TRANSPORTATION INFORMATION AND COMMUNICATIONS TECHNOLOGY RESEARCH INITIATIVE

Phase I Final Report
TRANSPORTATION INFORMATION
AND
COMMUNICATIONS TECHNOLOGY
RESEARCH INITIATIVE

Phase I Final Report

July, 1998

State and Local Policy Program
Humphrey Institute of Public Affairs
University of Minnesota

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.
Acknowledgments

The Transportation, Information and Communications Technology Research Initiative has been conducted by the State and Local Policy Program of the University of Minnesota’s Hubert H. Humphrey Institute of Public Affairs.

This project has been funded through the Minnesota Guidestar Program of the Minnesota Department of Transportation through the University of Minnesota’s Center for Transportation Studies.

The research team consists of Lee Munnich, Senior Fellow and Director of the State and Local Policy Program; Thomas Horan, Visiting Scholar at the Humphrey Institute and Director of the Claremont Graduate University Research Institute; Milda Bedzins, Adjunct Faculty at the Humphrey Institute and Director, Telecommunications and Information Society Policy Institute; Marnie Werner, Research Assistant, State and Local Policy Program; Virginia Johnson-Burke, Research Assistant, State and Local Policy Program; Don Koski, Research Assistant, State and Local Policy Program. Chris Hoene and Darrene Hackler of Claremont Graduate University have provided substantial research support to the study.

The Humphrey Institute project team was assisted enormously by the help of an advisory council, which provided guidance and direction to the study, providing a sounding board for the project team, and following through on recommendations.

The members of the Advisory Council are: Tom Bozinski, Senior Vice President for Information Services, Fingerhut Corporation; Joann Hanson, Director, Minnesota Office of Technology; Elaine Hansen, Commissioner, Minnesota Department of Administration; Curt Johnson, Chair, Twin Cities Metropolitan Council; Gene Ofstead, Assistant Commissioner, Minnesota Department of Transportation; and Julie Skallman, Assistant Metro Division Engineer, Minnesota Department of Transportation.

A Resource Team provided technical advice and support to the project. The team consisted of: Darryl Anderson, Telework Coordinator, Minnesota Department of Transportation; Bob Benke, Director of Office of Research Administration, Minnesota Department of Transportation; Natalio Diaz, Director for Transportation Planning, Twin Cities Metropolitan Council; Frank Douma, Telework Program, Minnesota Department of Transportation; Dennis Foderberg, Deputy Director, Center for Transportation Studies, University of Minnesota; Tom Sate, Infrastructure and Regulatory Affairs, Minnesota Office of Technology; Bill Schnellman, Director of Telecommunication Division, Minnesota Department of Administration; and Bev Schufl, Assistant Commissioner, Department of Administration.
EXECUTIVE SUMMARY

The mission of this first phase has been to take a comprehensive look at the links between information and communications technology and transportation by exploring the overall condition of the telecommunications infrastructure and readiness for telework in Minnesota, both from a supply and a demand point of view.

Our findings demonstrate that the telecommunications revolution will have multiple implications for transportation management organizations. Telecommunications technology will affect how, why and when individuals and freight move, and it will modify behavior, lifestyle and customer expectations. This will in turn affect residential and business locations, which impact demands on traditional transportation infrastructure. It is recommended that Mn/DOT continue to seek understanding of the relationship between telecommunications and transportation, to embrace telecommunications as a transportation mode, and to consider the ramifications of the telecommunications revolution on traditional infrastructure investments.

In addition to transportation impacts, telecommunications advances portend significant economic, social and community changes for the people of Minnesota. Collaborative efforts among the agencies involved, including Transportation, the Office of Technology and the Department of Trade and Economic Development, will be essential in putting these technological advances to their best use for the state.

I. Development of Telecommunications and Information Policy in Minnesota

The Transportation, Information and Communications Technology Research Initiative Project represents the first phase of a comprehensive look at the links between information and communications technologies and transportation. Like the surface transportation infrastructure of the 20th Century, the telecommunications infrastructure of the 21st Century can have a pronounced effect on the quality of life in Minnesota. These impacts both encompass and transcend Minnesota’s transportation system. That is, they 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.

Experience with planning and managing the transportation infrastructure puts the Minnesota Department of Transportation in a unique position to be an active partner in understanding and guiding — in partnership with the State Office of Technology, the Metropolitan Council, the Department of Administration and others — the development and implementation of this new infrastructure in a manner that maximizes societal gains for all Minnesotans. This preliminary scoping study is aimed at identifying key areas for in-depth examination by the Humphrey Institute on behalf of its transportation/ telecommunications partnership.
II. Findings From Five Scoping Tasks
The scope of the report is divided into five research questions focused on improving the understanding of the impact of information and communications technology on current travel behavior:

- What infrastructure capacity is required to allow people to conduct electronic business from anywhere in the state?
- What incentives can the state provide to encourage technology-intensive businesses to start up in and relocate to Minnesota?
- What tax and regulatory policy barriers exist that prevent Minnesota from developing required capacity and making the state a mecca for electronic commerce?
- What factors will influence or hasten the shift in popular consciousness that will make Minnesotans more likely to embrace new work paradigms, specifically telecommuting and more advanced work uses of information and communications technology?
- What is the impact on transportation requirements in the metro area if Minnesotans are empowered and enabled to work at home, and what will be the transportation infrastructure impact in rural areas?

Task 1: Assess capacity to conduct electronic business from anywhere in the state

Virtually all businesses, electronic or otherwise, are incorporating high technology into their structure in some way. Where companies locate in the future will be determined in large part by the access they will have to the telecommunications services they need, and Minnesota must be aware of these needs if the state is to become a “mecca of electronic commerce.” Telecommuting, as a subset of electronic business, is also highly dependent on what kinds of telecommunications are available and practical.

By conducting a limited survey of telecommunications and data service providers from around the state, we found that the cost and availability of access to high-speed data transmission, a basic necessity of telework, varies considerably and depends largely on what the providers perceive the demand to be in the market.

Some other perceptions of the telecommunications environment in Minnesota emerged from interviews and focus groups:

- A critical shortage of workers with high-tech and computer skills is becoming serious enough to hinder corporate growth.
- Businesses want higher, less-expensive bandwidth with easier access.
- Strong leadership from the political, business and educational fields is essential if a coordinated plan for the future is to be created and achieved.

Task 2: Incentives to encourage technology-intensive businesses

Through interviews and focus groups with individuals in business and government, we identified and assessed the incentives that would encourage technology-intensive businesses to start up or relocate in Minnesota. At the top of the list for businesses is a skilled workforce, something Minnesota is finding in short supply along with the rest of the country. To remain competitive in attracting workers, some companies are beginning to use telecommuting as an incentive in hiring. Firms are also encouraging Minnesota’s education community to start future workers young by ensuring an adequate science and technology curriculum in their K-12 education.

Minnesota also needs a clear, comprehensive economic development plan that defines the state’s goals, including electronic commerce, and a strategy to meet these goals. Such a plan will require a strong hand, preferably from the governor, to create programs that coordinate the efforts of state agencies, education and business in achieving a productive technology environment. This strategy must have a strong transportation and land-use dimension, so that economic development efforts in the high-tech field are consistent with the desired growth strategies of the Metropolitan Council and the transportation strategies of Mn/DOT.

Other incentives include better access and more flexible capacity; a manageable regulatory environment that does not put companies at a competitive disadvantage; and quality-of-life issues that would be considered by a relocating company.

Task 3: Tax and regulatory policies that present hurdles

Researchers found that although businesses specializing in electronic commerce are willing to pay their fair share of taxes, they are concerned that regulations and taxes set at the state and local level could put them at a competitive disadvantage. At the same time, Minnesota is reluctant to go first in creating any special regulations concerning electronic commerce for fear of discouraging businesses from locating in the state. For the sake of uniformity, the consensus appears to be that the federal government must lead the way in regulations concerning electronic commerce.

Task 4: Factors that will influence a shift in popular consciousness

The advent of telework as a transportation mode provides a new opportunity to enhance the efficiency of Minnesota’s transportation infrastructure; this is especially timely given the growth in transportation demand expected over the next twenty years. Moreover, telecommuting can serve as an important economic development tool by enabling corporations to attract and retain workers. Businesses who allow employees to telecommute will have a competitive advantage in a climate where workers with computer and technology skills are in short supply. Businesses are also finding that for workers who are suited to telework, productivity can increase. Some firms are also turning to telework as a means of saving space instead of taking on expensive building expansions.

Another recurring theme in improving telecommunications capacity came from communities that are developing advanced telecommunications networks as a way of attracting businesses and keeping residents. Two examples are the cities of Grand Rapids and Winona. In urban St. Paul, the Lowertown neighborhood has been creating a “cyber village,” attracting high-tech companies to the previously depressed area offering a well-wired environment.
Based on results from interviews, focus groups, reports and surveys, it is obvious that telework does not happen by accident. To enable an employee to work effectively from a remote location, there needs to be good planning, a common agreement and a vision shared by those involved. To achieve this, employers, employees and the government must understand how telework functions, why it can be advantageous and how it is best implemented. Based on a preliminary review of the data—as complemented by expert interviews—there appears to be considerable merit in developing a means for identifying both: 1) the key community and organizational prerequisites for enabling telework and 2) possible demonstration localities for enhancing the visibility of the telework/telecommuting option.

Task 5: The potential impact of telework on transportation infrastructure needs
Minnesota's plan for becoming a high-tech mecca must recognize the joint role of transportation and technology in stimulating both economic and community development. The means through which Minnesota's industries utilize information technology and establish organizational approaches that promote telework/telecommuting become the central link to transportation policy in this task. Initial research indicates the following: 1) Minnesota's economic base and growth industries are well-suited for telework programs; 2) targeting industries with specific telework solutions that they help design and promote improves the likelihood of success; 3) telework programs should not be viewed as a cure-all for transportation woes; 4) beyond telework programs, telecommunications alters the role of transportation from moving people to moving information. Continuing tasks will include:

- Through assessment of Minnesota's transportation problems and the companies and employees affected, develop a framework to tailor telecommuting programs for specific corridors. The Hennepin County case serves as an initial example.
- Analyze possible relationships where telecommunications and travel can come together to promote the development and revitalization of communities.

III. Conclusion
Based on preliminary data collection, focus groups and interviews, we conclude there is a significant emerging relationship between telework, Minnesota's workforce, transportation and the state's overall economic competitiveness.

Key areas for future action are:

- Develop and implement a feasibility study for an electronically enriched community demonstration project analyzing possible relationships where telecommunications and travel could come together to promote the development and revitalization of communities.
- Develop profiles for telecommuting programs to assess electronic travel readiness and scenarios in Minnesota, including community design and transportation system impacts.
- Analyze the relative importance of Minnesota's telecommunications infrastructure to the state's economic competitiveness and urban growth using selected Minnesota cities. Using other "competitor" cities, comparisons and conclusions can be drawn as to the importance of a high-speed telecommunications infrastructure in attracting and retaining high-growth businesses to the state. This analysis will assess the relative importance of telecommunications vs. transportation infrastructures in attracting businesses to Minnesota, as well as the land-use implications of this economic growth strategy.
- Develop outreach channels to the community in the form of a symposium on the demonstration project, forums and educational material based on telecommunication policy and community design to raise awareness of the possibilities of telecommuting and advanced telecommunications services.
- Consolidate and coordinate statewide executive leadership through the Governor's office for telecommuting and improved telecommunications standards in both the private and public sector.
# Table of Contents

Executive Summary ........................................................................... i
Introduction .................................................................................. 1
Development of Telecommunications and Information Policy in Minnesota .......... 1
Pressure for Change .................................................................... 2
Minnesota's Response .................................................................... 3
Joint Responsibilities ...................................................................... 4
Scope of Research Project .............................................................. 5
Methodology .................................................................................. 5
Critical Issues .............................................................................. 6
Telecommunications Infrastructure Capacity (Task 1) .................................. 7
The Electronic Business Infrastructure ................................................ 7
Differing Perspectives among Stakeholders ....................................... 7
Profiling Telecommunications Services .............................................. 8
What the profile shows ................................................................... 9
Comparing Other States .................................................................. 12
Telecommuting Issues and Business Incentives in Electronic Transactions (Task 2) ... 13
Telecommuting Issues .................................................................... 13
Business Incentives ....................................................................... 15
Tax and Regulatory Policies (Task 3) .................................................. 17
State and Local Policy .................................................................... 17
Federal Policy .............................................................................. 18
A look at the National Tax Association Report .................................. 18
Influencing Popular Perceptions (Task 4) .............................................. 18
Regional Economic Influences .......................................................... 19
Telework and telecommuting .......................................................... 21
Organizational Implications ............................................................. 22
Next Steps: Community-Based Outreach .......................................... 27
Transportation and Telework (Task 5) ................................................. 27
Telecommuting and Travel Behavior .................................................. 27
Telecommunications, Minnesota, and the 21st Century ....................... 35
Recommendations ......................................................................... 37
Appendices .................................................................................. 41
Introduction

Telecommunications, information technology, electronic networking and information services; all these have expanded dramatically. A variety of factors account for the expansion, including these:

- The continual advancement of digital technology
- The proliferation of new software
- The declining acceptance of regulation of the telecommunications industry
- The diffusion of computer access
- Business, educational and home user appetite for network services
- Rationalization of Internet space via the World Wide Web
- Increasing appeal of electronic transactions
- Large institutional interest in electronic services
- Desire to reduce environmental costs through electronic substitution
- The practical possibility of cost-effective global information networks

It is widely understood that we are now in the midst of an information age where telecommunications, information technology, electronic networks and information services are becoming essential to almost all environments and transactions including work, learning and leisure.

The information age carries with it profound consequences for economic and political life in Minnesota no less than elsewhere throughout the country and around the world. In Minnesota, two agencies with different but related responsibilities have collaborated with the Humphrey Institute to begin this research initiative, which will develop a clearer understanding of the impact of information and communications technologies on transportation needs, travel patterns, economic development and sustainability. This final report on Phase I discusses the findings of the last several months' work and serves as a source of direction for the development of future research.

Development of Telecommunications and Information Policy in Minnesota

Prior to 1990, public policy affecting telecommunications and information excited very little general interest in Minnesota. Initially, different regulatory models were applied to telecommunications (which mainly meant telephony) and media industries (radio and television). Within these models a regulatory division of labor evolved between the federal and state levels based on technologies which had been relatively stable into the 1960s. But new technologies and businesses appeared in the decades between the 1960s and the 1990s, including cable television, wireless signals for telephone service, and the linking of computers to the transport network for data services. The immediate reaction to the new technologies and services was to apply the existing models of regulation.
In the 1970s and 1980s, the federal arena was the scene of action as new policies in telecommunications were adopted that helped lay the framework for today's approach to regulation. Such policies included the division of telephony service into local and long-distance companies, the introduction of competition into the long-distance service market, and the licensing of new cellular telephone technology. Furthermore, states were pre-empted from direct involvement in the regulation of broadcast media, and eventually cable regulation was also concentrated at either the municipal level or the federal level with occasional legislative redistribution of prerogatives between the two. All this meant that, through most of the 1980s, the majority of states proceeded on a business-as-usual model of public policymaking in the area of telecommunications.

The prevailing model guiding Minnesota's public decision making on telecommunications issues before the 1990s was the regulated industries model, a concept that fell from favor in the 1990s. The essence of the regulated industries policy guaranteed cost plus profit to the monopoly local service telephone providers. It was implemented through ever more elaborate and arcane cost, depreciation and pricing formulas established through costly and protracted administrative and regulatory hearings.

The first major strike against the regulated industries model was the decision in the mid-1980s to end the AT&T monopoly on all telephone service by first dividing AT&T into long-distance and local companies, then opening up the long-distance telephone market to competition. By the mid-1990s, that same idea was applied to local telephone service. At the present time, the promotion of local competition is the guiding principle of the telecommunications policy model in Minnesota and at the federal level. There were several reasons for this shift from a regulated industries approach to the promotion of competition, including, among others, the perception that existing providers dropped their feet on new technology and services, concern that the cost-plus-profit formula left too much profit in phone company pockets, and the wish to open the door to new companies that could offer new combinations of service in a digitally networked world.

Pressure for Change

In the late 1980s and early 1990s, public interest picked up. The names of the state agencies that had control over this area of policy began to appear more often in the media: the quasi-independent Public Utilities Commission, the Department of Public Service and the Attorney General's Office. While the telephone companies have always been central to telecommunications policymaking, various other interests have become involved to a greater or lesser degree. Large end-users organized under the Minnesota Business Utilities Users Council were among the earliest to be heard in the policy process, along with unions in the communications industry. Throughout this decade other interests have become active, including end-user groups such as the Senior Federation, AARP, and consumer associations with strong concerns about price increases; ad hoc groups advocating more rapid dissemination of higher-capacity service; the cable television lobby and electrical utilities, based on the possibility that they could provide high-speed telecommunications services; and the computer networking and Internet industry with concerns over network design and pricing.

During the 1990s, a number of reports and studies examined the Minnesota telecommunications and information landscape. The Citizen League, in writing "Wiring Minnesota 1990," engaged in an extended study assessing the statewide infrastructure and recommending simplification and consolidation of state agencies. It also urged a more aggressive policy in Minnesota to assure access to advanced information infrastructure. Following that study, several other reports were developed under the guidance of the Public Utilities Commission ("Minnesota Telefuture," 1993), the Government Information Access Council ("Government Information Access Council Principles," 1996), and the Department of Administration ("Supporting Minnesota's Information Infrastructure," 1997), all arising out of a concern for the relative health of telecommunications and information services in Minnesota.

During these years, profound changes occurred in technology, in industry and in services, changes which forever shattered the tidy world of telephony policy making. A massively interconnected world emerged through the power of the Internet and the World Wide Web. The telephone world was caught by surprise as demand for data service boomed. The possibility that video companies could adapt to data or phone service, that phone companies would re-engineer to the data world, or that wireless services could aim to replace wire-line services all undermined the monopoly provider model with its rate of return fixed through regulation.

Minnesota's Response

The response to the new set of demands took two major forms in Minnesota. One was the passage in 1995 of a pro-competitive telecommunications law providing for competition in the local market, although the law was implemented in separate stages for larger companies and small, rural companies. At the federal level, the Telecommunications Act of 1996 mandated similar changes. State regulators have needed to coordinate the implementation of both sets of legislation. The second response was driven by another set of interests in the high technology and information services industries, as well as by strong demands from user groups in education, libraries, government services at all levels, health care, and economic development interests. This grouping of interests differed in their needs, but collectively they exerted pressure on state government to adopt a more pro-active and coherent approach to information infrastructure and information services policy in Minnesota.

As the scope of issues widened in the 1990s, state government came under pressure to find a home for the newer interests and to rationalize in some way its own approach to issues that no longer fit the narrow telecommunications mold. This led to the formation in 1996 of the Minnesota Office of Technology, which was anticipated to become the lead agency in the arena of technology and information.

Other state agencies, however, developed programs prior to the implementation of the Office of Technology. The two most notable departments are the Department of Administration and the Department of Education, now renamed the Department of Children, Families and Learning. The Department of Administration is the continuing
home of the telecommunications services entity, which leases services from the telecommunications service providers and in turn, offers these services to state and other public entities throughout Minnesota under the MNet label, a function which is authorized under statute 16b.465. The scope and status of the state's leased telecommunication network has from time to time been the subject of controversy, especially in greater Minnesota. Some Main Street, small-business users contend they pay more for similar services from local service providers. The State, however, leases lines from the local telephone companies at the tariff rate, and therefore specific instances would have to be examined.

Educational interests have joined hands across the entire sector of education and now manage their needs for telecommunications and information services through the Minnesota Telecommunications Education Council. They have been remarkably successful in gaining support at the legislature for technology deployment in schools. Nevertheless, not every school and not every child has access to the electronic tools and services that are a necessity today.

The Department of Transportation is a new player on the telecommunications and information policy scene although it has been at the forefront of ITS-specific applications. There are several dimensions to its work in this area. The first is a major project, launched December 31, 1997, to develop a fiber optic network around the state on the highway rights of way through a private-public partnership. The department has also been involved in developing the Cambridge Telecommuting Center and also has a significant interest in the use of smart cards for driver registration purposes, among other possible purposes the state might have for such cards. The Guidestar program also continues to test and apply new concepts to transportation.

**Joint Responsibilities**

The Minnesota Department of Transportation and the Minnesota Office of Technology have joined hands in this study because they both see a need to better understand the role of telecommunications and information technology in the immediate and longer-term future of transportation planning in Minnesota.

**Scope of Research Project**

Five major research tasks were identified for this study, developed jointly by the staff of the Office of Technology and the Minnesota Department of Transportation. The first task is to analyze Minnesota’s infrastructure capacity, in particular what infrastructure capacity is required and what is available to allow people to conduct business electronically from anywhere in the state. The second task is to identify incentives the state can provide to encourage technology-intensive businesses to start up and relocate in Minnesota. The third task assesses what tax and regulatory policy barriers prevent Minnesota from becoming a mecca for electronic commerce. The fourth task is to identify factors that will influence a shift in popular consciousness toward embracing new work paradigms, specifically telecommuting and more advanced work uses of information and communications technology. The fifth task is to analyze the impact on transportation infrastructure requirements in metropolitan and rural areas if people are able to work from home.

Research on Minnesota’s infrastructure capacity, business incentives, and tax and regulatory environment (research tasks 1, 2, and 3) revealed some important trends that allowed us to extrapolate the critical issues. Our goal is to tell a story that captures these trends, and from which we can proceed with ongoing research, including data collection and quantitative analysis.

**Methodology**

In the first phase of research we took a qualitative approach in addressing the questions raised in order to illuminate general issues and perceptions. Focus groups were conducted with three industry groups that have the potential to benefit from increased use of electronic commerce: the wood products industry, value-added agriculture, and the computer and software industry. Interviews were also conducted with individuals representing key state agencies, critical user groups, providers of communications services, or who were associated in some aspect with the identification of technology needs or provision of services. The goal has been to obtain perspectives from a range of interests rather than in-depth perspectives of any particular group.

In the second phase of research, we concentrated on telecommuting: why it is undertaken and what resources are needed to make it successful. To find the reasons why companies use telecommuting, we chose a representative list of metro-area companies and questioned personnel on whether they have telecommuting programs, if so, why, and if not, why not. We also conducted a survey at a telecommuting conference, assessed several outside reports and surveys on telecommuting, and conducted a focus group of people involved in corporate telecommuting.

We also surveyed a selection of telecommunications providers from around Minnesota to create an idea of what kind of data services are available to the employee who wants to work from the home and of what the current and future trends are in the availability of data services.
Also within this report we have included short examples of three cities that have successfully integrated advanced telecommunications systems into their communities: Winona, the Lowertown neighborhood of St. Paul, and Grand Rapids.

Critical Issues

The “story” that has emerged is one where the new information and telecommunication technologies are tightly intertwined with economic development, productivity, and growth; this interconnection will affect land use and transportation demand in several ways. Companies are using telecommunications technologies increasingly to their competitive advantage, when they can. In particular, telecommuting has moved to the center of the focus as a way for companies to attract and retain employees, increase productivity and conserve space. Currently, infrastructure that would allow telecommuting in Minnesota is spotty, i.e. in some areas good, and in some areas accessible only at prohibitive costs and with complicated logistics. Availability and prices vary drastically around the state.

Several critical issues emerged in interviews and focus groups with key stakeholders:

- **Telecommuting** may, for the state, be about transportation planning, but to businesses it is a system for an important economic development tool by enabling corporations to attract and retain workers. Businesses who allow employees to telecommute will have a competitive edge in a climate where workers with computer and technology skills are in short supply. It is also becoming useful as a solution for space constraints and the high cost of building expansion.
- There is a pressing need for a labor force with high tech and computer skills. There are not enough workers with computer skills to fill employers’ needs, creating the potential to stifle companies’ productivity and growth.
- **Quality of life** is becoming an important factor in creating a favorable business climate. Features of a region that enhance a high quality of living will contribute to competitive advantages for the business community. Telecommunication technologies that allow flexibility, mobility, and choice will contribute to a high quality of life.
- There are **differing levels of service and access** between communities across Minnesota. These differences cannot necessarily be attributed to rural or urban location. Rather, differences in service are directly related to the provider’s perception of market demand.
- Users of information and communications technologies want **higher bandwidth, cheaper bandwidth** and ubiquitous access.
- **Electronic commerce** is gaining momentum as a national and international method of business. The speed at which it is adopted will depend on bandwidth availability and security.
- There is a need for **coordination** by political, business, and educational leadership to identify a shared vision for the future.

Telecommunications Infrastructure Capacity (Task 1)

The first task of this project was to assess the capacity to conduct electronic business, particularly telecommuting, from anywhere in the state given the information infrastructure in Minnesota. We began with a general outline of the infrastructure needs for conducting electronic commerce. We then proceeded with the identification of key stakeholder groups and an exploration of their perceptions on critical issues of information infrastructure in Minnesota. From this research a general set of issues has emerged clarifying a “perceptual map” held by stakeholders. This map reveals the inconsistency among perceptions of telecommunications capacity in Minnesota.

The Electronic Business Infrastructure

Business conducted electronically and via the Internet has gone from being a phenomenon to a trend. A broad definition of electronic business could be the use of some aspect of computer and communication technologies to transact business. We know that electronic commerce is expanding rapidly with the implementation of higher bandwidth access and security technologies, and it is anticipated that it will continue to expand. These trends are driven mainly by private-sector innovation and investment. Right now, it appears that electronic commerce occurs largely at the national and international levels, but it is quickly filtering down to smaller entities. Worth questioning is the role that public policy and the state of Minnesota should play regarding these new developments.

Worth watching will be companies in Minnesota engaged in the sectors of electronic commerce noted above. We currently can take note of a few successful ventures that include, among others, Hubbard Broadcasting and USSB, and the software industry, which provides innovative software content. The United Nations Trade Point project is a further pioneer project in electronic commerce.

Differing Perspectives among Stakeholders

In interviews and focus groups with key stakeholders, we explored the state’s infrastructure capacity, examining current capacity, improvements needed, the requirements to conduct electronic commerce from anywhere in the state, the role for state policy, and some comparisons with other states. From this exploration, three general perspectives emerged, painting different portraits of Minnesota’s infrastructure capacity.

- According to one perspective, the telecommunications infrastructure in Minnesota is problematic. This position was articulated clearly by representatives of the computer, software, and high tech industries, who rely on high-quality, high-speed, reliable telecommunications. According to this opinion, current capacity is expensive, inconsistent in availability, not seamless, and not flexible in terms of meeting a business’s capacity needs as its needs change. Improvements to infrastructure should lower the cost of bandwidth, provide for ubiquitous access, and implement scaleable technology. In comparison to other states, Minnesota is perceived as less aggressive
about getting high-speed connectivity to every community, and technology is less flexible and less reliable. This group would recommend that state policy should be used to build ubiquitous bandwidth and interconnect systems. State policy should also focus on improving the educational system, which should be preparing higher numbers of high-tech workers.

- According to a second perspective, articulated by state agency representatives, Minnesota's infrastructure generally meets the needs placed on it. In general, capacity is considered more than adequate within the populated corridors from the Twin Cities to St. Cloud, Rochester, and Duluth. The problem is not with infrastructure; rather, there are problems with the "how-to" of using it, or problems with the support of technology once it is installed. According to this position, users can have access if they need it. Competition will ensure the provision of service at affordable rates. Prices will drop when a critical mass of demand is reached or when the technology becomes more efficient. This group would recommend that state policy should focus on bringing people from different sectors together to identify common goals. State policy also needs to provide for technology needs of the state educational system, in both K-12 and higher education.

- According to the third perspective, Minnesota's infrastructure capacity meets some needs and falls short in other areas. This position was articulated by certain business user groups and by rural and small-town users. Current capacity is generally adequate within the populated corridors, but many remote areas do not have access, or only have access at prohibitive costs. Capacity is uneven, but not necessarily along a rural-urban split. Rather, capacity is contingent on the presence of a provider willing to make the investments to provide a high level of service. Certain businesses have dedicated lines for their own use, but these do not necessarily benefit the community at large. Compared to other states, Minnesota is not as comprehensive in its efforts, although an information policy office puts Minnesota in a stronger position.

Table 1: Key stakeholders involved in connecting Minnesota through information and communications technologies.

<table>
<thead>
<tr>
<th>Legislative Leaders</th>
<th>Lawmakers who may also set the tone for policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>State agency actors</td>
<td>Office of Technology, Department of Administration, Department of Public Service, Public Utilities Commission, Attorney General Office, Minnesota Department of Transportation</td>
</tr>
<tr>
<td>Providers</td>
<td>Providers of telephony services, internet services, fiber installation, cable companies, wireless providers, electric utilities, municipal providers</td>
</tr>
<tr>
<td>Business Interests</td>
<td>Big business, high tech business, small business</td>
</tr>
<tr>
<td>Users</td>
<td>Public user groups, the non-profit sector, rural and small towns, residential users</td>
</tr>
</tbody>
</table>

Profiling Telecommunications Services

As mentioned above, telecommunications, especially the availability and prices of data services, vary considerably depending on where one is in Minnesota. Location determines the service provider, who for the most part determines the types of service available.

To "take a snapshot" of telecommunications service in Minnesota, we constructed a service profile (Table 2) to demonstrate the availability and prices of service around the state. Since our study focuses on telecommuting, we have concentrated on determining what high-speed data service is available to the home.

Level of service is one concern for potential telecommuters. Different levels of service, i.e., different speeds of data transmission, exist at varying costs. Identifying the right level of service, therefore, is an issue for the individual customer, who must balance the speed needed against the cost and whether that particular service is even available in his or her area.

Service availability is determined almost completely by the provider itself and what it perceives the demand to be. Some choose to provide one service and not another because they perceive that the demand "is not there," while another provider reads a different demand from its customers. Some of this difference has to do with the make-up of the customer base. One outstate Minnesota provider offers ISDN to businesses but not to homes because its rural customers haven't expressed a demand for it yet and the "incentive isn't there." A neighboring telecommunications provider does offer ISDN to homes, many of which are summer cabins, for people who would like to stay a few extra days and telecommute to their offices. The parent company of this same telecom has a philosophy that its rural customers should receive the same service as urban residents.

What the profile shows

Table 2 compares the offerings of seven companies providing high-speed data service to Minnesotans. From the profile, it is apparent that service varies quite a bit around the state and there is little uniformity in the offerings. The most common high-speed service available to homes right now is ISDN, but the fees vary, despite Minnesota's tariffed rates on ISDN (see Table 3). Few telecoms have a flat monthly price for any of their services. Many different factors can affect the price, including choice of speeds, choice of capacity, the distance from the home to the switch or station, connection charges, interstate or intrastate service, the percentage of the line passing through other telecoms' territories and many other factors. "Non-recurring" charges, which include the installation fee, can be just as complicated.

1 Interview, Gary Johnson, advanced services manager, Paul Bunyan Rural Phone Cooperative, April 16, 1998.
Table 2: Selected rates for high-speed data services in Minnesota

<table>
<thead>
<tr>
<th>Service type</th>
<th>Monthly rate</th>
<th>Installation fee</th>
<th>Percent available</th>
</tr>
</thead>
<tbody>
<tr>
<td>56K</td>
<td>$287</td>
<td>$360</td>
<td>100%</td>
</tr>
<tr>
<td>ISDN</td>
<td>$39</td>
<td>$75</td>
<td>30%</td>
</tr>
<tr>
<td>DSL</td>
<td>$40-60 est.</td>
<td></td>
<td>60%</td>
</tr>
<tr>
<td>T-1</td>
<td>Interstate: $845</td>
<td>Interstate: $385</td>
<td>100%</td>
</tr>
<tr>
<td>Fiber</td>
<td>Individual contract basis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Paul Bunyan Rural Telephone Cooperative, Bemidji, Minn.

<table>
<thead>
<tr>
<th>Service type</th>
<th>Monthly rate</th>
<th>Installation fee</th>
<th>Percent available</th>
</tr>
</thead>
<tbody>
<tr>
<td>56K</td>
<td>$128</td>
<td>$200 est.</td>
<td>95%</td>
</tr>
<tr>
<td>ISDN</td>
<td>Only available to schools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DSL</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-1</td>
<td>$354</td>
<td>$443</td>
<td>99%</td>
</tr>
<tr>
<td>Fiber</td>
<td>$4,110</td>
<td>$998</td>
<td>100%</td>
</tr>
</tbody>
</table>

TDS Telecom, Pequot Lakes, Minn.

<table>
<thead>
<tr>
<th>Service type</th>
<th>Monthly rate</th>
<th>Installation fee</th>
<th>Percent available</th>
</tr>
</thead>
<tbody>
<tr>
<td>56K</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISDN (128k)</td>
<td>$55</td>
<td>$56</td>
<td>100%</td>
</tr>
<tr>
<td>DSL</td>
<td>Planned for future</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-1</td>
<td>Individual case basis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiber</td>
<td>Individual case basis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Frontier

<table>
<thead>
<tr>
<th>Service type</th>
<th>Monthly rate</th>
<th>Installation fee</th>
<th>Percent available</th>
</tr>
</thead>
<tbody>
<tr>
<td>56K</td>
<td>Intrastate: $105</td>
<td>Interstate: $108</td>
<td>$36</td>
</tr>
<tr>
<td>ISDN</td>
<td>$190</td>
<td>$200</td>
<td>90%</td>
</tr>
<tr>
<td>DSL</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-1</td>
<td>Intrastate: $200</td>
<td>Interstate: $224</td>
<td>$36</td>
</tr>
<tr>
<td>Fiber</td>
<td>Individual case basis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

USWest

<table>
<thead>
<tr>
<th>Service type</th>
<th>Monthly rate</th>
<th>Installation fee</th>
<th>Percent available</th>
</tr>
</thead>
<tbody>
<tr>
<td>56K (Frame Relay)</td>
<td>$75-80</td>
<td>Approx. $100</td>
<td></td>
</tr>
<tr>
<td>ISDN</td>
<td>$149</td>
<td>$110</td>
<td></td>
</tr>
<tr>
<td>DSL</td>
<td>$40-120</td>
<td>$110</td>
<td></td>
</tr>
<tr>
<td>T-1</td>
<td>$350-400</td>
<td>$750</td>
<td></td>
</tr>
<tr>
<td>Fiber</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MRNet, Plymouth, Minn.

<table>
<thead>
<tr>
<th>Service type</th>
<th>Monthly rate</th>
<th>Installation fee</th>
<th>Percent available</th>
</tr>
</thead>
<tbody>
<tr>
<td>56K</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISDN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DSL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiber</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* MRNet is a major Internet service and data service provider in Minnesota, but they declined to have their prices included in the report.

---

3 Rates for 56K, DSL and T-1 vary considerably depending on distance, local communication charges at each end, interstate or intrastate, NECA rates and other factors.
4 Representative example: Blue Earth to Fairmont, 18 miles. Customer chose interstate rate since many of their calls go out of state.
5 ISDN will be available this summer to customers in New Prague.
6 Expected to be available this summer to Blue Earth customers.
7 Depends on distance.
8 T-3 10Mbit fiber-based service.
9 Plus charges for channel knowledge termination and fees dependent on distance and percentage of facilities crossing other telecom territory.
10 Unlimited time, 2 channels, 128K.
11 Promotional price.
State and Local Policy Program

goast.net, St. Paul, Minn. (currently offers only to businesses)

<table>
<thead>
<tr>
<th>Service type</th>
<th>Monthly rate</th>
<th>Installation fee</th>
<th>Percent available</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Line charge</td>
<td>Internet access</td>
</tr>
<tr>
<td>56K</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISDN (dial in, 128k)</td>
<td>$00</td>
<td>$149</td>
<td>$449</td>
</tr>
<tr>
<td>DSL (256k to 1M)</td>
<td>$40-120</td>
<td>$249-649</td>
<td>$509-609</td>
</tr>
<tr>
<td>T-1</td>
<td>$530</td>
<td>$899</td>
<td>$2,489</td>
</tr>
<tr>
<td>Fiber (Ethernet)</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This profile and these interviews suggest that telecoms have not had enough demand from residential customers to offer clearly defined, “off-the-shelf” packages of services. Few telecoms have evolve[d] their offerings into discrete packages. One company that does is US West, which offers its DSL service to consumers through its MegaBit Service, distinct packages priced according to speed using a fixed monthly rate and non-recurring installation charge.13

The price profile also suggests that older high-speed services are being dropped in favor of newer, faster services. In fact, providers in areas where there have not been high-speed service are in some cases skipping over intermediate services (56K and ISDN) and going straight to the newer technology, like DSL.14 A report by the Wisconsin Public Service Commission suggests a similar idea.15 Although they did not feel that ISDN will ultimately be replaced by DSL, the report states that many in the industry want to pursue DSL because it uses the copper wires already in place in homes, instead of installing new lines.16

Comparing Other States

Table 3 shows tariffed rates for ISDN in several states, including Minnesota. The tariffed rate is a basic line charge set by the state government. The tariffed rates in different states can be compared to each other, but those rates do not reflect the many other fees associated with implementing a high-speed line, which include installation, materials, internet access charges, and other recurring and non-recurring fees. These fees vary from provider to provider and according to density of population and geography. The more thinly populated an area, the more likely fees are to be higher or for the service not to be available at all.

<table>
<thead>
<tr>
<th>State</th>
<th>Service Area A</th>
<th>Service Area B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minnesota</td>
<td>$39</td>
<td>$92</td>
</tr>
<tr>
<td>Iowa</td>
<td>$46</td>
<td></td>
</tr>
<tr>
<td>Wisconsin</td>
<td>$16</td>
<td></td>
</tr>
<tr>
<td>Washington</td>
<td>$35</td>
<td></td>
</tr>
<tr>
<td>Oregon</td>
<td>$69</td>
<td></td>
</tr>
</tbody>
</table>

DSL is being introduced this year by US West in many of the cities it serves, but availability varies even within the metropolitan areas where it is available. Ameritech, the Baby Bell serving Wisconsin, Illinois and Michigan, is offering DSL on a trial basis in two cities in Michigan, while a very few smaller telecoms are giving DSL trials runs in Wisconsin.

Telecommuting Issues and Business Incentives in Electronic Transactions (Task 2)

The second research task was to 1) identify telecommuting and telework issues and 2) assess incentives to encourage technology-intensive businesses to start up or relocate in Minnesota. Issues of labor force preparation and quality of life and the business climate were persistent themes throughout the interviews. We also examined the role of educational institutions in contributing to the needs of business, and the need for a statewide economic development plan. But first we define the concept of telework or telecommuting.

Telecommuting Issues

For definitional purposes, teleworking encompasses "any form of substitution of information technologies (such as telecommunications and computers) for work-related travel."17 Thus, telework includes workers who use telecenters or home offices, home-based businesses, and mobile workers who may not have permanent offices. Telecommuting is a subset of telework. Telecommuting is "moving the work to the workers instead of moving the workers to work; periodic work out of the central office one or more days per week either at home or in a telework center."18 For example, an employee can work at home or at an alternative work site such as a telecenter rather than physically commuting to the office a few days a week or on a less regular basis. As seen in a telecommunications light, both, to some degree, substitute telecommunications and information technology for the commute to the office. Creating an environment that facilitates telework and telecommuting and promotes employer, employee, and consumer acceptance go hand in hand. An appropriate infrastructure must be in place to handle the demand such policies will promote. Efficient telework and telecommuting, therefore, must be a key goal of any such transportation and information technology infrastructure deployment.

12 Includes charges from telecommunications provider.
14 Interview, Andy Blum, Blue Earth Valley Communications, April 15 and May 19, 1998.
16 Ibid., p. 34.
18 Nilles, xix.
Lowertown, St. Paul

Within a few years, the Lowertown neighborhood of downtown St. Paul has gone from an area in need of rehabilitation to a growing center attracting high-tech companies. The creative environment is further enhanced by the technical people who work for these companies and various artists who have taken up residence in the blocks surrounding Mears Park. Since 1996, the number of high-tech firms that have moved to the Lowertown neighborhood has tripled to more than 30, forming a loose-knit community of mutual support that has been dubbed the "cyber village." Phil Pafko, chief of Internet service, wants Lowertown to be identified as a place where innovations and technology careers are made. That's the "cyber" part of it. The "village" part is people running into each other in the skylights or the park, he said.

Most of the high-tech firms are wired by Ethernet and are concentrated in three buildings overlooking Mears Park. Some wireless connections are used as well, since the city of St. Paul has regulations concerning running wire through public skylights. Brooka Fiber, a Missouri-based telecommunications provider, has also installed fiber throughout Lowertown, downtown St. Paul and other parts of the metro area.

A large, new neighbor for Lowertown is Lawson Software, which is constructing its new headquarters in downtown St. Paul. It is possible that their presence will attract other firms.

Our research indicates that the number of organizations with telecommuting programs for employees in increasing in Minnesota. In our conversations with some of these organizations, we found a number of common issues and concerns. Technological and infrastructure limitations stand out as primary issues. Many parts of Minnesota do not have the physical capacity necessary for companies to implement effective telecommunications programs. The research also indicates that the incentives that have driven companies and organizations in Minnesota to implement telecommuting programs for their employees have varied, but tend to focus on limiting office space needs, creating work environments that improve employee productivity, and recruiting skilled employees. The incentives tend to vary by the type of organization as well. Representatives of Minnesota-based computer technology companies report that their primary motivation for implementing employee telecommuting programs is the recruitment and retention of talent. On the other hand, a representative of a governmental organization stressed the importance of saving space as the driving force behind telework implementation.

These findings correspond well to the summary of a national survey of senior executives conducted in 1997 by the Olsten Center for Workforce Strategies. The Olsten survey reported that a majority of the respondents' companies had telecommuting arrangements and that this proportion was increasing. The primary reasons cited for offering telecommuting programs to employees were to increase employee productivity, to be more cost-effective, and to attract qualified employees. Telecommuting was most common within the high tech industries and among professional or technical staff. About half of the responding executives attributed employee productivity increases to telecommuting arrangements, and nearly three-fourths expected to increase telecommuting activities over the next year. As telecommuting grows on the national level, companies and organizations in Minnesota will likely follow suit.

Business Incentives

In its 1996 report to the Governor, the Information Infrastructure Working Group recommended the following vision statement: "By the year 2000, Minnesota will be the acknowledged leader in the use of information technologies for the benefit of all its citizens." It then listed three "critical aspects" the state could act on to lead the information revolution: provide leadership by facilitating partnerships and leading by example; create an information infrastructure by encouraging private sector initiative and partnering through policy, legislative and financial incentives; and assure a skilled, flexible workforce through lifelong learning.

Interviews with focus groups and the Minnesota High Technology Council, show two primary needs that, if met, would encourage high-tech businesses to start up or relocate in Minnesota. These are first, a well-trained and available workforce, and second, a coordinated economic development plan. The lack of properly trained workers is creating a crisis right now for high-tech companies. A skilled workforce and economic development are deeply intertwined.

For demographic reasons alone there are not enough people to work in the jobs available. Demographic trends, compounded with a declining number of people being trained in high-tech fields, has led to technology-intensive businesses struggling to find workers. Fewer people are graduating from post-secondary programs in technical fields now than were ten years ago. Also, a larger variety of companies are competing for people in high-tech fields, not just those companies traditionally considered high technology. One high-tech representative reports that the potential for telework has become a central piece of the company's employee recruitment package. Having a ready and willing workforce could be the single biggest incentive for a high-tech company to choose Minnesota. The need for a skilled workforce was also voiced at the software industry focus group and the telecommuting focus group.

To create a skilled workforce, workers must be located and trained. Locating skilled workers is becoming a national and even international exercise for a large number of companies, who are turning to all kinds of incentives (including offers of telecommuting) to lure employees. Therefore, for Minnesota residents to remain competitive in this job market, the education system must also be involved. The post-secondary education system must be beefed up, especially in the digital science and software fields. Companies are much more interested in investing in research projects that can eventually

20 Interview, Helen Holmes, Hennepin County, May 1, 1998.
23 Interview, Rick Knueg, Minnesota High Technology Council, Dec. 33, 1997
24 Interview, Michael West, Unisys, May 1, 1998.
be commercialized, and as a result, these companies are interested in locating near universities where such research is occurring.25

Although still highly ranked, the University of Minnesota has slipped in the rankings in various research fields. As part of its legislative agenda, the Minnesota High Technology Council is interested in anything to do with defining the upper end of the K-12 graduation standards and Profiles of Learning standards and encourages any enhancements of the science and math curricula. A pool of well-trained workers begins in the elementary and high schools, and employers want to be assured of the skills and knowledge a high school graduate will have.26

A strong, comprehensive state economic development plan is also a necessity. The state currently does not have a comprehensive economic development plan. If the state is going to meet its goal of becoming a “mecca for electronic commerce,” it should have an economic development plan that has a heavy focus on technology and technology education. The Information Infrastructure Working Group recommended a strong leadership role from the Governor and the executive director of the Office of Technology in defining a strategy, then making it happen through firm but flexible decisions.

Companies also need incentives to conduct research and development and to upgrade their technology.

Other concerns articulated by representatives of business:

- Many businesses need higher and more affordable bandwidth, and more flexible access to that capacity. Participants in the software industry focus group said the ideal situation would be access to flexible bandwidth, where they could use higher bandwidth on busy days and lower bandwidth on lighter days.

- Businesses fear a complicated regulatory environment, including things like taxes and controls on the Internet, would put companies at a competitive disadvantage. The state could also set an example for industry by making more government services available online and streamlining them for easier use. The state has a good web site, but a person is unable to connect with the government or receive services through that computer interface. The state needs to reduce the number of jurisdictions a person must go to physically, and instead concentrate on “one-stop shopping.”

- As people move out of a centralized workplace and become more mobile in their choice of working locations, they are becoming increasingly more able to choose for themselves where they want to live and consequently work. For that reason, quality of life will become increasingly important. States must concentrate on creating both a favorable business climate and a high quality of life.27

25 Ibid.
26 Ibid.

Our research indicates that a community’s efforts to promote telecommunications can serve as a magnet for businesses, as well as a method of retaining them. In the case of the City of Winona, Minn., private business and the public education sector have partnered to create the infrastructure that electronically connects the entire community. This has important implications for the quality of life in the community. Much like transportation has done in the past, telecommunications can form the community’s backbone by connecting its economic development, education, health, and entertainment sectors.

Minnesota has in place already a number of programs and projects to encourage high-tech businesses to relocate or start up in Minnesota and to encourage high-tech development in the businesses already here. Among the state’s departments, agencies and programs with direct interest in telecommunications are the Office of Technology, the Department of Trade and Economic Development, Minnesota Technology Inc. and Minnesota Project Innovation. Also, the University of Minnesota recently secured its role as a TradePoint site in the SEAL project in cooperation with the United Nations. The project makes the University the site of a hub for secure transactions over the Internet.

Tax and Regulatory Policies (Task 3)

The third research task was to analyze tax and regulatory barriers that may be preventing Minnesota from developing required infrastructure capacity and a vibrant electronic commerce sector. Our research has examined state and local policy, federal policy, and research done by the National Tax Association.

State and Local Policy

The perception is that state and local policies will either make or break the opportunities that are arising for businesses. Interviews have indicated that companies involved in electronic commerce expect to have to pay their fair share of taxes, but fear being singled out and being put at a competitive disadvantage to companies in other states and even other countries. The dominant fear is that individual states will begin passing their own tax laws and regulations, creating huge administrative problems for those firms participating in electronic business.

Minnesota currently does not have any special tax policy concerning electronic commerce in sales tax, use tax or corporate income tax. While states fear that the continuing growth of electronic commerce will erode states’ tax bases, they are reluctant to make any decisions that will put their state or the businesses located there at a competitive disadvantage or even a perceived competitive disadvantage.28

Minnesota breaks down its corporate income tax based on an allocation formula weighted 70 percent to sales, 15 percent to property and 15 percent to payroll located within the state. Some states, like Iowa, have changed their corporate income tax ratios to be based

28 Interview, Greg Heck and Joan Tujetsch, Minnesota Department of Revenue, legal services, Dec. 17, 1997.
100 percent on sales. Minnesota’s corporate income tax ratio, with its low concentration on property and payroll, was traditionally an advantage to the state, encouraging companies to locate their headquarters here. Now, however, it could be a hindrance if the general trend of states is to eliminate property and payroll altogether from their corporate income tax formulas.29

Some of the bills pertaining to telecommunications introduced at the state level include the 1995 State Telecommunications bill. Another bill introduced in the 1997 session would have removed or prevented regulations or barriers at a local level, ensure open competition and give open access to public rights-of-way for telecommunications companies.

**Federal Policy**

Consensus is that for the sake of uniformity, the federal government will have to lead the way in regulations concerning electronic commerce. At the federal level, the 1996 Telecommunications Act opened up telecommunications to an entire industry of communications companies. The Internet Tax Moratorium bill prevents any taxes or regulations imposed on Internet service or service providers for six to eight years, giving state and federal governments time to develop a uniform system before states take it upon themselves to impose their own regulations.

**A look at the National Tax Association Report**

It appears that policy makers are waiting for the completion of a report being produced by a group of leading tax experts for the National Tax Association. The draft was released at the November 1997 national tax conference, and the final report is expected later in 1998. Minnesota’s Department of Revenue received the draft to study and respond to, with comments due Jan. 1, 1998. The draft report proposes three methods of taxing electronic commerce:30

- Nexus and sourcing provisions using a billing address regime implemented through Congressional legislation
- A Congressionally implemented state tax information clearinghouse to improve use tax collection
- A “situs regime” for sales and use taxes on electronic commerce, assuming no federal legislation

**Influencing Popular Perceptions (Task 4)**

In Task 2 we defined the telework concept and its required infrastructure. Now in Task 4 we seek to explore the common perceptions of telework and telecommuting programs among industries, organizations, and employees.

With the 1995 Telework Task Force, Mn/DOT developed an organizational vision of telecommunications as a transportation mode. In this vision, telecommunications, especially telework and telecommuting programs, has multimodal transportation implications on bicycle, pedestrian, and community transportation planning programs in Minnesota’s sustainable Transportation Initiative. Telework and telecommuting combined with other efficient and sustainable modes of transportation can provide access to information points just as the interstate highway system and automobile have done over the past thirty years. However, telework and telecommuting encompass the virtual rather than the physical mode of access to information.

The overarching goal of this initiative is to present how Minnesota and its State departments, such as Mn/DOT, will undertake the twenty-first century requirement of overlaying technology in business, government, and everyday life. To make this transition, the broad scope of such an initiative must be narrowed to establish achievable goals and policies for private and public sector entities. Accordingly, Task 5 will set out to define the Minnesota economy as it pertains to overall economic growth as well as growth of its information economy. In presenting the regional economic influences of information technology, sectors that rely most heavily on an information infrastructure will be identified. Given the goal of overlaying the Minnesota economy with information technology, the means by which Minnesota’s industries utilize information technology and establish organizational approaches promoting telework/telecommuting are of particular interest. Investigating how these and other telework/telecommuting programs and policies impact travel behavior will give greater context to understanding telework as a transportation mode. Finally, highlighting public and private sector roles that facilitate telework will supplement Task 5’s analysis of the potential impact of telework/telecommuting on transportation infrastructure requirements in the metropolitan and rural areas.

**Regional Economic Influences**

With the Minnesota State government concerned with its future economy, a State Information Infrastructure Working Group framed a vision for Minnesota to be an acknowledged leader in the use of information technology for the benefit of all its citizens. Minnesota’s technological future is centered on three key areas: adequate infrastructure, electronic commerce, and a technically literate society. In achieving these goals, the State is developing an information economy to become a mecca of high technology and commerce. Minnesota’s economic base is often associated with the economy of the Twin Cities. The Twin Cities’ regional economy contains a diverse mixture of industries (finance, food, machinery and metalworking, computers and software, finance, printing and publishing, health care, arts and entertainment, medical instruments), healthy job growth (ranked seventh in job growth between 1993 and 1994 out of the largest twenty-five U.S. metro areas), both public and private top ranked, industrial and service headquarters (see table below for Twin Cities and other Minnesota companies), low unemployment rates (lowest among the largest twenty-five U.S. metro

---

areas), and high per capita income (14 to 17 percent above the national average from 1983 to 1994).32

Table 4. Minnesota’s Key Companies & Location

<table>
<thead>
<tr>
<th>Minneapolis-St. Paul</th>
<th>St. Cloud</th>
<th>Rochester</th>
<th>Hutchinson</th>
</tr>
</thead>
<tbody>
<tr>
<td>JPM</td>
<td>Fingerhot</td>
<td>IBM</td>
<td>Hutchinson Technology</td>
</tr>
<tr>
<td>Arbition &amp; Computing Devices International</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Best Buy</td>
<td>Piper Jaffrey</td>
<td>Mayo Clinic</td>
<td></td>
</tr>
<tr>
<td>Cendant Corporation</td>
<td>Unisys</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Data Systems</td>
<td>United HealthCare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cray Research (a division of Silicon Graphics)</td>
<td>West Publishing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dayton-Hudson</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Honeywell</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hubbard Broadcasting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imitron</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IVT Publishing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lavon Software</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meltronic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northwest Airlines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piper Jaffrey</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unisys</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United HealthCare</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Publishing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Of the industries located in Minnesota and the Twin Cities, two rely heavily on information technology, the medical instruments and the computer and software industries. The Minnesota Department of Trade and Economic Development reported that the software industry grew at a rate of more than 73 percent from 1987 to 1993, earning more that $850 million in annual revenues. The “software state” ranks fourth in the number of software companies nationwide with the majority of the firms specializing in development, multimedia, professional and information services, data centers, and telecommunications.33 In 1986, Minnesota’s medical instrument manufacturing and health care delivery sectors achieved nationwide status as the medical center of the U.S. when Time magazine referred to the cluster as “Medical Alley.”34 With the economy’s diversification in services, retail and wholesale trade, and manufacturing (28.1, 23.7, and 18 percent respectively of the total jobs in the Twin Cities during 1994)35 and continued growth of new services and high tech industries, various public policies can facilitate Minnesota’s growth and help it to achieve the status of an information technology mecca. In particular, services and high tech industries, such as medical instruments and computer and software, are more disposed to specific work policies that will utilize an information technology infrastructure which in turn may provide other positive externalities.

33 Ibid., 27.
34 Ibid., 34.
35 Ibid., 11.

Winona

Winona’s digital network began as an idea to introduce distance learning into the community. A community of 11,000 homes, Winona is geographically isolated, but the community is home to many public and private schools, including Winona State University and St. Mary’s University. Winona is also a highly educated community, wealthier than average and unusually philanthropic. The seed money to build Luminet came from a local foundation.

The system was started in 1995 as Luminet, partnering with US West, which laid the fiber optic ring around the city. Luminet’s founders envisioned the system as a non-profit education intranet that would be used by the community for meetings and distance learning, turning homes into classrooms and work sites. It was hoped that links between Winona State and the schools would eventually expand to include the city and county government. The private schools in the city had already committed to a virtual school program, with the goal of putting a computer in every student’s home.

Since that time, Luminet did not go in the direction that its founders expected. Winona State was not able to join in as full a capacity as was hoped because it was tied to the state’s system, MRNet. And while the schools do use the system extensively, the distance learning program did not develop as hoped.

On the other hand, Winona.net, the local newspaper’s web site, has developed several forums for public discussion on everything from teen chat and technology to the city council agenda. The civic links with the city and county are also extensive.

The system’s most enthusiastic users have turned out to be Community Memorial Hospital in Winona and Gunderson Lutheran Hospital in La Crosse, which use the network for continuing education and discussion, especially using videoconferencing. In 1996, by public demand, Luminet also became the community’s Internet service provider, a service that extends as far as Wabasha. In 1997, a for-profit company, Hiawatha Broadband Communications was formed and acquired Luminet. HBC is now developing a hybrid fiber/coaxial plant and will be offering high-speed service via cable modem when it becomes a cable provider later this year, in competition with the local cable service.

While the Winona system did not grow according to its creators’ original intentions, it has become increasingly important to the community, helping the city become home to a number of high-tech businesses. With the labor shortage, it is also hoped the network will be a means of retaining current residents and attracting new ones. There are telecommuters in Winona who use the system extensively to work from home.

Telework and telecommuting

One such policy is telecommuting or telework programs. Serving as a management tool, telework provides flexibility to meet customer and business needs.36 Given that the rapidity of information flows decrease response time for the production and distribution of goods and services, a flexible workforce is essential in an information economy. Whether Minnesota’s economy and the regional economy of the Twin Cities is apt to implement telework/telecommuting policies across the board, benefits of such policies to the economy make it worth investigating. The existing economic base (high tech and services) seems to be one that would facilitate a predominant organizational culture of telework. This section reviews existing telework/telecommuting policies in order to determine which employees/employers are predisposed to telework, how the popular

conscioussness of employers and employees can be changed in favor of telework, and what innovative companies are doing in terms of telework. These questions will be addressed in the following section that concentrates on the organizational implications of telework.

Following the organizational implications of telework, the connection that telework has with transportation policy and planning will be analyzed as it pertains to travel behavior and infrastructure requirements. The transportation analysis will concentrate on the impact of telecommunications on travel behavior. Combining both organizational and transportation perspectives will convey some understanding of the spatial changes prompted by information technology’s impact on business and residential location decisions and provide evidence of the changing transportation demand.

To prepare the State of Minnesota for its desired role, the relationship of telecommunications and travel behavior is essential to understand. Consequently, this report seeks to edify several possible influences from both the organizational and transportation perspectives and suggest implications for private and public sector roles. However, given the long road ahead for the public sector to facilitate telework and infrastructure readiness, this report will also propose and scope additional analysis that will fully address the necessary collective private and public sector partnerships and the specific capacity of Mn/DOT in the twenty-first century.

Organizational Implications

Telework does not happen by accident. A worker does not wake up one morning and discover that he or she is working from home. For an employee to work from a remote location, a series of decisions must be made regarding resources, infrastructure, policies, and procedures. For telework to take place, there needs to be planning, and for telework to be successful, there needs to be not only good planning, but a common agreement and vision shared by the players involved. So how does a company or state begin implementing telework?

Creating the Vision

As an example, a leader of a drill bit manufacturing company reshaped the company’s vision from one of manufacturing drill bits into one of considering how customers make holes, thus changing the way they thought about their business and diversifying their product line. Today, while they still sell drill bits at the local building supply outlets, they have expanded into lasers and other technologies never imagined by their previous vision. As in the example, the states, industries, and companies that successfully implement telework will be those which are able to reshape their environment to form a new understanding of what it means to work.

Concrete Visualization

One of the findings of Clark was that for both managers and employees, the perceived legitimacy of telework was one of the primary predictors of behavioral intent. In that study the legitimacy was measured as the degree to which subjects saw others within their organization or department teleworking. The degree to which someone sees colleagues – or others similar to them – teleworking is a good predictor of their intent to telework. Unfortunately, by its nature, telework tends to be less visible than showing up at the office.

To address the issue of legitimacy and visibility, creation of videos or other campaigns by the company, industry, or State may be appropriate. Two years ago Microsoft put out a 30-minute video which helped people visualize in very concrete ways how teleworking can benefit workers in a variety of environments. It showed various unusual forms of virtual offices (and, not surprisingly, how Microsoft products help make that possible) in very vivid and creative ways. Such videos when appropriate and targeted will do much to help employees and managers form a concrete understanding of the legitimacy and appropriateness of telework.

Industry Specific Visualization

Different industries often have different attitudes and beliefs about telework. Managers in construction, services, manufacturing, finance, transport, and retail sales on average tended to believe that telework was compatible with the way they do business. Managers in government were neutral and those in mining were slightly negative. Managers in construction, services, and manufacturing rated compatible higher than the overall group and also demonstrated a higher than average attitude toward supervising teleworkers. In fact, managers in all industries expressed at least a slightly positive attitude toward supervising remote workers. However, only a few managers in the construction and mining industries were neutral or above when expressing the intent to supervise teleworkers. The managers expressing the strongest disagreement to managing teleworkers were in government and retail sales.

Because different industries visualize telework differently and have very different beliefs about its appropriateness, any public approach will need to be carefully targeted to meet the specific needs of a selected group. Any “one size fits all” approach to selling telework is likely to be less effective. Industry acceptance might be promoted by working with industry groups to plan appropriate uses of telework and promotion campaigns. Rather than promote a generic idea of teleworking, targeting specific industries with specific solutions that they help design and promote may do a great deal to motivate managers within those industries – tailoring the program for each. Industry-specific definitions might be a far more successful way of conveying the concept.

Clark, S. D. The Decision to Telework: An Investigation of Influential Factors, (Claremont, CA: Claremont Graduate University, 1998).


Clark, The Decision to Telework: An Investigation of Influential Factors (Claremont, CA: Claremont Graduate University, 1998).
Another leverage point for managers in which publicity could be appropriately employed is that of perceived usefulness. A publicity campaign which informs the public about the benefits of various forms of telework may be very appropriate. A series of one minute public service spots which demonstrated how various types of occupations and industries have created virtual office environments (perhaps underwritten by companies who manufacture the products which are being used, as in the case of the Microsoft video) would help increase both perceived legitimacy and perceived usefulness for viewers.

Company-Specific Visualization

For individual organizations implementation of telework will need to be specific to their particular needs and objectives.

Style Issues

While organizations vary, environments that are "telework friendly" will tend to employ technology in ways which are not only appropriate for the company but also allow for more flexibility in where and when the work is performed. This might include: moving from a "paper-based" process toward one which uses more electronic based documents; holding less face-to-face ad-hoc meetings in favor of more mediation that is amenable to mediation by technology; and developing an outcome-based environment in which both management and employees see the emphasis as accomplishing a task rather than putting in time at the office.

A representative of a technology-based company in Minnesota stressed the importance of having a high-ranking champion within the organization who fully supports the program.40

Policy Issues

In order for telework to become institutionalized, clear and concrete policies need to be developed for private employers as well as public employers. While Minnesota does have policies on studying the feasibility of telecommuting, private entities may want to examine such policies to determine if the arrangement would be feasible for them.41 In part these policies will serve as guidelines but they will also be a mechanism for helping managers and employees visualize telework in a particular organization. These guidelines need to be flexible enough to allow for experimentation and change and yet detailed and clear enough to promote a dear and positive vision of this new work arrangement. Such policies should address types of jobs which are most appropriate for telework in the particular industry or company. Most industries and companies have at least some positions in which physical presence is not constantly a requirement of the job. Most also have positions in which physical presence is fundamental. These need to be distinguished. For example, Mariscal Weeks Frielander, a law firm in Phoenix, Arizona, allows only attorneys and administrative staff to telework. America West Vacations, a division of America West Airlines, allows salespeople who have a better than average sales record and have been with the company for at least one year to telework.

Telework policies also must address the types of work which are most appropriate. Within job types, some tasks lend themselves to more flexible work arrangements while others performed by the same person may require physical presence. Which tasks are these? Research, writing, documentation, technical support, and live phone reception are candidate tasks for remote work while heart surgery and janitorial services are not.

Meeting policies also need to be dealt with. Many office jobs require meetings and a number of questions need to be answered to develop effective telework policies. How frequently do employees need to be available for these meetings? Can these meeting be moderated by group software? Can meetings be limited to certain days of the week and/or hours of the day so that people know when they are "on call" for ad-hoc meetings (either remote or on-site)?

Telework programs must also include availability policies. Work usually has to be coordinated between people. If people are working remotely, when do they need to be available to others by phone, fax, e-mail, etc.? What are the key corporate values in this regard?

A number of infrastructure concerns, in terms of phone lines and other technology issues must also be addressed. If a person is working from home, do they need to have at least two phone lines so that they can be reached by phone while they are on-line to the office? What equipment and software compatibility is required? What speeds of access are appropriate? How does the company and the individual configure and use the technology to facilitate the accomplishment of goals rather than become a barrier to their accomplishment?

In considering policy, the major findings from a focus group by the Metropolitan Washington Telework Resource Center should also be considered:

- "The concept of telecommuting and telework seems to be acceptable to employers as a logical extension to alternate work schedules, such as flexible work hours and compressed work weeks.
- Telecommuting seems to be most frequently considered in response to the needs of an employee or group of employees, rather than a top-down management initiated action.
- Technology appears to play an important role in the interest in telecommuting. For example, employers with older computer systems indicated limited telecommuting potentials for telecommuters until more advanced computer capabilities were in place.
- The major issues voiced by participants about telecommuting related to client acceptance, adequate technology, inability to measure ob performance, possible loss of team spirit, and potential liability and legal problems. Consulting firms and
government contractors in the area were especially concerned about the reaction of federal contracting agencies to telecommuting.
- Advantages of telecommuting identified by participants included employee productivity, cost savings on real estate and parking, and enhanced employee morale.
- Support from both top management and from employees is needed to promote telecommuting in the region.
- Information about telecommuting programs at firms or agencies of similar size and scope is needed. A peer-to-peer network would help enhance this communication.
- Employers are not willing to spend a good deal of effort to obtain information on telecommuting before they have identified the potential benefits to their firm. Once a decision has been made that telecommuting should be pursued, more willingness was expressed in devoting staff and financial resources towards developing programs.
- More support was voiced for telecommuting from home than from the use of regional telework centers.\(^\text{42}\)

Infrastructure
Organizations must also develop an appropriate infrastructure for supporting the form of telework that they are implementing. Marshals Weeks Frielder, for example, placed computers in law offices, created a policy of scanning all documents into the system so that they would be available on-line, set up a remote access system via a LAN with emphasis on the security of information, and is now adding 24 more phone lines for additional remote access. America West Vacations provided computers, modem, telephone and headset, and additional phone lines for employees. Depending on the organization, other hardware, software, and training may be necessary, including: group support software, an e-mail system, a network infrastructure, extensive training in electronic document management, remote work training, training of managers in supervising remote workers, and ongoing training and support programs for remote workers and their managers.

Motivation and Training
Ruppel and Harrington found that middle level managers tend to be the most resistant to implementing a telework policy.\(^\text{43}\) This is supported by Clark who found that while employees generally had a positive attitude toward telework, they typically did not perceive that they had control of the decision process but were subject to corporate policy and work social structure. IBM's program has close to 20,000 of it sales and service personnel and administrative and management staff regularly utilizing some form of telecommuting. While "significant savings in real estate costs, increases in customer satisfaction, improvements in employee productivity, and enhanced abilities to attract

new and retain existing workers" are noted as major benefits, the programs success arises from the fact that top management supports it.\(^\text{44}\)

Thus, key steps for successful implementation of telework will include: clear policy directives regarding corporate support for teleworking; clear guidance and training to emphasize the importance of telework to the company; teaching middle level managers appropriate techniques for supervising remote workers and employees how to perform appropriately in these new circumstances; and appropriate motivation so that both managers and employees are willing to expend the energy necessary to change traditional behaviors.

Because employees appear to feel constrained by corporate policy and social structure at work and feel that they have little behavioral control, managers appear to be the more powerful part of this decision making dyad. A policy approach which influences companies and managers will also affect employees, who generally already have a more positive attitude about telework. Key leverage points for motivating managers that may be manipulated by public policy would be perceived legitimacy, perceived usefulness, perceived corporate benefits, industry acceptance, and government policy.

Next Steps: Community-Based Outreach
While the key feature to telework's success occurs in the private sector and at the management level, a pragmatic approach is to deal with the communities in which such telework activities are located. The Metropolitan Council's multi-million dollar effort in promoting livable communities through demonstration grants presents a unique opportunity to examine how telecommunications can create future livable communities. The Livable Communities' program objectives will be reviewed to determine whether a wired livable community is possible. Following this action, program components for a wired livable community will be identified, and target communities for the project will be proposed.

Transportation and Telework (Task 5)
Telecommuting and Travel Behavior
The dynamic between telecommunications and transportation takes several forms. From a traditional transportation perspective, advances in telecommunications that facilitate telecommuting promise reductions in congestion and vehicle emissions—substitution effects. At the same time, increases in non-commute trips, just-in-time logistics, and travel efficiency and productivity may promote additional travel—stimulant effects. Thus, both substitution and stimulant impacts on transportation impacts are likely. Beyond the traditional transportation perspective, telecommunications may fundamentally alter the way in which we think about transportation. This trend is seen in the growing shift in emphasis among transportation agencies away from the movement of people to the movement of information. How these trends will affect transportation and society is


largely unknown. Nevertheless, it is obvious that communities must work with both the public and private sectors to maximize the potential benefits of these trends.

The section to follow outlines both substitution and stimulant effects, as well as the broader implications of telecommunications, with respect to transportation and travel in Minnesota. The purpose of this study is to scope out potential short and long-term impacts of Minnesota becoming a telecommunications mecca upon travel behavior and the state’s transportation system. Toward that end, this study proposes to examine a set of specific scenarios in the Minneapolis-St. Paul metropolitan area. These scenarios, briefly outlined at the conclusion of the paper, are intended to serve as case studies of how the intertwining of telecommunications and travel might occur to the greatest benefit for transportation, regional economic vitality, and the people of Minnesota.

Substitution or Stimulant? Telecommuting and Transportation

Substitution Effects

In theory, telecommuting is seen as a substitute for travel, allowing employees to work at home, utilizing modern, fax, the web, and e-mail, rather than commute to work. Total vehicle miles traveled (VMT) and emissions of environmentally hazardous chemicals should subsequently decrease as a result of reduced travel through telecommuting programs.

Evidence provided by Mokhtarian, Niles, and a variety of telecommuting case studies and pilot projects shows that VMT and emissions savings are significant for those who participate in telecommuting programs. In an analysis of one telecommuting pilot project, Mokhtarian and Varma found that per capita VMT for telecommuting participants decreased from 66.4 miles to 31.2 miles, more than half the regular commute distances.45 The same study showed significant reductions in emissions for telecommuters: a 51-percent reduction in particulate matter, a 35-percent decrease in nitrogen oxide emissions, and a 21-percent reduction in carbon monoxide emissions. A pilot program in Minnesota produced similar findings. Total results from the pilot showed savings of over 30,000 commute miles driven, 1,500 gallons of fuel, 2,000 fewer commute trips made during peak periods, and an estimated 1,620 pounds of pollutants not released into the atmosphere.46

Other benefits may also be realized as a result of telecommuting, including: reduced need for additional freeway lane-miles, lives saved and accidents avoided, travel time savings, and reductions in infrastructure and maintenance costs. The USDOT forecasted that telecommuting could eliminate the need for 7,000 to 11,000 lane-miles of freeway by 2010, saving $13-20 billion.47 In a similar forecast, the USDOT estimated that telecommuting could result in 400 to 800 miles saved, somewhere between 58,000 and 120,000 accidents avoided, and travel time savings of over 1.7 billion hours by 2002.48 Other studies have forecast over 1,100 lives saved, 1.6 million accidents avoided, 3.1 billion hours of time saved, and mitigation of over $600 million in infrastructure and maintenance costs based upon a hypothetical travel substitution rate of 10-20 percent.49

Thus, for telecommuters, telecommuting is a significant substitute for travel. The potential for savings in VMT and emissions, as well as the other benefits outlined above, leads to the conclusion that telecommuting, as a subset of telecommunications, has the highest potential for travel reduction.50

Considering these results, the obvious next question is are enough people telecommuting, or will there be enough in the future to substantially impact travel patterns such as congestion. The answer forwarded in the majority of the research is that the number of telecommuters on any given day is not high enough to significantly impact travel.

Estimates of the number of people telecommuting on any given day are typically between 0.5 percent and 1.5 percent of the workforce, reducing overall VMT by no more than 1 percent.51 Some estimates note that these numbers may be inflated given the potential for telecommuters to live further from work and latent demand—forces that will be touched upon below.52 Mokhtarian provides perhaps the best estimates and forecasts for telecommuting. Using the present situation as a base case, and a future case where the number of telecommuters doubles, she models telecommuting’s impact on travel. In the base case she finds that only 1.5 percent of the workforce is telecommuting on any given day, eliminating at most 1 percent of total VMT. In the future case, in which she forecasts that 2.4 percent of the workforce may be telecommuting on any given day, VMT savings will be at most 1.5 percent. She concludes, “Thus, a sizable (and highly speculative) increase in the ability of workers to telecommute still results in relatively low levels of activity on any given day.”53

A number of explanations are offered for the relatively small future impact of telecommuting on travel. First, telecommuting is only a part-time practice, typically engaged in no more than 1-2 days a week. Second, current telecommuters tend to have longer than average commutes, which predisposes them to participation in early telecommuting programs. As telecommuting becomes more prevalent, commute distances will approach the average as people with shorter commute distances increase participation. High attrition rates also minimize long-term telecommuting impacts. Mokhtarian and Varma found that approximately 50 percent of all people who began telecommuting quit within nine months.54 Thus, a combination of factors suggests that we

45 Patricia L. Mokhtarian and Krissina V. Varma, “The Tradeoffs Between Trips and Distance Traveled in Analyzing the Emissions Impacts of Center-Based Telecommuting,” (Davis, Calif.: Institute of Transportation Studies, University of California, Berkeley).
46 Minnesota Department of Administration, Telecommuting Pilot Program Assessment, 12.
50 Mokhtarian.
51 John S. Niles, Beyond Telecommuting: A New Paradigm for the Effect of Telecommuting on Travel, (Global Telecommunications, 1994).
52 USDOT.
53 Mokhtarian.
54 Mokhtarian and Varma.
should not expect a substantial increase in the ability of telecommuting to substitute for travel.

Despite these findings, telecommuting can still be justified from a transportation mitigation standpoint (although this should not be the sole reason). Compared to other transportation demand management (TDM) strategies, bus transit for example, telecommuting’s impacts are fairly similar. Furthermore, telecommuting is less costly and comes with a variety of additional benefits, such as increased worker morale and productivity and additional time spent with families and communities. Additionally, telecommuting programs that specifically target peak period congestion have the potential to yield greater benefits than those outlined here. Recent trends in telecommuting have also revealed an episodic role for telecommuting—designed to alleviate travel demand during episodes of inclement weather (particularly relevant for Minnesota), natural disasters, or during large events. For these reasons, telecommuting remains a worthwhile pursuit from a transportation perspective.

**Stimulant Effects**

While telecommuting does produce substitution effects, it may also stimulate additional travel. Reductions in VMT and commute trips are often offset by additional, albeit shorter, trips by the telecommuter such as to the grocery story, to pick up or drop off children from school, or to run various errands. In addition, on non-telecommute days, studies have found that telecommuters are less likely to use alternative forms of transportation such as car and van pools or mass transit. Long term, as telecommuting programs become more commonplace and increasingly routinized, telecommuters can potentially move farther and farther away from their actual place of work. Non-telecommute distances could subsequently become even longer, pushing traffic problems into additional suburban and rural areas. These and other effects are addressed in the sections to follow.

**Increases in Non-Commute Travel**

While commute travel is reduced through telecommuting, also resulting in time savings for the telecommuter, many telecommuters may make additional non-commute trips and spend more time in out-of-home activities. As mentioned above, trips to the grocery store or to run other types of errands, or even to avoid cabin fever from working at home, may generate additional non-commute travel. The findings, however, do not indicate that non-commute travel occurs to a significant degree. A pilot study of telecommuting found that the number of non-commute personal trips actually decreased. In total, Mokhtarian estimates that increases in non-commute travel will mitigate no more than 6 percent of the total savings in VMT from telecommuting.

**Decentralization and Urban Form**

A seemingly obvious impact of telecommuting is the gradual decentralization of metropolitan areas as telecommuters become increasingly able to move farther from their places of work. The implications for urban sprawl and suburbanization, as well as infrastructure constraints on suburban and rural areas, raise concern over the decentralization impacts of telecommuting. Here again, however, there is little supportive evidence. Mokhtarian forecasts that even amid increased frequency of telecommuting individuals would only live on average about two miles farther from work. Over time, this small distance may still mitigate some of the overall travel savings from VMT.

A key explanation for the lack of substantial decentralization impacts is that the decision to move or relocate is one that encompasses a host of transaction costs, of which the ability to telecommute is only a small part. Given the high attrition rate among telecommuters, it is also unlikely that people would make a relocation decision based primarily upon telecommuting. A better understanding of the telecommuting-decentralization relationship is that telecommuting serves as an enabling device, such that when people make the decision to relocate the ability to telecommute enables them to consider options farther from work. In short, urban sprawl will most likely continue but not as a significant result of telecommuting.

**Latent Demand**

Latent demand refers to the elasticity of travel. The argument is that for every decrease in travel volume there is a corresponding increase in demand for the vacated space. Latent demand most often comes from development, economic growth, diverted and transferred traffic, shifts in destination, and the inducement of additional trips. Thus, many argue that much of the space freed up by decreases in travel volume from telecommuting is subsumed by latent demand. The USDOT estimates that a 1-percent decrease in volume will result in anywhere from a 5-percent to 9-percent increase due to latent demand. Mokhtarian’s model estimates the latent demand rate to be at approximately .5 percent. At a minimum, it is therefore likely that latent demand could mitigate one half of the travel volume benefits from telecommuting.

**Induced Demand**

In some instances, telecommuting may actually create additional travel demands. While the extent to which such demands are occurring has not yet been measured, Niles offers some examples of how additional travel is induced. First, because telecommuting and telecommunications generate time savings, they are viewed as accelerating time-based competition and commerce. Increases in time-based commerce often stimulate single-purpose trips by single-occupancy vehicles, typically during non-peak hours. Travel volumes and congestion subsequently increase. Telecommuting also increases the need for rapid response and just-in-time logistics, such as the dispatch of customized vehicles (overnight package and home food deliveries are examples).
The Combined Effect

In sum, the research presented here indicates that we can expect some travel savings from telecommuting, but no more than 1.0 percent to 1.5 percent of total household vehicle miles traveled, even if the number of telecommuters doubles in coming years. Additionally, travel savings substituted through telecommuting may in large part be mitigated by off-setting stimulant effects. Mokhtarian concludes that net reductions in travel will most likely be only 44 percent of what would be assumed if stimulation effects were not taken into account. Nevertheless, there remains a role for telecommuting in understanding travel. Specific benefits may be realized by targeting individual corridors for telecommuting programs, as well as episodic programs. An example of a corridor targeting strategy is provided for the Medical Alley area of Minnesota, the corridor from Rochester to the Twin Cities and beyond to Duluth, in the "policy implications" and "recommendations" sections. Beyond traditional transportation measures and telecommuting there may be entirely new roles for transportation under the larger umbrella of telecommunications.

Beyond Telecommuting: Broader Implications of Telecommunications on Travel

The previous discussion has focused upon traditional transportation concerns--vehicle miles traveled, trip reduction, congestion, and air quality. Yet, telecommunications transcend our understanding of the traditional relationship between technology and travel. The very focus of transportation is undergoing a shift from the movement of people to the movement of information. In short, the challenge is to find solutions to traditional travel problems utilizing non-traditional means, i.e., telecommunications.

With regard to the broader implications of telecommunications, transportation must be considered in conjunction with less-traditional impacts, such as economic development and re/development, equity, health, education, and the livability of communities. A prime example of this new focus is the relationship between home-based businesses and travel. Home-based businesses simply do not fit traditional transportation models. Their travel patterns are fundamentally different, relying less on commuting and more on delivery and just-in-time logistics, as well as off-peak trips. For them, the issue is not the reduction of travel, but rather the increased flexibility of travel. From a transportation perspective they require a whole different range of services and the overall impact may be an actual increase in travel.

As further example, a number of areas where transportation must play a larger role are outlined below.
Economic Development, Redevelopment, and Downtown Revitalization

One area where transportation can now play a much larger role is in helping to provide economic opportunities where they did not exist, or were lacking, previously. This is particularly true for inner cities. Inner cities typically suffer from a lack of jobs and opportunities due to the relocation of jobs to the suburbs. Linking individuals from the inner cities to suburban jobs has been problematic due to a lack of resources (for example, it is difficult to drive to a job in the suburbs if you do not own a car). Yet, traditional transportation solutions, such as mass transit, have had little impact. An alternative transportation strategy, through teleservice delivery, is to provide training and a variety of employment support services in inner city neighborhoods. Telecenters, or delivery points located near telecommuting centers with jobs, is one way of providing these services. As an example, the Lake Street/Sears Tower area in Minneapolis-St. Paul could benefit greatly from a joint telecommunications-transportation redevelopment initiative. Telecenters designed in this manner could also provide low-cost access to disadvantaged communities. A transportation strategy such as this would therefore be working toward the overall improvement of the community and region (see recommendation and subtask 3 below).

Teleservice delivery could also be used to provide health care assistance through remote access for diagnosis and consultation to rural or disadvantaged areas. Niles notes that federal health care regulations often require office visits as a condition for payment of a physician’s services. Such a policy, if altered to implement telecommunications, could increase the overall efficiency of the health care system and would lessen the need for physical trips to local health facilities.

Additionally, telecommunications offers educational benefits through distance learning and a variety of governmental benefits including: electronic document handling, planning and operations databases available to local municipalities to facilitate system-wide conformance, and informational services for the public, such as electronic bulletin boards and kiosks.

By encouraging activities such as these, transportation agencies can further promote the movement of information rather than people while at the same time focusing upon improving the efficiency and flexibility of the current system.

Summary

With regard to telecommuting's impacts on travel, while the aggregate system-wide impacts are relatively insignificant, opportunities remain for specific peak period and episodic benefits to be realized. These micro-level benefits suggest a solid foothold for telecommuting in future transportation planning in Minnesota and a strategy for the future, as outlined in the policy implications and recommendations below. Beyond telecommuting, opportunities exist for transportation agencies, working in conjunction with the private sector, to greatly enhance the livability and vitality of communities through the intersection of telecommunications and travel.

Telecommunications, Minnesota, and the 21st Century

Given the possibilities for advances in the relationship between telecommunications and travel, opportunities exist for a much stronger relationship in the state of Minnesota, particularly in the Minneapolis-St. Paul metropolitan area. A number of characteristics bear this point out. Minnesota is experiencing sustained economic growth in a number of telecommuting-friendly industries: computers and software, medical products and services, and financial services. These industries employ thousands of high-skill office/desk employees, individuals well-suited to telecommuting. Coupled with the large number of Minnesota State employees, as well as the University of Minnesota's location, the Minneapolis-St. Paul metropolitan area is particularly well-positioned for increases in telecommuting programs in coming years.

According to Gil Gordon of Gil Gordon & Associates, telecommuting consultants for the last fifteen years, the Minneapolis-St. Paul area, like the Seattle and Atlanta areas, is primed for telecommuting advances as a second-tier city undergoing rapid growth, placing increased strain on its existing transportation system. At the same time, transportation planners in Minnesota are facing the reality that traditional answers to transportation problems, such as moving more people and cars by increasing roadway capacity, is neither financially or politically feasible. Mn/DOT's increased commitment to telework and telecommuting in recent years is therefore both necessary and expedient.

Policy Implications

Several policy implications emerge from the discussion of the literature, presented below in terms of corporate, non-transportation, and transportation policy.

Corporate Policy

Corporations that are more able to have employees telecommute (location independent job functions are more probable telecommuters) should be targeted with telecommuting programs that are differentiated to meet individual employer needs. The redistribution of home and work must be ingrained into the work philosophy and management. Critical changes and success factors for each company must be identified and applied through policies, training, marketing plans, and even cultural change. In addition, management procedures must be revised in terms of evaluating performance, conducting human resources, and equipment and information technology support systems (computers, telecommunications lines, remote access to network servers, and the cost of connectivity). While employees may be more easily convinced that telecommuting is possible, educating employers about telecommuting must show the benefits not only to employees but also to the company from a cost standpoint. Telework programs that utilize a non-territorial office (hoteling) method can allow companies to decrease total

65 Niles.
66 Niles.
68 Given such policy implications, policy recommendations follow in the next section.
However, increasing congestion in the Twin Cities may make this more of an issue in the future.\textsuperscript{71} A corridor telecommuting strategy would serve to identify highly congested areas during peak periods that are in large part due to several large corporate employers. In targeting those companies to actively implement telecommuting strategies, the benefit would be to decrease congestion during peak periods. Even though total period travel may be increased with telecommuting, evidence suggests that reducing peak period congestion has greater benefits to reducing overall emissions and other externalities. A corridor telecommuting strategy may prove to have greater impact on travel behavior, especially in conjunction with mass transit, congestion pricing strategies and perhaps a future Automated Highway System. Additionally, corridor telecommuting strategies could take advantage of previous collaborations or relationships among companies in a corridor. For example, Medical Alley has the Medical Alley Association, a collaboration of health care and medical service companies in close proximity to each other. In addition, the employee job functions found in the corridor may be conducive to telecommuting, making the Medical Alley corridor suitable for a specifically tailored telecommuting program.

Another possible telecommuting initiative is an episodic telecommuting program for heavy snow days and other inclement weather episodes. Generating public and private partnerships for the program and preparation of public service announcements would be necessary. When the weather is deemed unfavorable, public service announcements would advise employees to stay home and telecommute. Surveys on employees' number of trips and trip length during those days should be compared with baseline data and other episodic data—earthquakes and floods. Given that episodic telecommuting does not promote a constant pattern of telecommuting, this program should be followed up by further education of participating employers about the benefits of more permanent telecommuting programs. Instruction of how to continue the program on a more permanent basis will help accelerate program success. As Gordon notes, the episodic approach could play a key role in promoting initial corporate participation, leading to more comprehensive and long-term programs.\textsuperscript{74}

Recommendations and Scope

With additional review of the telework and transportation literature and analysis of the data from this initial phase of the project, a greater understanding of Minnesota’s existing infrastructure and the improvements required to promote telework in the state can be determined. Direct implications of telework for Minnesota’s infrastructure and Mn/DOT’s role must be considered in any planning for future growth and development. Telework from a system level of demand analysis, peak period trips are reduced for a relatively small percentage of total commuters. However, of more relevance to this task is the change in the nature and distribution of travel with telework/telecommuting. Measuring the effects as trip substitution for the commute or stimulation (midday trips, picking up children from school, and other recreational activities) can produce different results. Direct measures of infrastructure need based or telecommuting totals are therefore negligible.

\textsuperscript{71} University of Minnesota and Metropolitan Council. “Twin Cities Industry Cluster Study.”

\textsuperscript{74} Gordon.
The direct implications of telecommunications for Minnesota’s infrastructure range from demand on services to business location to trip substitution generation, and therefore this complex interaction is not easily measured in terms of infrastructure needs. Integrating an assessment component into all ongoing telework/telecommuting programs would assist in clearly showing the change in the distribution of trips and the physical infrastructure needed for this change. Assessment of telecommuters and teleworkers would require detailed travel diaries of all private programs and public sector-directed surveys of home-based business workers’ travel demands. The continuation of this study will seek to widen the lens on analyzing telework’s potential impact on Minnesota communities and the means through which such telework/telecommuting programs can be prepared for and facilitated. The following are recommendations for Phase II of the study.

**Recommendation 1:** Develop and implement a feasibility study for an electronically enriched community demonstration project analyzing possible relationships where telecommunications and travel could come together to promote the development and revitalization of communities.

As a result of the scoping study we see the need to conduct a “hands-on” demonstration to heighten awareness of and support for telecommunications strategies. This task would address the feasibility of a demonstration project to show the highest potential use and benefits from developing innovative E-enriched community sites. These sites would be linked to fast-track higher-speed transport capacity which would reach out to public or private networks to employers, markets and service centers. Demonstrating the highest potential uses and benefits would relate directly to transportation planning and the potential role of telecommuting in that planning and investment, as well as to telecommunications infrastructure investment and service roll-out decisions.

This demonstration would address directly the widely recognized “last mile” problem which is said to block faster deployment of higher speed network capacity to residential users and home businesses, as well as strategically located telework centers. The essence of the last mile problem is that providers can’t build capacity without proven market demand; but lack of capacity inhibits growth of market demand which would justify the building. Decisions about expanding basic network capacity are further complicated by the fact that more than sixty local telephone service companies operate in Minnesota. Both the last mile problem and the fragmented service map in Minnesota reduce development incentives. This demonstration project would remove barriers to development by creating a breakthrough which would help bridge the gap between the willingness of providers to engage in such risk to expand capacity and the justification for building expanded capacity.

We recommend a demonstration project with various partners which would explore the integration of telecoms infrastructure, real estate, telecommuting capacity, transportation options and community design factors to foster new forms of development and re-development in urban, suburban and rural areas. The end result would be set to a new standard in Minnesota for sustainable, livable, economically competitive communities based on an electronically enriched environment.

The primary activities would be: (1) to explore the interest and participation level of potential public and private partners; (2) to develop a framework for a potential three site project including at least one new development, one retrofit community, and one rural community; (3) to explore the potential for funding mechanisms; (4) to create a Working Group to advise on strategy and implementation; (5) to elicit community ideas and enlist support through symposia and presentations. Positive discussions are underway with the Metropolitan Council in regard to potential sites and activities.

**Recommendation 2:** Develop profiles for telecommuting programs to assess electronic travel readiness and scenarios in Minnesota including community design and transportation system impacts.

While the demonstration program represents an important opportunity to enhance the visibility in select locations, we also see a need to understand the broader range of community (both public and private sector) actions possible to support electronically mediated work, commerce and related trip substitution. The next project phase would therefore develop and compile a range of data to ascertain Minnesota telework and related electronic trip substitution trends and needs (including devising and revising new data as part of University of Minnesota annual survey); and then examine scenarios for enhancing demand for telework and related electronic travel in the state especially as it pertains to the economic (e.g., workforce shortage) and transportation goals of the state. These scenarios would include inner urban, suburban, and rural applications and would be based on: 1) existing (and new) survey data on levels of telework and telecommuting, 2) related qualitative and quantitative data on availability of adequate facilities (bandwidth, support services, etc.), 3) existence of “critical mass” of knowledge intensive employees and employers, and 4) local community goals and policies for electronic services. Drawing upon these data, community design scenarios would be developed for integrated electronic travel as a “transportation mode,” including parameters estimates on travel behavior impacts. Potential examples of these profiles include a study of teleworkers employed by Hennepin County (in discussions), a comparable study in the private sector, and a corridor study.

Activities would include: 1) review of census and survey data from Minnesota, as complemented by data from other states, 2) development of profile categories for “high potential” communities, 3) delineation of key telework amenities and supportive policies, 4) integration of data into community design scenarios, and 5) an expert forum on scenarios (including policy and transportation impacts).

**Recommendation 3:** Comparative Analysis of Telecommunication Infrastructure and Economic Competitiveness in Selected Minnesota Cities.

The telecommunications infrastructure is a potentially important new lever to enhance the Minnesota’s economic competitiveness. We recommend an analysis of the relative importance of the telecommunications system—as an infrastructure—in attracting and retaining high growth businesses to Minnesota. Comparative case studies would be used to compare The Twin Cities to competing “command and control cities”. Using available
data of infrastructure, benchmarks would be developed to compare Minnesota to other competing “command and control cities” including Phoenix, Austin, and Tampa. Analysis would include trends regarding high-tech and e-commerce firm location activities including land use implications. Industry cluster interviews would be conducted to ascertain industry perspectives on the role of telecommunications infrastructure in retaining and attracting businesses.

**Recommendation 4: Develop Multiple Outreach, Educational, and Training Modules on Transportation and Telecommunications Policy Issues.**

Based on the scoping study, we see the need to entail the development of several outreach, educational, and training activities relative to telecommunications and transportation. This would include, at a minimum: 1) a public symposium on the E-enriched Community Demonstration program, 2) a University-wide forum on “Community Design for the Information Age”, and 3) related graduate/extension educational material and courses on “Telecommunications Policy” and “Transportation, Information Technology and Urban Design”.

**Recommendation 5: Consolidate and coordinate statewide executive leadership for telecommuting and improved telecommunications standards in both the private and public sector.**

The Governor would call a meeting at the Governor’s Residence for the CEOs of the 25 largest companies in the state, plus the mayors of Minneapolis and St. Paul and the seven county administrators to talk about a telecommuting version of the 5-percent club.

The Governor would call another meeting at his residence for the telecommunications providers that serve the seven county area and discuss the enrichment of telecommunications services in the state. Among the issues should be the possibility of raising the minimum baud rate above 9,800.

On a final note, we would like to commend Commissioner James Denn and the leadership team of the Minnesota Department of Transportation for demonstrating outstanding foresight in planning to meet Minnesota’s telecommunications and transportation needs. Mn/DOT’s long-term commitment to continued learning, demonstration and action on this issue will position the department for its emerging role in the 21st century.
Appendix 1

Summary of Results of Survey from TAM Conference, March 26, 1998

Those who responded to the survey that was distributed at the TAM conference represented a variety of organization types and positions within them.

Of the 34 survey respondents, half (50%) represented private business, while 21% worked for government agencies and 18% in the non-profit sector.

The majority of the survey respondents came from international (44%) and local (41%) organizations, while a smaller percentage (15%) represented national organizations. Most (74%) of the organizations represented by the respondents had more than 250 employees, while 15% had between 50 and 250 and 12% had fewer than 50.

The range of positions within organizations ranged from mid- and upper-management to IS support, sales, and human resources. The greatest number of respondents (41%) defined their position as "Other," including positions such as administration, planning and development, and owners of their own businesses.

Respondents were also surveyed concerning their organizations’ current telecommuting program. Of the 31 respondents to this section of the survey, 13 (42%) reported that their organizations had a program in place, while 10 (32%) said that none had been implemented and 8 (26%) reported that their organizations had initiated a pilot program or had an informal arrangement that allowed certain employees to telecommute.

The survey results indicate that the use of telecommuting is increasing in Minnesota. Of 24 respondents, 17 (71%) reported that the number of employees that telecommute in their agencies was growing, while 2 (8%) stated that there was little change in the number of telecommuters and 5 (21%) were unable to confirm whether or not the program was growing within their agencies. None of the respondents reported a decline in the number of telecommuters in their organization.

Survey responses show that telecommuting programs have moderate support from top management within the organizations of the respondents. On a scale of 1 to 5, with 1 representing high top-management support, the mean survey response was 2.9 (there were 23 responses). The survey also asked the participants for their opinion of the effectiveness of the telecommuting program in their agency. Using the same scale, the mean response was a 2.3 (21 responses). The results of this survey therefore indicate that telecommuting programs are perceived to be more effective than they are supported by top organizational management.

Respondents were then asked to rate the reasons their organizations were interested in telecommuting. Rated most important were reducing office space needs and costs and increasing employee productivity, morale, and commitment. An improvement in ability to attract and retain employees was also given high priority as a reason for the organization to implement a telecommuting program. Rated as moderately important reasons were reducing stress, time, and costs associated with commuting, reducing travel, enhancing air quality, and reducing energy use. Reasons noted but rated with relatively low priority included decreasing absences, addressing special situations and needs, and balancing job and family responsibilities.

The survey then requested that the respondents rate the importance of barriers to telecommuting within their organizations. The barrier rated with the overall highest importance was the supervision and management of telecommuting employees. The costs involved in setting up a telecommuting program and a concern that the work was unsuited for telecommuting were identified as moderately important barriers. An inability to adjust to new work arrangements was rated as a relatively unimportant barrier to telecommuting in this survey.
When asked to identify what types of Minnesota State policy support would be of assistance to their organization concerning telecommuting, the responses included, in order by number of responses: incentives, e.g. tax breaks, etc.; workshops or training courses; educational outreach; conferences and symposiums; and technical assistance.

Other comments:

- I am a consultant to companies with telecommuters and home-based businesses. I design home offices, individually or help develop standards for corporations.
- I'm an independent computer consultant. I'm currently not telecommuting but will be looking for a contract where I can telecommute.
- Management support for sales telecommuting group is high, not for general office staff, that is lean after recent merger last year. Two years ago when I started telecommuting in Rosemount/Lakeville area ISDN was not available. I had to order (7) 56K circuits (at twice the cost of ISDN) until ISDN was available.

Appendix 2

OLSTEN SURVEY SUMMARY:
1997 OLSTEN FORUM ON INFORMATION MANAGEMENT, 1998 SURVEY:
MANAGING WORKPLACE TECHNOLOGY

Survey background:

- Conducted under auspices of William Olsten Center for Workforce Strategies (5th annual workplace technology report by Olsten).
- Responses from nearly 300 sr. exec's (panel of high-ranking information systems exec's & vice presidents & directors) from US & Canada.

Results:

- 51% of companies have telecommuting arrangements (up from 44% (or 42%?) the year prior & almost double from the first year of the survey). About 1/2 of these companies report productivity increases as a result.

Reasons cited for offering telecommuting:

- 35%: more cost-effective
- 33%: to attract qualified employees
- 45%: to increase employee productivity
- others: addressing employees' personal needs, childcare issues, providing connectivity to remote salespeople, accommodating employees with disabilities

Types of employees that telecommute:

- 74%: Professional/Technical
- 35%: Sales/Marketing
- 24%: Accounting/Financial

74% of companies expect to increase telecommuting activities over the next year.

Telecommuting by industry:

- 82%: High Tech
- 71%: Utilities/Transportation
- 67%: Insurance
- 62%: Services and Retail/Wholesale