760 \)) = 100.70, p < .001).

Job Satisfaction and Organizational Commitment

Employee satisfaction and organizational commitment are two attitudes widely examined in organizations because each has important bottom line implications. Both are related to low turnover and reduced absenteeism—such outcomes typically reduce human resource costs for
organizations. Both attitudes were explored in the survey. An independent samples t-test was conducted to evaluate the hypothesis that telecommuters exhibit greater job satisfaction than non-telecommuters. Agreeing with previous studies, the test was significant: (t(776) = 2.68, p = .008 and indicates that non-telecommuters (M = 3.87, SD = .83) overall exhibit less job satisfaction than do telecommuters (M = 4.03, SD = .81).

Contrary to previous findings, telecommuters in this sample do not report stronger affective organizational commitment than do non-telecommuters. Results of the t-test were non-significant with t(783) = -1.91, p = .06. In a range of 1 to 5, telecommuters have a mean commitment of 3.28 (SD = .66), and non-telecommuters average 3.19 (SD = .60)—in neither group is commitment particularly strong.

**Summary**

- Survey findings suggest respondents may choose telecommuting in response to personal and employment factors.
- A longer than average commute seems to be a key factor in the decision to telecommute.
- Interest in telecommuting among non-telecommuters increases commensurate with the trip length to and from work.
- Most respondents exercise their telecommuting option on a part time basis.
- In terms of productivity, telecommuters tend to portray the attitude presented in previous studies—that is, they believe productivity and remote work are related.
- As average, telecommutes at both workplaces travel to work significantly fewer days the findings suggest that electronic travel functions to decrease both the number and the distance of work-related travel (vehicle miles traveled, VMT) and the associated emissions during peak commute hours.
- For the most part, electronic travel seems to have been a positive experience for telecommuters. Few participants express concern about possible negative experiences such as coworker resentment or feelings of isolation.
- Almost 25 - 30 % to a quarter of the respondents expressed concern with one possible telecommuting constraint—the belief that telework will diminish potential for promotion.

![A Profile of the Telecommuter](image)

**Barriers to Telecommuting**

Where telework is already on the agenda, the barriers that are most frequently reported for employers and respondents have changed little during the last years:

- restrictive taxation and regulation, or uncertainty about how tax and regulatory rules apply in particular modes of teleworking
- resistance from management who sometimes fear losing control
- lack of confidence that respondents will work effectively in the absence of hands-on supervision; this links with the degree of formality or informality in management styles in different organizations
- trade unions and employee resistance when telework is seen as part of a destabilization of the labor market; regarding the association between telework and part-time work and the outsourcing of tasks previously undertaken by permanent staff within a company. (Doug Lura concedes that the initial developments such as the non-exempt/hourly rate employee work, has caused concern among union representatives at Hennepin County.) Sometimes a re-emergence of piece-meal work or a new Taylorsism with perfect technical supervision, key-stroke counting etc.)
- The personal perspective on telecommuting is sometimes linked with the increase of self-employment—it is feared that moving "off site" will be the first step towards moving to self-employed status and to lose potential job promotions
- relatively under-developed infrastructures in some urban and rural areas
- the perceived high on-cost of the necessary equipment and services

**Notes**

11 D Lura: Hennepin County - personal correspondence (1999)
A lack of infrastructure capable of supporting data-intensive teleworking at acceptable speeds, such as ISDN, ADSL, or two-way Cable, is not only a serious barrier to the uptake of teleworking in an absolute sense, it also introduces relative differences between regions in the state. As Tom Bezinski, Fingerhut Companies, accurately states: "The biggest problem at this juncture is that bandwidth to homes is inadequate—improved bandwidth on a more consistent basis in all the areas where Fingerhut is located is a necessary precursor to telecommuting expansion."

Where the organizational culture is unsympathetic to teleworking, or managers are poorly trained, teleworkers may find themselves marginalized and denied access to ongoing training, full participation in decision-making, and promotion prospects. There is considerable evidence that teleworking works best where hierarchies are flat, bureaucratic rules are minimized, job descriptions are flexible and workers are encouraged to work to targets, which they have negotiated with their managers or teammates. This seems to be the case at Fingerhut Companies and the Hennepin County Government. It is also easier to introduce telecommuting into organizations, which already have a well-developed electronic communications culture—in which staff are already used to using voice-mail, e-mail and other forms of communication, which make location less relevant.

**Study Limitations**

A comparison of results with 1990 US census data reveals essential differences between it and the samples surveyed. Respondents to the survey are more likely to be women and have attained a higher education level than those sampled nationwide. Hence, attempts to generalize findings to organizations throughout the United States should be made with caution. The notable ambiguity of survey results relate at once to the nature of the subject, but in several instances is more an artifact of the limitations of both the research design and instrument. First, the goals investigated were broad and thus only allowed cursory examination. An in-depth probe into any single issue addressed by the survey would have allowed for substantive and perhaps more conclusive findings. As suggested by others, design strategies for examination of telecommuting should include a longitudinal perspective. Changes in behavior are difficult if not impossible to achieve using the static, single shot lens imposed by a cross-sectional survey. Longitudinal data would provide for, at least, more definitive description of relationships.

**Implications and Recommendations**

There is evidence that a higher degree of economic freedom and a less regulated economic climate encourages individualism and acts as a spur to enterprise and innovation and its results can be seen in the high levels of "informal" teleworking observed in the US but also in countries like Netherlands and the UK. For companies and authorities, the main point is to be aware of this factor and its impact on the nature and pace of Information Society developments. A country with a high level of public intervention and public ownership or direction of industries and services may move faster in implementing large scale public applications of technology, but the private sector may wait for appropriate signals from government and a strong public consensus before innovative working methods can be widely adopted.

However, governments can apply proactive measures to facilitate telecommuting developments. For example, in Denmark a small change in the tax laws took place in the summer of 1997, which meant that a computer supplied by an employer for private use in an employee's home was not subject to tax as long as it is also available to be used for work-related tasks. As a result many, especially larger, companies initiated schemes in which typically 75% of employee households are being supplied with a Pentium computer, often also including a printer, modem and Internet subscription. As a result, some estimates now put the incidence of telework in Denmark as high as 15% of the workforce, although depending upon definitions a more realistic estimate is between 5% and 15%.

There is more than one approach to telecommuting; this study focused on the "traditional" route of telecommuting, where telecommuters stay part of the "traditional organization", are typically home-based or in a satellite office and enjoy the benefits for both employer and employee. Studies show, however, that new, small organizations built around networked technology have been established in the last 5-10 years, often resulting from outsourced tasks from larger traditional organizations. Their methods and location of working may be fundamentally different as they are constantly adjusting to send changes in market needs and opportunities, including working at home, in satellite offices, in mobile mode or at any suitable workplace, whether or not owned by the organization. The new benefits, surveyed in this study, will be taken for granted as they are part of the organization's raison d'être. This is similar to the complete self-employed and freelance strategy that many independent or outsourced workers are pursuing. It will be of future interest to determine how and if traditional organizations change in Minnesota and require different work methods as suggested above. In this context it is interesting to note that that even though a significant amount of telecommuters live relatively close to their workplace, the majority lives further away from the work location, scattered around the metropolitan area—presumably enjoying the benefits of the urban economic strength while pursuing a different lifestyle (see also spatial distribution maps).

Telework may also be able to contribute to the de-materialization of economic activity, for example by reducing the need for large, centralized office facilities and replacing these with much more modest locations designed only for meetings and as the occasional base of a nomadic and decentralized workforce. This has become an attractive business proposition for many companies, though this needs to be weighed against the materialization of alternative infrastructures necessary to support such a workforce. Monitoring a number of selected companies, one might be able to show if the structure of selectee enterprises will change in a given time period.

Interestingly, 1990 Census findings indicate public transit use has significantly declined across the nation. Research findings suggest this decline may be tied to an increased demand for greater personal freedom and flexibility than possible with public transportation. The interest shown by non-telecommuters and commuter mode choices made by telecommuters suggest remote work opportunities may provide another appealing alternative to public transportation. Telecommuting should continue to feature prominently in public policy in anticipation, perhaps, that its utilization would attain the levels early predicted for public transit use. In addition, future research should probe the relationship between transit use and telecommuting. Is telecommuting viewed as a substitute for public transportation and are transit user's somehow more inclined to embrace remote work?

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Results from the current employee survey indicate many telecommuters have entered into this flexible work arrangement rather recently. Further exploration of emergent issues at this early stage will ensure the continued success of both telecommuting programs. In this respect it will be interesting for companies and sociological research to describe, as it was attempted in this study, teleworkers according to their work-relevant characteristics such as education, income level, gender, among other characteristics. Other studies indicate that two types of teleworkers and distance workers might develop within the next decade: a highly educated, well paid, flexible leadership type and a less educated, outsourced secretarial type. It would therefore be interesting to determine whether respondents had the choice to telecommute or were pressured to do so. Scholars that observe an increasing societal gap would certainly argue that the first group will have freedom of choice whereas the other group will increasingly have none, referring to a new "digital divide" or "cyber segmentation."43

Finally, the perceived benefits of telecommuting seem to override concerns about its possible negative implications for future promotion. However, most respondents have engaged in telecommuting for only a short time (one or fewer years). The long-term implications of this "node" choice for career development await longitudinal measures. Note that non-telecommuters rated job advancement concerns high among reasons not to telecommute, adding additional weight to arguments that the relationship between telecommuting and career development bear closer examination.

Another relevant fact seems to be the provision of education and training by employers or agencies to enable employees to participate and use these new technologies. Most training is still organized for the young and for students only, not for people already in the workplace. However, people with outdated or inadequate vocational training or technological skills will find it increasingly difficult to access or maintain skilled jobs in the market. The level of continuing education and training, the rationale for selecting or not selecting employees to participate and the potential changes concerning their position within a company structure, will become increasingly important factors to examine.

REFERENCES


Bozinski, Tom, Senior Vice President, Information Services / Fingehut Companies. Personal correspondence (1999).


Mokhtarian Patricia (1998), Varma Krishna: The Tradeoffs Between Trips and Distance Traveled in Analyzing the Emission Impacts of Center Based Telecommuting. UC Davis


Pansing, Cynthia Eric N. Schreffler and Mark A. Sillings, (January 1999), A Comparative Evaluation of the Cost Effectiveness of Fifty-Eight Transportation Control Measures, Transportation Research Recor #1641, Washington DC.


United States (April 1993), Department of Transportation: Transportation Implications of Telecommuting
APPENDIX:

The appendix of this study lists and discusses all of the educational and outreach activities including conference presentations, courses and meetings that were conducted as part of this research project. The conferences, meetings and presentations described in this section were seen as successful tools to raise awareness and spread information about new developments in the technological sector and to bring together interested actors and stakeholders of all levels. The following is a catalogue of all of the educational and outreach activities including conference presentations, courses and meetings that were conducted as part of this research project. These events are organized in chronological order.

INTERNET AVENUE

The meeting regarding the Internet Avenue concept for Central Avenue in Northeast Minneapolis was held on February 9, 1999. The meeting included Minneapolis City Council members Paul Ostrow and Joe Biernat, who represent the two wards that cover Northeast Minneapolis. Tom Horan, visiting scholar, SLPP, was initially contacted by the Internet Avenue group. Tom and Lee Munnich, Director SLPP, were asked to meet and provide input based on their research. The basic idea was to include fiber optic cable in the plans to repave Central Avenue and offer high bandwidth at reduced costs as an incentive to attract internet-related businesses. SLPP’s contribution was to suggest that this might be a necessary but not sufficient condition for such development to occur. Access to low-cost bandwidth would certainly be important to such businesses, but many other factors could influence whether businesses could be induced to locate on Central Avenue. At the meeting, it was agreed that technology alone would not be sufficient to attract businesses. "Bandwidth" is a necessary but not sufficient condition to have businesses locate along Internet Avenue." Instead, the need was expressed to concentrate resources and efforts on making Central Avenue a safer, more attractive, more lucrative place for businesses to locate. It was also suggested that without significant revitalization and economic development efforts at the front end, that the bandwidth would not be enough to bring in or keep businesses.

The company, SavvyNet, has been hired by the City to produce a feasibility study on the installation of high bandwidth fiber along Central Avenue, its potential impact on the area, and the opportunity of marketing a free bandwidth package as an incentive to draw "information rich" businesses to Internet Avenue (Central Avenue, between 14th and 27th Avenues North). SavvyNet was assembling a team of experienced consulting and engineering firms to determine the technical and construction requirements, as well as a plan for business development on Internet Avenue.

Participants:

Marnie McGrath, Council Member Assistant, First Ward; Paul Ostrow, City Council Member, First Ward; Joe Biernat, City Council Member, Third Ward; Dave Boyd, Council Member Assistant, Third Ward; Roger Downey, City ITS Staff; Sharrin Miller Bassa, MCDA Staff; Tom Horan, Visiting Scholar SLPP; Milda Hedblom Adjunct Faculty, SLPP; Lee Munnich Director SLPP; Paul Mitchell, Neighborhood Coordinator; John Peters, Neighborhood Coordinator.
ALEXANDRIA WORKFORCE DEVELOPMENT CONFERENCE

The Alexandria Workforce Development Conference was held on April 6-7, 1999 in Alexandria, MN. Darryl Anderson of Mn/DOT was the panel moderator and a co-presenter for the session on April 6. The title of the presentation was "Update on State and Local Policy Program Telecommunications Research and Its Relation to Workforce Development Issues." Cynthia Parsing, Transportation Research Manager at SLPP was the presenter.

APA NATIONAL CONFERENCE

Tom Horan, Ph.D., Director of Claremont Graduate School of Research, gave a presentation on "Telecommunications and Transportation" at the APA National Conference, April 26, 1999 in Seattle. The Mn/DOT-organized discussion panel also included Adeel Lari, Mn/DOT, and Richard Nordvold, BRRBB.

MINNESOTA PUBLIC WORKS SPRING CONFERENCE, MAY 1999

Between May 12 and 14, 1999, the Spring Conference of the Minnesota Public Works Conference was held, titled "Technology and Competitiveness for the New Century". Mild K. Hedblom, Director Telecommunications Forum/Daim International Consulting presented "Municipal Technology Platforms: Helping Cities Help Themselves."

THE CENTER FOR TRANSPORTATION STUDIES CONFERENCE

The Center for Transportation Studies Conference was held at RiverCentre in St. Paul on May 18-19, 1999. The telecommunications panel session was held on May 18 and was entitled "Spurring Telecommunications Infrastructure: Supply and Demand Implications." Lee Munnoch, Director SLPP, presented "The Supply of Telecommunications Infrastructure and the Potential Demand for Telework and Telecommuting: Preliminary Policy Implications of Trends in Four Minnesota Regions." Darryl Anderson and Adeel Lari, both from Mn/DOT were the other presenters. Cynthia Parsing, Transportation Research Manager at SLPP, was the moderator.

TRANSPORTATION, TECHNOLOGY, AND URBAN DESIGN COURSE HUMPHREY INSTITUTE, SPRING 1999

The course provided an overview on the impact of technological advances on urban structure, form, and design for graduate students at the Humphrey Institute and other interested students at the University of Minnesota. The course included an historical treatment of the rise of transportation infrastructure and how technological developments—principally the automobile and highway construction—became inextricably linked to progress, debates, and preferences about desirable urban form. The course also considered how recent technological advances (beginning with a new generation of smart cars and highways and extending to cover the entire gamut of digital technologies) are affecting the quality of urban experience from a social, environmental and design perspective. A set of methodologies for designing new community forms ("digital communities") was examined. A unique feature of the course was its interdisciplinary approach linking policy, urban planning, transportation, technology, and urban design insights. The course also featured a mix of empirically based studies, local case studies and general historical and conceptual treatments. Topics analyzed and covered in the course included:

History of Technology and Urban Form: The evolution of cities was always linked to technology changes and technological leaps forward affected cities spatially and socially.

The Design Approach: The epistemology of design and its political and social aspects in relation to city form are connected to the technological changes occurring.

Transportation and Urban Design: From the streetcar era to the Interstate Highway System, the transformation of cities and its consequences such as different ring suburbs and population changes become apparent. The question arises whether in the post highway era the invisible telecommunication technology will have impacts that are equally dramatic in its magnitude.

Digital Technologies and the City: Different aspects of work and labor related technologies allow not only a different life and work forms but more so will have spatial consequences for the city structures.

Digital Places: The question whether place or specific places will increasingly become irrelevant is a common belief, as consequence of digital technology.

Strategic Community Design: If new technologies indeed affect the physical reality in which we live, then a new planning approach seems necessary for communities, which will combine a reality of physical and digital places.

Visions of Future Communities: How might communities and communities’ strategies look like to accommodate future needs? Does New Urbanism offer solutions within a world of globalization and concentration?

Instructors: Tom Horan, Lee Munnoch

TELECOMMUNICATIONS AND INFORMATION SOCIETY POLICY FORUMS

The Telecommunications and Information Society Policy (TISP) Forum works with public and private partners to host a series of policy programs on telecommunications and information society policy issues. The forum works to bring together stakeholders, leaders, policymakers and experts from all telecommunications and information sectors in an open, neutral forum. This enables stakeholders to identify and clarify key issues and desirable outcomes.

Headed by Mild K. Hedblom, Senior Associate and Forum Director, HHHH, the 1998-1999 TISP Forum year opened with a new affiliation for the program: the State and Local Policy Program within the Humphrey Institute. This new affiliation recognizes the increasing policy interest at the SLPP in the area of telecommunications and information infrastructure issues. Reports and Transcripts of the sessions are available.

1998 - 1999 Background

One of the trends in telecommunications and information policy notable on the Minnesota scene and elsewhere was the increasing diversification of stakeholders in the policy and service
questions. The measure of this trend can be taken in several ways. At the state agency level it became clear that a half dozen plus agencies now had significant program interests or legal responsibilities in the area. In addition to the long established roles for the Public Utilities Commission, the Department of Public Service and the Attorney General's office, and the Department of Administration, we need to recognize the Department of Transportation and the Department of Economic Development and the Department of Children, Families and Learning also now have significant program activities relating to telecommunications. The impact of the information age on all functional activities of government means that aspects of these issues impinge on almost all agencies in utter disregard of organizational charts or even legislative intent. One of the challenges ahead in state government is to reduce the fragmentation and relative isolation in the handling of key telecommunications and information issues.

Programs in both October and February brought the major broadband players to the platform to discuss their plans for the evolution of information services to broadband in the near future. The major theme of the October program featuring AT&T, IBM and Hughes Networks was the need to move facilities investment ahead of the demand curve and to recognize that the capacity to attract investment rests on the ability of countries around the globe to create fair, independent regulation of liberalized telecommunications markets. The February program looked at the broadband question through the eyes of Teledesic, which is organizing a massive satellite launch with a huge software operating system intending to provide voice, video and data services on a global basis. The CEO of Teledesic outlined the major challenges and opportunities and stressed particularly the difference such a system could make to developing countries.

Among the most innovative initiatives taken up in Forum programming this year was that which examined the attempt to meld into a single telecommunications and information infrastructure demonstration project development planning which combines elements of real estate development, transportation/telecommuting, telecommunications and information services and design considerations. The program outlined the working model, which would be taken to numerous Minnesota communities as partnerships are established.

The Forum has been established as the preferred venue for early public presentation of prospective legislation in the Minnesota legislature. Both the January and the March programs drew large audiences who engaged in extremely lively debate about the need for fundamental rewrite of Minnesota's basic telecommunications legislation. Significant changes in law and regulation at both national and state levels over the last several years are now on the books. Yet many significant goals remain out of reach, as telecommunications environment diversifies more and more anomalies appear which can have significant distorting effects. For example, competition is hardly robust, complaints about service quality and marketing abuses are significant, access to advanced services is still uneven across the state, and universal service goals and funding remain highly controversial. The rationale for proposed new legislation is to develop framework that would treat all providers more equally and better meet the present and future needs of the public in Minnesota. This same search is taking place at the national level and the proposed re-write of the Minnesota statutes has drawn the attention of the FCC, which has invited consultation about it.

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**Forum Participants 1998 - 1999**

The following individual participants and contributing organizations helped create the 1998-1999 Telecommunications & Information Society Policy Forum programming and content:

- James D. Smiley, Vice President, Minnesota, US West
- Senator Steve Kelley, Minnesota Senate, Chair of Ad Hoc Committee on Information Technology
- Admiral Bill Owens, Vice President, Teledesic, LLC
- Milda K. Hedblom, Senior Associate, Forum Director, HIHT, CISIS Fellow
- James Pribyl, Executive Staff, Public Safety, MCI WorldCom, Inc.
- Randy Young, Executive Director, Minnesota Association for Rural Telecommunications
- Scott Brener, US West, Director of Public Policy
- Dan Lipschultz, Office of Attorney General, State of Minnesota
- Mahal Mahon, Director, Technology and Infrastructure, IBM
- Mike Nelson, Program Director, Business Development, Hughes Network Systems
- Andy Wohl, Director, Business Development, Hughes Network Systems
- Richard L. Auld, Deputy Director, Minnesota Office of Technology
- Edwin H. Cohoon, Deputy Commissioner and Chief Financial Officer, MnDOT
- Lee W. Munnich, Jr. Senior Fellow and Director, State and Local Policy Program
- Darryl Anderson, Telework Coordinator, Minnesota Department of Transportation
- Curtis Johnson, Chair, Metropolitan Council
- Murray Kornberg, Vice President of Acquisitions and Financing, CSM Corporation
- Allen Lovejoy, Principal Planner, PED, City of St. Paul
- Jim Prosser, City Manager, City of Richfield

**TISP Programs 1998 - 1999**

- "Doing It Better: A New Model for Joint Action in Telecommunications, Telecom/Information, Economic Development and Community Livability in Richfield and Lowertown, St. Paul"

  In this opening Forum, lead commentators and panelists examined the model being pursued with private and public partners in Richfield and Lowertown, St. Paul, involving early intentional planning for telecommunications and information infrastructure so as to enhance both public and private purposes in city development projects. Comment was provided by representatives of the state agencies which have encouraged the model, including the Minnesota Department of Transportation and the Office of Technology, by the Humphrey Institute, which has been host to the project, leadership from St. Paul, Richfield and the Metropolitan Council and the lead private developer of the Richfield project. September 23, 1998.

- "New Broadband Technology and the Future Of the Internet: AT&T, Hughes and IBM"

  Top level leadership from three of America's key telecommunications technology companies held the platform at this program held in conjunction with the Hereditary Meeting of the International Telecommunications Union in Minneapolis. Dr. Milda K. Hedblom questioned Mahal Mahon, Director of Technology and Infrastructure at AT&T, Mike Nelson, Program Director for Internet Technology at IBM, and Andy Wohl, Director of Business Development at
Hughes Network Systems on their priorities for telecommunications policy which will enable rather than obstruct the global internet: October 21, 1998

- "Sen. Steve Kelley Presents: A Proposed Re-Write of Minnesota's Basic Telecommunications Legislation"

This event reflected the now well-established role of the TISP Forum as the preferred platform for the early presentation and development of key legislative thinking in Minnesota. As Chair of the Ad Hoc Committee on Information Technology and Chair of the Telecommunications and Technology Subcommittee of the Jobs, Energy and Community Development Committee in the Minnesota Senate, Senator Steve Kelley is a key figure in telecommunications and information policy. This program examined his outline for a new framework for telecommunications policy in Minnesota. Comments were provided by leadership of stakeholder groups including MCI WorldCom Inc., Minnesota Association for Rural Telecommunications, US West and the Office of the Minnesota Attorney General. January 27, 1999

- "The Teledesic Story: The Internet in the Sky"

Teledesic is the boldest and biggest venture among several broadband satellite companies aiming to provide broadband telecommunications services from hundreds of mobile satellites. This Forum program was fortunate to have as its guest Admiral Bill Owens, the CEO of Teledesic who presented the strategies, issues and challenges as Teledesic attempts to build a true global Internet in the sky. Broadband satellite systems are one of three new big bandwidth initiatives including underwater fiber (Project Oxygen) and land-based big pipes (Level Three and Qwest).

- "Telecommunications Deregulation: Chapter 237-238 Re-Write"

This program returned to development work on a new approach to basic telecommunications policy through examination of Sen. Steve Kelley's proposal to rewrite Chapter 237 and 238 of Minnesota statutes. Many different viewpoints were put forward by a wide range of participants in the roundtable discussion hosted by Dr. Mild K. Hedblom with Senator Kelley as chief respondent to the comments and concerns put forward. March 15, 1999.

- "Let's Get Digital: The US West View for Digital Growth in Minnesota"

A special combined April-May program featured the second in occasional "CEO Conversations" James D. Smiley, Vice-President in charge of Minnesota US West operation, took the platform for an extended conversation about the importance of digital development in Minnesota from US West's perspective. It was an unusually important conversation since it led to a widely-shared consensus among the key stakeholder groups represented in the conversation that the time has come for action on a basic re-write of telecommunications legislation in Minnesota in order to respond to the reality of digital convergence.