

Strategic Plan for Enhancing Mobility On the Information Highway

Preface

According to the recent Arthur D. Little report, *Can Telecommunications Help Solve America's Transportation Problems?*, if a "reasonable" 10-20% of vehicle trips were substituted with a telecommunications alternative nationally, nearly six million automobile commuters will work at home, three billion shopping trips will be replaced, thirteen million business trips and over six hundred million truck and airplane delivery miles will be eliminated each year. The report further states that conservatively, these substitutions will provide \$23 billion in annual benefits resulting from:

- ◆ Elimination of 1.8 million tons of regulated pollutants produced by vehicles,
- ◆ Saving 3.5 billion gallons of gasoline,
- ◆ Freeing up 3.1 billion hours of personal time from reduced highway congestion, and elimination of commuting, shopping and business trips, and
- ◆ Reducing some half a billion dollars in maintenance costs for the existing transportation infrastructure.¹

The California Department of Transportation (Caltrans) understands well the benefits of developing the electronic highway alternative. The agency responsible for the state's highway system had invested billions of dollars in a physical infrastructure that, even today, is no where near to ubiquity. Still, population centers throughout the state are increasingly becoming more decentralized and adding to the burden on the existing infrastructure. Investigating the electronic highway alternative, Caltrans has, since 1992, spent more than \$7 million dollars in researching and developing programs that lay the foundation for creating a truly "Smart" state. California as a Smart State will make available the remote delivery of services, telework, distance-learning, telehealth, telecommerce and other applications of the "electronic" highway. Caltrans has thus become an important catalyst organization to move the state towards the "Smart" concept. However, in light of its recent decision to scale back its exploration into this area, it is now up to the State leadership to carry the work past the

¹Boghani, Kimble and Spencer. *Can Telecommunications Help Solve America's Transportation Problems?* Executive Summary.

investigative stages by either charging Caltrans or some other State or independent agency to continue our state information infrastructure development. Understanding that other states have already begun to implement their own state information infrastructure plans, our leadership must act now in order to keep California competitive and move our great State into the 21st Century.

Situation Analysis

The revolutionary pace of change in technology and applications is creating significant new challenges for California. The very structure and nature of work and the delivery of goods and services are fundamentally changing. This heightened, foundational shift from a manufacturing-based economy to an information-based economy carries with it particular new demands on business, education and government institutions.

In California, this will result in:

- ◆ a shift from traditional goods-producing industries to unique products with higher "knowledge value" than those that can be produced in lower-cost states and regions around the world. Among them are entertainment, fashion and business services.
- ◆ economy that is based less on large, defense-oriented companies and more on networks of smaller, more commercially adept firms. Particular emphasis will be on new technological fields such as computers, software and biotechnology.
- ◆ an increased focus on world, as opposed to national or regional markets. California is home to the nation's largest customs district, and its two largest ports. Leading export industries such as avionics, entertainment and software are also based here.²

This is not to suggest such changes will not occur just in California. Governments around the world are preparing themselves to accommodate the New Economy by coordinating and implementing strategies to improve their delivery of products and services through the sophisticated use and deployment of information technology. As detailed in the 1992

²Kotkin, Joel. *California: A Twenty-First Century Prospectus*. Center for the New West (1996)

report *San Diego in the Global Village*, Japan plans to create a nation wired with fiber-optic cable by 2015.³ Singapore is becoming an "Intelligent Island," a teleport that is serving as a Pacific hub for many Western companies. France, England and Germany have also taken significant steps toward building advanced communications infrastructures.

The Federal government has acknowledged the critical importance of a U.S. transformation and is supporting the development of the National Information Infrastructure (NII) and related technologies in order to enhance U.S. competitiveness in international markets. The NII is also seen as the emerging basis for industry and government to conduct business less expensively while providing better service.

The *Global Village* report concluded that regions should begin work now to build their information infrastructures: "As the world moves swiftly toward global interconnectivity, economic and social rewards will go to the ... regions that organize themselves to participate effectively in the information-led economy that is emerging. Those areas that do not choose to follow this path will be left behind."⁴

Such assertions have the support of a vast amount of research. The WEFA Group (Wharton Econometric Forecasting Associates) and Chase Econometrics, for example, project 20% average compounded rates of return for investment in telecommunications network infrastructure planned in another state (North Carolina). University of California researchers estimate that every \$1 invested in telecommunications infrastructure in the US produces \$5 in economic benefits. These economic benefits arise from:

- 1) Reduced telecommunication costs as more users use the networks, which drives down the cost per user.
- 2) Productivity gains across many lines of business and government.
- 3) Reduced transaction processing costs throughout the economy.
- 4) Reduced transportation costs.
- 5) Reduced costs to state and local government from lower demand for construction of new public school buildings, university and college facilities, and government office facilities.

³ International Center for Communications, San Diego State University (October, 1992). *San Diego in the Global Village: Telecommunications Infrastructure Study, Phase One, for the City and County of San Diego*.

⁴ *ibid.*

- 6) Increases in gross state product statistics, employment, and other economic measures.
- 7) Increases in private sector revenue from new business ventures, such as developing computer software to provide new services made possible by the technological advances in telecommunications.
- 8) Resultant increases in state tax receipts.

Finally, the US Computer Systems Policy Project estimates that a national electronic highway initiative will create as much as \$ 300 billion annually in new sales across a range of industries.

Still, businesses and individual consumers will benefit from this potential only when outdated regulations are removed at both the state and federal levels. Regulatory changes are needed that will allow new levels of competition to exist and drive down costs for everyone, including government, and broadly benefit California's economy.

The California Public Utilities Commission (CPUC)—in its 1993 report, *Enhancing California's Competitive Strength: A Strategy for Telecommunications Infrastructure*—called for "a vigorously competitive market" in telecommunications in order to spur private investment in advanced facilities. The agency also established a timetable for deregulation. Additionally, the CPUC recognized that for this to become reality, there must be a change in attitude by our leaders:

*Technology is making competition in all telecommunications markets economically feasible: wireless, satellite, cable and telephone systems are becoming true potential competitors as the costs go down and the sophistication of technology increases. Yet, businesses and individual consumers will benefit from this potential only when outdated regulations are removed at both the state and federal levels.*⁵

State-Level Initiatives Under Way

Understanding that advanced communications technologies will enhance mobility and the regional economy, there are a number of states that either adopting, or implementing plans designed to create electronic information utilities, or State Information Infrastructures. They are realizing that advances in telecommunications and the development of the NII are creating the need for bold regional strategies (see box).

⁵ California Public Utilities Commission (November, 1993). *Enhancing California's Competitive Strength: A Strategy for Telecommunications Infrastructure*.

Access Indiana Information Network (AIIN)	An interactive information and communication system created to provide equal electronic access to information, regardless of geographic location, for residents and businesses across Indiana. Access is provided by the network to state, county, local, association, and other public information. The Network is one part of a three-part initiative of the State of Indiana designed to improve the quality of life of Indiana's citizens through the use of information technology service providers and state agencies cooperating together. (See http://www.state.in.us/no-frame.html)
Technology 2000	Utah's initiative to implement an electronic highway connecting Utah citizens with Utah's businesses, schools, government offices, health care providers etc. Technology 2000 is a summary of Utah's electronic highway services that are available now or those services that will be available within the next 2-3 years. In the document the benefits and costs of each service are described. If a Utah business or citizen wants to begin using the service, a contact or access methodology is described. Finally, the exact status of the service is described, indicating whether the service is either immediately available for use or when in the near future it will be available. (See http://www.state.ut.us/governor/tech2000/)
Florida Communities Network (FCN)	A shared resource network among the communities of Florida organized around the issues the citizens care about. Economic development, public safety, health care and access to government are just a few of the issues that determine Floridians' quality of life. The Florida Communities Network will link information about these issues, and others, in order to solve problems and expand the potential of Florida's communities. Existing infrastructure in the state will support huge volumes of high speed, digital transmission of voice, data, and video around the state. (See http://www.state.fl.us/fcn/z/overview/execsum.html)
Washington Information Network (WIN)	Kiosk-based information network. A partnership between the state's Department of Information Services (DIS), IBM and over 20 state, federal and local agencies, the system offers 56 applications that provide government services including education, employment, health and social services, business and transportation applications. WIN terminals are found in malls, libraries and public buildings throughout the state. WIN operates on a client-server model and connected via telephone lines to the WIN central server in Olympia. WIN uses full-motion video, stereo audio, graphics, animation, colors, blink-points, on-screen text, and two language options. (See http://www.wa.gov/dis/win/winhome.html)
Georgia Statewide Academic and Medical System	Claims to be the "largest and most comprehensive distance learning and healthcare network in the world." As of April, 1996 there are over 300 sites included in the distance learning network, which includes K-12 public schools, colleges, universities, technical institutes, hospitals, prisons, Georgia Public Television and ZooAtlanta. There are currently 59 telemedicine sites. The network is managed by the Georgia Department of Administrative Services. (See http://www.gactr/uga.edu/gsams/gsams.html)
Northwest Arkansas Community Information Network	Joint effort between the University of Arkansas and community members with an interest in improving access to the information that affects citizens' daily lives: politics, education, environment, and more, by making it available on-line through the Internet. (See http://www.uark.edu/community/comnet.html)
Kentucky Information Highway	A statewide telecommunications and information network developed by Kentucky state government in partnership with the state's 20 local telephone companies teamed with LCI International. The statewide network, with an "access ramp" in every one of Kentucky's 120 counties, will link state agencies together by consolidating state government's numerous networks. link all school districts across the state, improve health care for rural Kentuckians through telemedicine applications and attract new business and grow existing businesses that depend heavily on information technology. (See http://name1/state/ky/us/hwy/hwy3.htm)
North Carolina Information Highway	Migration from the present statewide telecommunications systems for transmitting voice and data signals to an advanced technical infrastructure, featuring high-volume fiber-optics and high-speed message handling equipment. The implementation of the network will result in the construction of an information highway configuration throughout the state that will accommodate a number of planned technology projects aimed at improving student performance, presenting education equity across the state; providing the best of medical diagnostics and treatment regardless of geographic locations; offering equal and unimpeded access to the state's most extensively stocked libraries, leading research facilities, and most powerful computing centers; attracting and retaining industry; identifying and apprehending criminals; and offering more responsive and better services of all types to our citizens - all of which will encourage economic development. (See http://www.ncih.net/summ.html)
Vermont GovNet K12net	Network infrastructure which serves government offices in Montpelier and Waterbury as well as district offices in twelve cities and towns statewide. From the backbone nodes, 56 kbps backfeeds serve other government offices, schools, and libraries statewide. In addition there are dial-up sites located in every local calling area of the state facilitating network access with a local phone call from any school or library in the state that elects to have dial-in access. SLIP and PPP access, as well as VT100 access, are supported on a dial-up basis. K12net is an extension of GOVnet designed to provide network access to K-12 schools in Vermont. Through K12net, the state is able to provide the "infrastructure" or highway which interconnects all schools and libraries in Vermont. Internet access is also available through K12net. (See http://www.cit.state.vt.us/govnet/about.htm)
Wisconsin BadgerNet	Project plans to establish an advanced telecommunications infrastructure throughout the State; create a statewide information technology plan with emphasis on telecommunications systems; and link individual state agency telecommunications plans and procedures with a cohesive, comprehensive statewide plan. (See http://badger.state.wi.us/.statewide/.badgernet/)
Maryland's Public Information Network (Sailor)	Sailor is an on-line information system that provides Marylanders with no-charge access to Internet resources, including a growing number of state and local government files. It is emerging as Maryland's Public Information Network. Access is possible from home, workplace, public library, school, higher education institutions, and prisons. A project of the Maryland library community, Sailor represents the efforts of more than 100 volunteers offering countless hours of service. Since 1993, task groups comprised of volunteers from public, school, college and university, and special libraries have been instrumental in the planning, design, and implementation of the Sailor network. Sailor is coordinated by the Division of Library Development and Services (DLDS), Maryland State Department of Education. The Sailor Operations Center at the Enoch Pratt Free Library is responsible for technical and support operations. Currently, the Sailor telecommunications network consists of 18 host sites around the state who provide direct access to the Sailor Network in 21 counties (See http://rs.intermc.net/nic-support/nicnews/archive/april96/sailor.html)
Colorado Rural Telecommunicatio	Increase economic activity in rural Colorado through the use and application of existing and planned telecommunications infrastructure. (See http://www.yampa.com/aerie/resource/crtp.htm)

It is incumbent upon the State of California to encourage the development of its own statewide information infrastructure as well, perhaps springboarding from the previous work undertaken by the Caltrans. Caltrans to date has sponsored a number of information technology research and demonstration projects and has committed itself to extending the physical transportation infrastructure into the realm of virtual highways.

Developing the Electronic Highway Alternative

In its *California Transportation Plan*, Caltrans--proposing to "Develop the Electronic Highway Alternative"--stated the potential for telecommunications to expand mobility by bringing information and services to the consumer:

Technology and electronic highways are both an alternate transportation mode and means of maximizing use of traditional transportation systems through linkages with the Federal IVHS Program. Going beyond just "bringing the work to the worker," this view sees mobility expanding through telecommunications to bring services to a broad mix of consumers and taxpayers, moving information and services rather than people. Examples include education, health care and government information. The deployment of telecommunications technologies for transportation needs to be fully and systematically coordinated with other modes of transportation. Federal, state and local agencies must cooperate with the telecommunications industry to establish the physical infrastructure and regulations to address transportation applications for telecommunications.⁶

This is not a new perspective. Project California, launched in 1992 by the California Council on Science and Technology, identified six advanced transportation technologies and examined them for their ability to impact economic opportunity and enhance the quality of life in California. The study determined that of all the advanced transportation industry areas, advanced telecommunications offers the largest job creation potential. The project concluded that in order to attract new businesses in the advanced telecommunications sector, California must provide an advanced infrastructure of interoperable networks, and that it must create a

⁶ California Department of Transportation (1994). *California Transportation Plan*.

market environment that promotes innovation. To this end, the following activities were recommended:

- ◆ The definition of a regulatory environment that promotes strong competition, encourages the introduction of new products and services, and guarantees universal access with reasonable pricing;
- ◆ The stimulation of consumer awareness of advanced telecommunications functions and costs through the implementation of grand-scale demonstration projects; and
- ◆ The training of managers and workers in the integration of telecommuting into the day-to-day life of businesses.

Advanced Infrastructure Needed

The report *Getting Results: The Governor's Council on Information Technology* pointed out that every constituent industry of the Information Age is at home in this state -- computer hardware and software; television, motion pictures and music; periodical and book publishers; and the telecommunications companies that connect them together and to their customers by wire, cable, cellular and satellite technologies. In recommending the establishment of an Office of Technology, the Governor's Council on Information Technology (GCIT) recognized that by utilizing information technology not just as a tool, but as a catalyst for the reassessment of its mission and a resetting of goals, the State has an enormous opportunity to reap the vast economic rewards of exploiting the opportunities afforded by these maturing technologies.⁷

Indeed, the real challenge for California is not just in building the infrastructure needed to support these telecommunication networks, but ensuring that the benefits are widely understood by all the beneficiaries -- private industry, health-care providers, educators, government agencies and others -- and that the technology is aggressively embraced by all sectors of our economy. For it is not enough for California to learn how to compete with the other 49 states. California must also learn to deal with the emerging city-states of Seoul, Singapore, Osaka, London, Paris and Berlin.⁸

There is widespread agreement over the growing importance of telecommunications to economic development as we move from a manufacturing-based

⁷ Governor's Council on Information Technology (1995). *Getting Results: The Governor's Council on Information Technology*, for Pete Wilson, Governor, State of California

⁸ San Diego (October, 1992).

economy toward a service-based economy. Increasingly, the "product" of business tends to be viewed as information. Long-range, comprehensive strategies to build robust communications infrastructures are essential to retain existing business and industry, and to promote powerful incentives for the growth of new information-sensitive enterprises.

In the past, regions prospered because of their proximity to major transportation routes whether seaports, rivers, railroads, highways or, more recently, airports -- or because they developed profitable specialties in the industrial economy. But advances in telecommunications -- telephones, fax machines, video conferencing and now the global computer links provided by the Internet -- have created new "electronic rivers of commerce" that make it possible for industrial and service-sector firms to locate virtually anywhere. Telecommunications has grown in importance to a company's ability to compete in this rapidly evolving business environment. Although other factors, such as business climate and local labor costs, influence business-location decisions, the telecommunications environment is taking on an ever greater meaning in this regard.^{9,10}

What is the NII?

The NII is a collection of technologies and equipment that makes it possible to move information electronically. Based on the Department of Defense's ARPANET and the National Science Foundation's NSFNET before it, the NII is evolving quickly from a national to a global (GII) infrastructure.

The development of the NII is being driven by two largely independent market forces. The first is the extraordinary spread of digital networks. Many people know the NII as the "Internet," which can be considered the network of networks. Formerly the domain of the university and government research community, it is now embracing industry and the private sector, because these latter two groups have discovered its usefulness in distributing and retrieving information.¹¹

⁹ *ibid.*

¹⁰ PonTell, S., et al. (1995). WorkSmart. Prepared for the U.S. Federal Highway Administration, California Department of Transportation and San Bernardino Associated Governments by the Center for the New West; International Workplace Studies Program, Cornell University; Programs and Information Science, Claremont Graduate School.

¹¹ Center for Science & International Affairs. John F. Kennedy School of Government, Harvard University. *Information Infrastructure Sourcebook*, version 3.0, vol. 1 & 2.

The second market force driving the development of the NII is the emergence of broadband and interactive services for the home. These include direct broadcast satellite, interactive cable TV, the capability of compressing video signals and transmitting them over telephone lines, CD-ROM technology, and video-on-demand for the home.¹²

The federal government has already recognized the importance of developing the NII and related technologies to enhance U.S. competitiveness in international markets, as detailed in the U.S. Dept. of Commerce's 1993 report, *The National Information Infrastructure: Agenda for Action*. It is also seen as the emerging basis for industry and government to conduct business less expensively and provide better service.¹³ In light of this, the federal government has been encouraging a government-industry partnership in applying information technology.^{14,15}

Capabilities provided by the NII

The NII is making it easier for people to work, shop, and communicate with each other conveniently and is used most commonly for these purposes:

- ◆ Commerce: Products and services are beginning to be offered over the NII, allowing people to shop more conveniently from home. This is the fastest-growing component of the NII. An increasing number of companies consider making use of the NII a competitive advantage and a vehicle for marketing and communications. In addition, hardcopy materials, such as medical records, government licenses, and letters can be replaced by electronic equivalents, which can be sent faster and less expensively over the NII than through conventional postal mail or messenger services.
- ◆ "Face-to-face" meetings: Videoconferencing technology is reducing the need for face-to-face meetings, which can be time-consuming and very expensive if travel (especially over long distances) is involved. This technology can be used to take high school and college courses from institutions located far away, allow doctors on

¹² *ibid.*

¹³ <http://indy.radiology.uiowa.edu/NLM/BergernerKienzle.html>, *Iowa Rural Telemedicine Project*

¹⁴ Committee to Study High Performance Computing and Communications: Status of a Major Initiative, et. al. (1995). *Evolving the High Performance Computing and Communications Initiative to Support the Nation's Information Infrastructure*. Washington, D.C.: National Academy Press.

¹⁵ A Report by the Committee on Physical, Mathematical and Engineering Sciences, et. al., (1994). *High Performance Computing & Communications: Toward a National Information Infrastructure*

opposite sides of the country to easily share their expertise on a given patient's case, facilitate working from home, etc.

- ◆ Collaboration: Collaborative environments are environments in which two or more people at different locations work together in a single virtual environment. As with videoconferencing, this technology reduces the need for face-to-face meetings.

Key NII technologies

These are the key NII technologies upon which the capabilities described above are based:

- ◆ World Wide Web (WWW): The WWW, and its associated viewers such as NCSA Mosaic and Netscape, are quickly becoming de facto standards across most computer systems (Macintoshes, PCs, and UNIX workstations) for developing, distributing and accessing information within the NII. They support navigating information and documents through hypertext links, displaying and obtaining images, and filling out and submitting forms. Future WWW applications are likely to include integration with databases, videoconferencing based on packet video (see next item), and viewing of three-dimensional and virtual environments.
- ◆ Packet video: Most videoconferencing today takes place over dedicated phone lines. This is only a short-term solution since easy-to-use, real-time, packet-based videoconferencing is becoming available via public-domain software tools such as Cornell University's CUSeeMe. The quality of such videoconferencing environments needs to be enhanced, however, for this technology to be adopted broadly.
- ◆ Wireless communications: The ability to move around freely, unencumbered by "wires" but still remaining "connected" to the NII, will generate even more growth in NII use and applications.

Remaining Technical Issues

The current NII infrastructure can support many of the applications and services described above. However, many technical issues still remain that, once addressed, will enhance the usability of the NII. These areas, which could benefit greatly by leadership at the state and federal levels, include:

- ⇒ Common data formats.
- ⇒ Management of databases distributed over multiple computers in different geographic locations.

- ⇒ Services to search and retrieve data more comprehensively and easily.
- ⇒ Capability to bill for services and information.
- ⇒ Security and data integrity.

Many states are implementing NII-based programs and are trying to overcome these limitations.¹⁶¹⁷ Additionally, the federal government is pushing for across-the-board revisions in telecommunications regulations to lower the cost and support the development of the exchange of massive quantities of data, audio and video information.¹⁸ These efforts are all critical components in facilitating the use of the NII as a new mode of transportation.

Beyond the general technical and regulatory issues, the issue of broad access to the NII also persists. The federal government is currently transitioning today's Internet/NII to commercial providers. While it continues to focus on research of next generation networks and applications, it is not directly addressing one important area. That is, ubiquitous, broad-based access to the NII. States are in a much better position than the federal government to facilitate and help provide NII access to all its citizens. The current NII is reaching a small and somewhat elite segment of the population. Bringing network access and resources to remote or disadvantaged communities is an important consideration in the development and growth of the NII.

Indeed, for the power of the NII to be fully realized, ubiquitous, broad-based access is necessary. This will primarily be accomplished through the development of smaller, more localized network infrastructures that are being linked together, making it incumbent upon the State to implement and maintain a State Information Infrastructure (SII) that will provide easy and low-cost access with a minimum of regulatory barriers.

Transportation issues will increasingly come into play as the focus of exploiting these new technologies over the next few years will be on creating and maintaining a "virtual highway" that will facilitate electronic commerce and travel.

Conventional trips will be replaced by "virtual trips," in which you will be able to conduct business, go shopping, and literally see the sites without leaving your home or office. The NII is already impacting many facets of our society by providing greater access

¹⁶ *ibid.*

¹⁷ <http://indy.radiology.uiowa.edu/NLM/BergernerKienzle.html>

¹⁸ Patch, Kimberly, *Gore maps out NII highway*, (Vice President Al Gore, National Information Infrastructure Proposal), PC Week v10, n51 (Dec 27, 1993):8.

to information, improving our ability to communicate with each other, and enhancing business opportunities by reducing costs, allowing product information to be easily updated, and speeding products and services to customers. For example, electronic kiosks in shopping malls can let people conduct business with government agencies then and there instead of traveling to an additional destination. Transmitting medical images such as X-rays and CAT scans over fiber optics can save traveling by patients, doctors, radiologists and couriers.

Moreover, in addition to telecommuting, advanced telecommunications systems can be used to provide up-to-the-minute traveler information, allowing people to knowledgeably plan travel times and routes. Another application of advanced telecommunications technology is the potential for adapting control systems currently used for air traffic and maritime vessel movements to create a traffic management system for the State's urban highways.^{19,20}

Regional Strategies Being Implemented

Currently, regional public/private efforts to implement technology-based strategies are emerging in a number of geographical regions throughout the State.

San Diego

The San Diego-Baja (Mexico) region has taken a major step toward becoming a telecommunications hub, or "teleport," on the Pacific Rim. The **InfoSanDiego** Task Force was formed in late 1994, a critical component of Mayor Susan Golding's **City of the Future** program, which, in turn, was the outgrowth of the 1992 telecommunications infrastructure study, *San Diego in the Global Village*, that was completed for the City and County of San Diego.

InfoSanDiego, as detailed in the *City of the Future* study, would establish a region-wide partnership to create an integrated electronic information system on both the Internet's World Wide Web and the city's kiosk system.²¹ The information would be

¹⁹ Transportation Research Board, National Research Council (1990). *Transportation Telecommunications, National cooperative Highway Research Program, Synthesis of Highway Practice, #165*.

²⁰ PonTell, S., et al. (1995).

²¹ International Center for Communications, San Diego State University (June, 1995). *Cities of the Future: Report of the Mayor's Task Force on InfoSanDiego; Health Care; Privacy, Security and Intellectual Property; and Education*.

accessible globally as well as regionally, promoting, among other things, electronic commerce.

The earlier Global Village study concluded that, among other things, telecommunications including telecommuting -- have grown in importance to a company's ability to compete in the current business environment, and to economic development as we move from a manufacturing-based economy toward a service-based economy. The follow-up *City of the Future* study determined that unless we can bring the full benefits of these advances in telecommunications home to businesses, government and individual consumers, we will fail to capitalize on the genius the technology affords us. The study concluded that "as the world moves swiftly toward global interconnectivity, economic and social rewards will go to the ... regions that organize themselves to participate effectively in the information-led economy that is emerging. Those areas that do not choose to follow this path will be left behind."²²

Furthering these precepts, the *InfoSanDiego Task Force* report made three key recommendations:

- ◆ The establishment of "Life-Site Schools" to serve as community centers for the integrated delivery of health care, government and library services to link parents and their children to the schools in their communities;
- ◆ The development of a "health-care utility," a private/public sector cooperative linking hospitals, clinics, physicians, laboratories and imaging centers for routine transfer of standardized patient information and laboratory tests; and
- ◆ The launch of "InfoSanDiego," a universally accessible, PC- and kiosk-based information service serving the broadest possible needs of San Diegans.²³

The **City of Chula Vista**, a San Diego suburb, is serving as a working model for the recently funded Smart Communities project that will blend community telecommunications networks and distributed settings for the remote delivery of services, telework, distance learning, telehealth, telecommerce and other applications of the electronic highway alternative.

²² *ibid.*

²³ International Center for Communications, San Diego State University (June, 1995). *Cities of the Future: Report of the Mayor's Task Force on InfoSanDiego; Health Care; Privacy, Security and Intellectual Property; and Education*.

Sponsored by Caltrans and being conducted by the International Center for Communications at San Diego State University, the project will result in the development of a Smart Communities guidebook for use by other communities throughout the state. In addition, the project will provide a framework for the development of a Local Information Infrastructure in the San Diego area and elsewhere.

San Francisco Bay Area

The **Smart Valley** project was initiated in the south San Francisco Bay/San Jose area, otherwise known as "Silicon Valley." Now in its third year, Smart Valley is a real-life pilot demonstrating the benefits of an electronic community, and has become a model for the implementation of these technologies. The project's mission is to deliver, and thus demonstrate, the real-world benefits of a regional version of the National Information Infrastructure that will enhance the global competitiveness and quality of life in the San Francisco Bay Area. Smart Valley is working with more than 20 pilot initiatives focused on demonstrating applications of information technologies. In addition to telecommuting, these initiatives include education, health care, government, multimedia and electronic commerce.²⁴

In addition, private industry has formed CommerceNet, a collaborative effort to facilitate business-to-business communication and electronic commerce via the Internet and the World Wide Web.²⁵

Sacramento/Davis

The **Net at Two Rivers (N2R)** project was spawned in early 1995 to develop a shared telecommunications network that would not only focus on the urban community in and surrounding Sacramento, but also link the region's municipalities and outlying rural areas.²⁶ The organization's goal is to develop a dispersed, decentralized, interoperable and self-sustaining regional network and information infrastructure that promotes the free and open flow of information throughout the 15-county region, just as two important water resources converge at the State's capital city, the Sacramento and American rivers, flow to sustain crops throughout the valley. N2R is the coordinating body.

²⁴ <http://www.svi.org/>.

²⁵ <http://www.commerce.net/>.

²⁶ Net at Two Rivers (1995). Informational brochure.

The community networks in the regional partnership include the El Dorado (Nevada) Community Net, the Tahoe/Truckee Community Net and the Davis Community Net. The city of Davis, with support from Caltrans, is already implementing a testbed community network using telecommuting and distance learning as new forms of "transportation" to reduce travel in motor vehicles and ultimately improve air quality.

The approximately 40 N2R partners include representatives of higher education, K-12 schools, libraries, health care, government, existing networks, user groups, local businesses and community-based organizations. The program organizers believe implicitly that N2R will have a strong beneficial impact on the economic development of the region, much of which is rural and/or considered at risk of being left behind as the urban areas join the Information Age.

Los Angeles Metropolitan Area

The **Enterprise for Economic Excellence (EEE)** is a program designed to coordinate and develop a regional information infrastructure through a series of five strategic initiatives:

- ◆ Develop and operate a network system called the LINKUP Regional Network;
- ◆ Provide technical assistance to our businesses, governmental agencies, and school districts;
- ◆ Develop seminars, outreach programs, and educational activities for our businesses, government, and educational agencies;
- ◆ Facilitate restructuring education by using technology to bring businesses back into communication with local educators;
- ◆ Develop "real" World Wide Web internet applications to advance this new medium of communication.

The five strategic initiatives will provide a technically rich environment supported by educational activities aimed at fostering a prosperous economy. They support the LINKUP: concept of a new public/private relationship created around technology to keep dollars in the region and to give local businesses a competitive edge, and to learn how to compete in the global economy. Participating in the EEE program include Citizen's Business Bank, GTE, Hewlett-Packard, San Bernardino County, San Bernardino County Central Credit Union, San Bernardino County Superintendent of Schools.

The unique partnership of private and public sectors cooperatively investing in the economic viability of the region is a movement that should continue to transform our economy. The EEE has learned that many of the obstacles in developing the Linkup Regional Network and networked applications needed to enhance the way we live, work, and play are organizational and social in nature, not technical.

The **WorkSmart** project was designed to engage leading Southern California organizations in a collaborative effort to explore the development of "integrated workplace strategies" to help them achieve their business objectives. In an integrated workplace strategy, the individual workplace options -- home-based telecommuting, telebusiness and neighborhood work centers and non-territorial offices -- are designed from the ground up as part of a system of loosely coupled work settings connected by the periodic physical movement of people and the electronic movement of information. The idea is that employees and their supervisors together decide which combination of work options makes the most sense.²⁷

Public/Private Partnerships

These regional efforts are important first steps, and are complementary to the federal-state nexus that is taking place. But the work that the regions are doing must become part of a cohesive whole that furthers the development of a coordinated statewide information infrastructure initiative. The state has responsibilities for education, transportation and environmental quality, which require coordination and cooperation. In a similar fashion, the regional efforts described above need to be integrated at the state level if California is to remain competitive in the global economy.

For example, while Smart Valley is a business initiative, it did not secure a number of important public-policy linkages with government and academia, unlike San Diego's City of the Future initiative, which involved the Mayor's office, the City Council, the County Board of Supervisors and San Diego State University.

The Achilles heel of the free enterprise system is that fierce competition typically means that businesses do not often cooperate with each other. Yet, in the emerging global competition, the lines between the private and public sectors need to be blurred if California is to revitalize its economic foundation and re-establish itself as a leader in the world's economy.

²⁷ PonTell, S., et al. (1995).

This was pointed out in the *City of the Future* study:

While the adversarial system has served us well, we may have to adjust our policies to accommodate a fact of life in the nineties: We competing not just with ourselves, but with companies and regions all around the globe. Now we must find ways to work together in concert, in partnership, through one alliance or another, to create not just the information highways of tomorrow, but the information goods and services which will provide the real wealth and growth in our economy....

San Diego has long been a leader in the implementation of telecommunications technology.... San Diego, due to the region's cable and telephone companies, gas and electric utility company, its water utility, universities and the Navy, has a great deal of broadband capacity (via fiber optic cable, broadband wired and wireless systems) already in place. Currently, however, these are discrete systems, unable to "talk to each other," and [serve only] the specific needs of each controlling institution.

The report concluded that "the City of San Diego should establish a private/public partnership to build a community-wide communications infrastructure to serve all of the citizens of San Diego" ... by which San Diego "can rapidly develop as a 'smart' city."²⁸

Summary of Caltrans Projects

Over the last few years there has been a growing awareness in California of the potential for advanced telecommunications technologies to alleviate the State's transportation, air quality, energy and employment problems. One of the first statewide reviews of the relationship was conducted at the "Transportation Redefined" conference in 1992.²⁹ This conference attempted to identify the policy shortfalls and potential new policies that could stimulate the infusion of telecommunications and electronics technologies into the nation's transportation system. Broadening the awareness of the role that telecommunications could play in transportation was the goal of a Caltrans cosponsored conference entitled "Telecommunications as

²⁸ San Diego (March, 1994).

²⁹ A Policy Development Conference, sponsored by the California Engineering Foundation (November, 1991). *Transportation Redefined - The Movement of People, Goods and Information*

Transportation: Pouring the Electronic Highway" at Pacific Bell's Telecommunications Expo (Texpo) in 1993.³⁰

In order to obtain information on the mobility aspects of telecommunications technology Caltrans has supported a number of demonstration and research projects.³¹ Specifically, Caltrans has been attempting to determine how telecommunications can substitute for physical trips, inform travelers of mode choices, and help transportation system managers better balance supply and demand. The projects are designed to address three elements needed for mobility: *infrastructure, applications and users*. Each project focuses on one or more of these elements in order to determine the best approaches for supplying the infrastructure, developing the applications and gauging the demand for services.

Infrastructure

Caltrans has supported several projects designed to set up and evaluate the effectiveness of providing access to telecommunications at various locations. The University of California, Davis, has a multi-year research project to explore the potential for neighborhood-scale telecenters to serve transportation demand.³² The focus is on eliminating single-occupant vehicle trips by locating telecenters within residential neighborhoods where they are accessible by walking, cycling or short-transit trips. The project has established telecenters in several metropolitan regions of California, from which workers of multiple organizations can telecommute one or more days each week.

The UC Davis project also tracks the status of all other telecommuting centers in California, some of which were set up to provide transportation alternatives following the Northridge earthquake in January, 1994.³³ The tracking report presents utilization statistics, marketing strategies and sources of funding for each center. Some potentially important factors regarding the successful

³⁰ Conference Report, Texpo Conference and Exposition, San Francisco, Calif. (April 7, 1993). *Telecommunications as Transportation: Pouring the Electronic Highway*

³¹ California Department of Transportation, Division of Traffic Operations, Office of Transportation Demand Management, Special Projects Branch (November, 1994). *Summary of Caltrans Projects: Telecommunications Technology Applied as a Mode of Transportation*, Second Edition.

³² Institute of Transportation Studies, University of California, Davis (March, 1994). *Telecommuting Centers and Related Concepts: A Review of Practice*.

³³ Institute of Transportation Studies, University of California, Davis (December, 1994). *Status Tracking for Existing and Planned Telecenters in California*.

implementation of telecenters have been identified. These include:

- ◆ Combining marketing efforts of centers in a region
- ◆ Marketing to small employers
- ◆ Diversification of the telecommuting center
- ◆ Working toward a self-supporting center

Suggestions for diversification include offering services and equipment for home-based telecommuting, utilizing work spaces as distance learning centers, and providing services to a wider range of workers, such as business guests at nearby hotels. Evaluation of pricing strategies has shown that price alone does not determine the success of a center; other factors, including location and marketing strategies, are also influential.

Caltrans is also evaluating other types of locations for telecommute use. In conjunction with the Los Angeles County Metropolitan Transportation Authority (LACMTA), Caltrans is exploring the concept of using fiber-optic capacity within the right-of-way of the rail line for service delivery and information movement.³⁴ The Blue Line TeleVillage Demonstration Project will establish telework centers at train stations in South Central Los Angeles. Through a telecenter at the Antelope Valley Fair, which was originally set up in response to the Northridge earthquake, Caltrans is exploring the potential for using the satellite wagering facilities of rural fairgrounds to provide electronic access to small communities. And through a partnership with the California Community Colleges, Caltrans is investigating the links between transportation and college facilities.³⁵ The program will establish residential area-based offices on college campuses for use as telework centers by non-college employees, as well as for distance education and administrative telemeetings.

Applications

To date, a few applications have been investigated. The telecenters offer telecommunications connectivity, but the applications used are determined

³⁴ Metropolitan Transportation Authority (n.d.). *Televillage*, Metropolitan Transportation Authority Publicity Pamphlet.

³⁵ Curriculum and Instructional Resources Division, Chancellor's Office, California Community Colleges (n.d.). *Educational/Telecommuting Centers: Request for Applications - Application Information for Grants for Project Sites*.

by the user or employer. The Community Colleges project will investigate distance learning and teleconferencing.³⁶ The Community Fairgrounds project will also offer videoconferencing facilities in rural communities. The major exposure to applications is in the Davis Community Network, which is discussed below.

Users

Caltrans developed a brochure and guidebook to provide information on how telecommuting helps businesses and how to set up a telecommuting program.^{37,38} In a partnership with the San Bernardino Association of Governments (SANBAG), the Center for the New West developed working relationships with several corporations to help them assess the opportunities and potential for adopting new work practices through the WorkSmart Project.³⁹ The Center teamed with businesses to help them develop proposals for implementing integrated workplace strategies, which is discussed in greater detail below.

Caltrans is also providing financial support to an Economic Partnership formed by the Southern California Association of Governments (SCAG) to accelerate the consumer use of advanced transportation technologies.⁴⁰ The Partnership is organized with a series of industry cluster advisory panels, one of which is the Telecommunications Cluster. This cluster will identify market opportunities and barriers, and will develop strategies for accelerating the onset of telecommunications mobility in the region. The project will establish a regional outreach program aimed at top executives to encourage the use of telecommuting.

Community Network

The most ambitious project to date, and one which brings all three mobility elements into play, is sponsored through the University of California, Davis.⁴¹ This demonstration project in the City of

³⁶ *ibid.*

³⁷ California Department of Transportation, Division of Traffic Operations, Office of Transportation Demand Management (n.d.). *Telecommuting - A Guide for Executives*

³⁸ California Department of Transportation, Division of Traffic Operations, Office of Transportation Demand Management (n.d.). *Telecommuting - A Handbook to Help You Set Up a Program at Your Company.*

³⁹ "WorkSmart Prospectus." A Project Funded by California Department of Transportation and San Bernardino Association of Governments.

⁴⁰ "The Partnership: Southern California Economic Partnership" Organizational Summary.

⁴¹ Division of Information Technology, University of California, Davis (1994). *Davis Community Network Annual Report.*

Davis electronically links the residences and businesses in the community. It will test the viability of extensively interconnected telecommunications systems among users and service providers to enhance mobility for a number of purposes.

An array of technologies, such as cable television, dedicated and on-demand ISDN, and wireless connections, will be used to provide various services, including teleshopping, community participation in local government, distance learning, and telemedicine. The Davis Community Network connects households, businesses, government offices, university facilities and others to create a "smart community." The project will also explore the potential for remote network nodes that can expand the community network concept to other locations in Northern California.

Traditional Paradigm No Longer Applies

Analysts agree that the electronic delivery of information can, and should, become an integral component of resolving what are now known as Transportation System Management issues. However, attempts to implement these strategies have achieved only limited success. The technological infrastructure needed to implement such strategies is improving daily, but there are mulish attitudes that need to be overcome before the information superhighway begins to noticeably deflect travelers from our State's ribbons of concrete and asphalt.

Traditionally, transportation management efforts -- formerly known as Transportation Demand Management (TDM) -- centered on building more roads and highways while encouraging ride sharing and the use of alternate forms of transportation to reduce the number of single-occupant vehicles. ***But these traditional transportation paradigms all but ignore the considerable role that telecommunications is beginning to play in linking people with each other and businesses to the marketplace.***

At the federal level, the TDM philosophy has been identified as the search for "solutions to our transportation problems that will give us not only increased mobility, but also greater economic productivity and a cleaner environment."⁴²

⁴² U.S. Department of Transportation, Federal Highway Administration & Federal Transit Administration (January, 1994). *Overview of Travel Demand Management Measures*, prepared by Comsis Corporation and the Institute of Transportation Engineers, et al.

Similarly, Caltrans, in its 1994 transportation report, states that its goals are to increase vehicle occupancy and reduce traffic congestion. The following list summarizes the types of transportation management programs implemented throughout the country:

- ◆ telecommuting
- ◆ telecenters
- ◆ carpools and vanpools
- ◆ public and private transportation
- ◆ unmotorized travel (e.g., biking and walking)
- ◆ flexible work hours, compressed work week
- ◆ service improvement to transit
- ◆ preferential lanes
- ◆ subsidies, discounted passes and parking fees
- ◆ emergency taxi service, guaranteed ride home
- ◆ student programs (e.g., night time shuttles, electric shuttles)
- ◆ improved lighting for pedestrians and bicyclists
- ◆ customized transportation services.⁴³⁴⁴

This traditional approach may be shortsighted. Taking a sweeping, comprehensive perspective, the economic well being of the state is at stake, requiring a more broad-based approach that develops transportation management solutions at the same time that it fosters vigorous economic development. Nationally, the focus of transportation management has broadened to emphasize the importance of telecommunications in reducing highway travel, including telecommuting and telecenters for workers. This could be expanded even farther to include telemedicine, distance learning and the delivery of government services.

The Transportation Research Board of the National Research Council supports this view, concluding in its Transportation Telecommunications report: "Although transportation agencies are relatively progressive users of telecommunications systems, they will need to evaluate the impacts of the growth of area-wide communication to identify telecommunication facilities that are dedicated to transportation, but may be used for multiple purposes."⁴⁵

The State of Washington is already moving in this direction. In its 1995 *Transportation Policy Plan*, the following links between transportation and telecommunications were made:

- ◆ Telecommunications and travel substitution;
- ◆ Improved access to transportation decision making;

⁴³ *ibid.*

⁴⁴ Brochures from the Commute Group and University of Wisconsin, Madison.

⁴⁵ Transportation Research Board, National Research Council (1990). *Transportation Telecommunications, National cooperative Highway Research Program, Synthesis of Highway Practice, #165.*

- ◆ Improved efficiency of traditional transportation services;
- ◆ Coordinated development of telecommunications and transportation.⁴⁶

Programs Are Under Way TeleWork/Telecommuting

In California, small steps are already being taken, including several projects either initiated or supported by Caltrans. Primary among these have been efforts to promote telecommuting. However, commuting to and from work amounts to only one-fifth of regional driving. The Cluster Project is identifying means reducing travel in the remaining four out of five trips through the use of telecommunications. Telephone and video conferencing, distance learning, telemedicine and electronic commerce are just a few examples of travel alternatives.

The WorkSmart study pointed out that it is in these kinds of efforts that agencies like Caltrans seek to influence not transportation choices so much as work choices. Their success depends on the business community choosing to rethink, and, ultimately, to restructure how it convenes its workforce in space and time; and success in this area is imperative if transportation system management is to succeed.

However, the findings of the WorkSmart project suggest that *many existing transportation and public policy initiatives are not well-suited to support the emerging ways of working.*⁴⁷ The final report suggests that through the use of integrated workplace strategies, organizations can develop more effective business practices that also further transportation system management objectives.

Searching for Solutions

Southern California has wrestled with the problems of congestion and pollution more than most regions; it has had to come to grips with such issues early on, and is necessarily a leader in the search for solutions. Some of these, for example, encouraging the development of "smart" highways (which use computer technology and remote sensors to monitor traffic conditions and road use) and alternative-fuel cars and trucks, are engineering-driven approaches that one expects to find in an agency like Caltrans, one of the world's leading transportation engineering organizations. But other solutions--support for telebusiness centers and programs to promote

⁴⁶ Washington Department of Transportation (1995). *Transportation Policy Plan*

⁴⁷ PonTell, S., et al. (1995).

telecommuting, for example may, at first glance, seem less likely. They begin to make considerable sense, however, if one moves from dealing with what are in effect the symptoms of a problem (traffic congestion, automobile pollution) to its root causes.⁴⁸

Among these are the facts that (1) people seek affordable and safe housing and good schools, and (2) they must find employment. In the first instance, population growth has continued to push residential development to the suburbs; in the latter, significant numbers of jobs have remained in locations closer to the city center, or at least some distance from where masses of people choose to live.⁴⁹

The Inland Empire (San Bernardino and Riverside counties), for example, will grow by one million people over the next 8 to 10 years. Currently, there are more than 238,598 residents of the region who commute into Los Angeles and Orange counties daily (Inland Empire Quarterly Economic Report identifies more than 1 million employed residents of the region, with a local job base of approximately 750,000⁵⁰). If present employment patterns persist, the number of commuters will double in 10 years, but given the constraints imposed by the area's transportation infrastructure, this is not a reasonable future.

Costs Are on the Rise

The time needed for commuting will continue to grow, and the cost of commuting will also increase. While the Los Angeles economy is likely to maintain its place as the 12th or 13th largest in the world, attracting employees will become increasingly difficult over the next decade, as will the cost of recruiting training and retaining them.

Caltrans and SANBAG recognized these problems, and in response initiated a number of programs and policies intended to mitigate pollution and traffic congestion, and to increase average vehicle ridership (AVR). Considerable effort and funding has also been devoted to exploration of the use of electronics and computers to help drivers navigate via the least congested routes (using satellite systems to help locate exact positions and suggest alternative routes), as well as making possible a variable pricing strategy (not unlike special off-peak night electricity rates, but where travel at off-peak times is charged at a lower rate).

⁴⁸ *ibid.*

⁴⁹ *ibid.*

⁵⁰ *Inland Empire Quarterly Economic Report*. San Bernardino, Calif.: Inland Empire.

In addition to these transportation initiatives, both Caltrans and SANBAG have also supported a number of programs intended to influence the behaviors that contribute to traffic congestion and pollution, particularly telecommuting.

Traditional Work Models Breaking Down

As previously mentioned, much of the success of such efforts in mitigating our traffic problems depends on the business community choosing to restructure how it convenes its workforce. The traditional employment patterns of Southern California have allowed for an increasing concentration of employees at workplaces in central locations, while the residences are widely dispersed and becoming even more so. But that model of everyone coming to a single workplace is breaking down because of the saturation of the transportation network and the dispersion of a population seeking affordable housing. The prevalence of dual income households further exacerbates pressure on the infrastructure.

People are traveling longer distances to work and they arrive tired and stressed from the commute.^{51 52} The increasing cost of transportation due to gas taxes, smog controls, parking fees, and--possibly in the future--congestion pricing, pollution pricing, and fees for vehicle miles traveled, will ultimately be borne by the employers as they compete to attract the most qualified employee for each position.

Supply vs. Demand Approaches

In 1991, the first telebusiness workcenters were opened in the State of California, with initial support from local transportation commissions, the State, and the private sector. The centers were established in the inland region of Southern California with three clear motives:

- ◆ Economic development
- ◆ Improvement of air quality
- ◆ Reduction of traffic congestion

The local transportation commissions, in partnership with area businesses, created the telework centers in communities outside central Los Angeles. This supply-side approach assumed that if centers were

⁵¹ Calthorpe, P. (1993). *The Next American Metropolis: Ecology, community and the American dream*. New York: Princeton Architectural Press.

⁵² Stokols, D., Novaco, R. W., Stokols, J., & Campbell, J. (1978). "Traffic congestion, Type A Behavior and Stress." *Journal of Applied Psychology*, 63 (4), 467-480.

available, employers would use them. This has not happened yet.

Two reports focusing on these supply-driven telework centers found that while employees who did work in the telework centers liked them, few used the centers.⁵³ Because the explicit goal was to comply with transportation regulations designed to reduce commuting, telework centers tended to offer comparatively little work flexibility. When the trial ended and firms had to begin paying market rates for workspace in the telework centers, few companies chose to continue having even a few employees work in the centers.

One of the conclusions of the Becker, et al., report was that the supply-side approach, in which Caltrans initiated the provision of telework centers, failed because it promoted telework centers and telecommuting *principally* as a way to comply with air-quality regulations. The starting point was not an understanding of how organizations work--or should work in order to succeed and prosper as a business.⁵⁵

Demand-Side Approach

In contrast to the supply-side approach, a demand-side approach would start not with the provision of space, but with an understanding of what an organization requires to strengthen its competitive edge. Many organizations viewed the air-quality regulations as a kind of necessary evil; their goal was to meet the minimum requirements of the law. Rarely have these compliance activities been seen as integral to strategic business practices -- that is, as *both* satisfying legal requirements *and* benefiting the business.⁵⁶

Consequently, senior management often did not participate in the kind of fundamental discussions and rethinking about new ways of working required by efforts at significant strategic organizational change. The concept of telecommuting and telework remained outside the main focus of most business discussions. This is ironic, since many organizations continually grapple with ways to exploit new information technologies. But the mere existence of new technologies and work alternatives is insufficient to motivate fundamental change in the ways companies

⁵³ Bagley, M. N., Mannering, J. S., & Mokhtarian, P. I. (1994). *Telecommuting Centers and Related Concepts: A Review of Practice*. Davis, Calif.: University of California, Davis, Institute of Transportation Studies.

⁵⁴ Becker, F., Quinn, K. L., & Callentine, L. U. (1995). *The Ecology of the Mobile Worker*. Ithaca, N.Y.: Cornell University International Workplace Studies Program.

⁵⁵ *ibid.*

⁵⁶ PonTell, S., et al. (1995).

do business. Technology remains more an enabler than a driver of change.

Integrated Workplace Strategies

In an integrated workplace strategy, the individual workplace options -- home-based telecommuting, telebusiness and neighborhood work centers and non-territorial offices -- are designed from the ground up as part of a system of loosely coupled work settings connected by the periodic physical movement of people and the electronic movement of information. The idea is that employees and their supervisors together decide which combination of work options makes the most sense. This depends on the stage a project is in, the most effective workstyle for individual workers and for the group, the nature of the work being done, and so on. Different groups, different individuals within a group, and the same group at different points in time will formulate distinctive strategies. Each strategy will take advantage of whatever time/place combination provides the greatest advantage in work effectiveness.

The WorkSmart concept reinvents the work paradigm, recognizing that much of the time work will be accomplished at home, occasionally it will be accomplished at a remote central office and at other times work will be accomplished elsewhere, according to the employer's needs. The "elsewhere" locations will need to be as diverse and flexible as necessary, but the tools -- technical infrastructure, technical support, etc. -- all have to be in place to support a ubiquitous distributed work system.⁵⁷

Elements of integrated workplace strategies exist in many organizations today, but organizations that have woven individual elements of new working practices into a comprehensive strategy are extremely rare. A major objective of the WorkSmart project was to help each participating organization identify and explore the particular integrated workplace strategy best suited to its circumstances and objectives. The project team then considered the transportation demand implications of the chosen strategies.

Through the implementation of integrated workplace strategies within both private and public organizations--combined with strong leadership from agencies such as Caltrans--effective transportation system management can be achieved.

⁵⁷ *ibid.*

Widespread Applications for New Paradigm

This paradigm for telework can also be restated for other aspects of our lives, including telemedicine, distance learning, teleshopping and electronic commerce.

Telemedicine/Telehealth

While the media have loudly touted 500 consumer-oriented channels of entertainment, shopping and news along the information superhighway, or *infobahn*, the worldwide medical community has quietly searched for, and found, far more significant uses for that highway. Among them: saving lives.

Although telemedicine cannot and should not be an end all--a universal solution to all our health-care delivery problems--it can help overcome time and distance, the greatest barriers to the delivery of health care, especially to non-metropolitan areas. This application of the "telecomputer" to health care will provide physicians and other health care professionals in general, with their technological equivalent of the "black bag." The "radio doctor" of the 1920s is quickly being replaced with the "virtual doctor" of the 1990s. This is telemedicine--the name adopted for the idea of caring for patients, regardless of distance, using telecommunications, information technology and communication systems.

While skeptics suggest that telemedicine is dangerously close to being over-hyped and over-marketed--and in some corners, under appreciated or not understood by physicians and other health-care professionals--it nevertheless remains a viable, valuable and evolving professional tool. This situation will be resolved as existing and emerging technologies become less expensive and more widely deployed; when more and more healthcare applications are available, tested, and used; when our human experience and education teach us that telemedicine can be very "user friendly"; and when results become more available about the real benefits (and costs) of implementing telemedicine. Mike Lapolla, director of academic health services and director of the Telemedicine Center in Oklahoma, suggests that telemedicine is "the metaphor ... for an electronic umbilical cord that professionally links metropolitan and rural health-care providers. Who knows the countless ways that we can all benefit from that?"⁵⁸

⁵⁸ OSU College of Osteopathic Medicine, Oklahoma State University, Telemedicine Training and Research Center, "Combined Medicine and Technology," educational brochure (1995).

Telemedicine Projects and Programs

Examples of telemedicine efforts are literally springing up everywhere. Telemedicine networks, projects, programs, demonstration initiatives are either operating or being proposed in almost every state of the Union. While the number keeps growing, telemedicine applications, projects and programs have been either implemented or are planned for in at least 40 states. Grant activity, consortia building, partnerships and various interested parties are all creating what contemporary organizational development experts call the "virtual" organization.

These organizations are bringing together industry and government, the health care industry, health-care providers, and academia to meet the increasing demands of the managed health care environment. The terms "lean and mean", "doing more and better with less", re-engineering", "reinventing", and "virtual health-care center" are entering the health-care lexicon as these new partners compete and collaborate, all using telecommunications as a critical success factor. Despite unresolved legal and policy issues, these groups are moving ahead with their own defined vision of telemedicine. The InfoSanDiego Task Force report recommended the development of a "health-care utility," a private/public sector cooperative, collaborating with the California Community Health Information Network under development.

Following in their footsteps, is a growing effort to re-engineer the entire health-care industry. Common to other industries, the health-care industry is painstakingly having to examine how it does business, how it has done business, and how it may need to do business in light of increasing financial pressures and the speed at which health care is emerging as a managed care environment.

Health-Care Reform

The current emphasis on health-care reform may, ultimately, be the driving force behind adopting telemedicine applications on a broad basis. Information and the delivery of services, when and where they are needed, will be the enabling factor that allows medicine to deliver on its promise of reform. Telecommunications will play a critical role by eliminating many of the physical and economic barriers to quality medical care by bringing medical technologies and services to patients and providers, rather than the other way around. Moving medical information, instead of patients, will partially replace the concrete highway with the information highway.

Tele-Education/Distance Learning

Distance learning is an education process that uses technology to deliver educational content to students in locations that are geographically separate from the educational institution. The primary advantage is that there is a wider student audience. Students in these different geographical areas will have access to information and degree programs that they otherwise would not have been exposed to. Secondly, the student does not have to be in either the classroom or even in the same geographic area as the educational source. In addition, more of the population will ideally become more educated in their areas of interest or expertise, and distance-teaching is able to involve outside speakers who would otherwise be unavailable.⁵⁹

The print-based model of distance education has survived the test of time and continues to be utilized extensively. Through the 1960s and 1970s, a "second generation" of distance education was characterized by open broadcast (radio or television) supported by print materials and correspondence instruction. The "third generation" of distance education has been characterized by teleconferencing systems. These systems began with audio conferencing and have progressed to video conferencing as it has become economically accessible to the education community. The fourth phase of development of distance education is based on the integrated use of new developments in telecommunications and computing, including the use of the Internet and the World Wide Web.⁶⁰ The emerging multimedia computer technology will most resemble real-time, interactive instruction (also called "virtual reality").

Distance Learning Is Cost Efficient

The catalyst for most of the developments in distance education are the ever-increasing capacity and standardization of electronic communication media. Increasing capacity is the result of the availability of satellites for long-distance communication and the gradual replacement of copper wires by fiber-optic cables of greater capacity. Standardization is occurring with the worldwide implementation of global telecommunications network capable of carrying all forms of audio, video, text or computer data.

Cost calculations show that telecommunication-based instruction can be more cost-efficient than print-based

⁵⁹ Willis, B. (1993). *Distance education: A practical guide*. Englewood Cliffs, N.J.: Educational Technology Publications.

⁶⁰ Romiszowski, A.J., & Iskandar, H. (1992, November). *Use of voice-mail tutoring in distance education*. Paper presented at the ICDE World Conference in Distance Education, Bangkok, Thailand

instruction.⁶¹ Furthermore, the costs of telecommunications is falling, whereas the costs of educational space, staffing and transportation are rising, so that over time, the increased use of telecommunications-based education will become economically favored.

According to Hiltz and Turoff,⁶² Vallee,⁶³ Kearsley,⁶⁴ Grief,⁶⁵ and Wilkinson and Sherman,⁶⁶ we are rapidly becoming a networked society that will adapt to utilizing telecommunications-based communication as easily as face-to-face communication is utilized in society today. Research on distance education has shown that, when appropriately planned, it can be as effective as conventional classroom education.^{67,68}

The *InfoSanDiego Task Force* report recommended the establishment of "LifeSite Schools" to serve, among other things, as community centers for the integrated delivery of government and library services to link parents and their children to the schools in their communities. This is being developed in cooperation with Sony Corporation and SDSU's College of Education.

Defense Conversion

Communications technologies have the potential to alleviate the negative economic effects that have resulted from the impacts of defense-related downsizing. In California, these impacts have been harsh for defense-dependent industries, communities and workers. Approximately 520,000 direct and indirect jobs have been lost as a result of defense industry cutbacks and military base closures, primarily in the Los Angeles, San Diego, Sacramento and San Francisco Bay regions. The recent report from the state's Defense Conversion Council

⁶¹ *ibid.*

⁶² Hiltz, S.R., & Turoff, M. (1978). *The network nation: Human communication via computer*. Reading, MA: Addison-Wesley.

⁶³ Vallee, J. (1982). *The network revolution: Confessions of a computer scientist*. Berkeley, CA: And/Or Press.

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⁶⁴ Kearsley, G. (1985). *Training for tomorrow: Distributed learning through computer and communications technology*. Reading, MA: Addison-Wesley.

⁶⁵ Grief, I. (Ed.). (1988). *Computer supported cooperative work: A book of readings*. San Mateo, CA: Morgan Kaufman.

⁶⁶ Wilkinson, T.W., & Sherman, T.M. (1991, November). Telecommunications-based distance education: Who's doing what? *Education Technology*, 31(11), 54-59.

⁶⁷ Collis, B.A. (1991). Telecommunications-based training in Europe: A state-of-the-art report. *American Journal of Distance Education*, 5(2), 31-40.

⁶⁸ Steinberg, E.R. (1992, Spring). The potential of computer-based telecommunications for instruction. *Journal of Computer-Based Instruction*, 19(2), 42-46.

indicates that the strategic plan for defense conversion is currently being developed concurrently with other statewide planning efforts that address the economy. These efforts should be coordinated with other efforts throughout the state to plan and implement information networks. For example, information on markets, funding and technical assistance could be available to transitioning businesses. Severely impacted defense firms require information to support product development, increase market access, and redefine their role in the changing global economy. These businesses will also need to make intensive and innovative use of computer networks in order to communicate externally with suppliers and customers. In addition, distance-learning technologies could be utilized to assist in the retraining effort.⁶⁹

Virtual Library Visits

California State Library's InFoPeople project began in 1994 and grew from only a few connected sites to over 180 libraries in communities throughout the state. Involving a diverse group of libraries, including the Alpine County Library in Markleeville as well as the Watts Branch of the Los Angeles Public Library System, the project has taken a unique approach toward equipping libraries and resources to connect to the Internet. The program has had a tremendous success in linking communities together around the library. Schools, political associations, senior citizens groups and other organizations have all been involved in putting the new resource to use in creative and practical ways. Rural communities geographically isolated from the rest of the state have taken advantage of the library-based resource to obtain state and government information.⁷⁰

Government as an Outsourcer

The GCIT also recommended that government agencies emulate the current trend in the private sector. Successful companies are eschewing the soup-to-nuts approach, focusing instead on their core competencies and buying the rest from the leaders in any given market, a process commonly called "outsourcing." The report further stated:

California's schools and agencies need to do much more than contract for technology from our leading-edge companies. They should also adopt some of the ways these companies do business. Like companies that are thriving in the face of increased pressure on costs and performance, government should look beyond increasing the efficiency

⁶⁹ <http://www.cedar.ca.gov/plan/execsum.htm>

⁷⁰ <http://www.lib.berkeley.edu:8000/>

of existing functions and work toward cost-effective results. Technology makes information collection, processing, transmission and access more efficient for government agencies. However, it also makes it more cost-effective for the private sector to handle certain operations for government -- or even deliver some services directly to the public.⁷¹

Indeed, if our thinking is constrained by focusing on specific technology and processes rather than desired results, by a belief that certain problems can only be solved by government, and by the notion that consumers can only be protected by government imposing restraints on competition, then many of the benefits that information technology has brought to California's most successful companies will not reach government, its customers, or its taxpayers.

The implications of this approach are clear. A statewide initiative to coordinate the integration of advanced telecommunications into the workplace, health care and education should include our State agencies as they move toward a greater reliance on private industry for certain products and services.

Motivational Roadblocks to Overcome

Attempts to implement the well-intentioned strategies outlined above have achieved only limited success. While the technological infrastructure needed to implement such strategies is improving daily, there are motivational as well as financial, legal and regulatory roadblocks to be removed before the information superhighway begins to appreciably replace our State's highways as a primary mode of transportation.

The WorkSmart project pointed out that local transportation commissions, in partnership with area businesses as well as Caltrans, have created telework centers in several communities throughout the state, including Davis, Santa Cruz, San Bernardino-Riverside and Chula Vista. This supply-side approach assumed that if centers were available, employers would use them. ***This has not happened yet.*** These centers have not become self-supporting, and many organizations have been overwhelmed by difficulties in equipping, supplying and supervising telework centers.

Emerging forms of telecommunications make highly distributed work and workforces possible, but they do not eliminate the need for work-related trips. In fact,

⁷¹ Governor's Council on Information Technology (1995).

they are likely to make these trips less predictable. This works against programs such as ride sharing, which are based on people coming and going at predictable times. In fact, the emphasis on increasing average vehicle ridership *may have led us down the wrong path*. The ride-sharing component of the future of work is only one small element of the whole picture. A campaign aimed at altering public perception of the way we work, live, learn, play and govern ourselves might make a lot more sense. The mere existence of new technologies and alternatives is insufficient to motivate fundamental change in the way we conduct our lives and the ways companies do business.

Conclusion

What is needed is strong leadership at the state level to put these various issues into focus and coordinate a bold strategy to use advanced telecommunications to not only respond to transportation system management issues, but to oversee the complementary deployment of a State Information Infrastructure to ensure the economic well being of the citizens of California as we enter the 21st century.

While there exist strong responsibilities on the part of the state and municipal governments to form partnerships to exploit advanced telecommunication technologies toward the betterment of the daily lives of their citizens, *technology projects underway in California are largely a number of uncoordinated efforts*. Governor Wilson has launched two task forces to identify telecommunications strategies, but there are minimal efforts proceeding at the State level. In fact, the current trend is to abrogate existing programs; to throw the baby out with the bathwater, as it were. Developing a strategy to enhance mobility throughout the State, whether on asphalt or on the information highway, is vitally important to the State and each citizen.

Public agencies ignore the opportunities and challenges inherent in the changing nature of our lives at their peril. In the past, when communities disregarded the potential impact of railroads or interstate highways, often they withered or perished. Similarly, communities today face obsolescence if they do not prepare for the impact of change on all facets of their lives and re-establish themselves on the banks of the emerging technological rivers of commerce.

Admittedly, much work remains to be done, but there is room for optimism. The governor's reports, as well

as those completed by the CPUC, San Diego and others, seem to be pointing in the right direction. An Office of Technology has been established and a director has been appointed. Moreover, the work that Caltrans has done shows that the pieces are starting to fall into place. Likewise, the review of the activities in the regions and some local municipalities indicates a high degree of interest in a coordinated, statewide information initiative. Nineteen ninety-six may be the year that all the dots are connected, putting California in a unique position to move forward in this important area of utilizing advanced information and telecommunication technologies to enhance mobility within California and to ensure a thriving State economy.

To help in achieving these goals, it is strongly recommended that a clearinghouse--a "Smart Communities" Institute if you will--be created in order to assist in bringing together all the information infrastructure initiatives and demonstration projects currently floating independently around the state. Specifically, the Institute could:

- ◆ Work with Caltrans to carry forward initiatives undertaken to date.
- ◆ Assist in the development of a Statewide Information Infrastructure.
- ◆ Develop a collaboratory of California information infrastructure projects and provide that important link between public and private efforts.
- ◆ Ensure that maximum personal, local, regional and state benefits are attained from all that information technologies have to offer.
- ◆ Continue and assure California's leadership in today's knowledge-based economy with local and regional participation in world markets.

As other states begin to develop their own strategic visions, California must act now in order to remain ahead of the pack when it comes to technology deployment initiatives. Such an Institute could serve as the vehicle which brings together all constituencies that have a stake in California's SII and help guide the effort to create the most comprehensive infrastructure plan in the nation.

Strategic Directions Necessary

The Information Age is here, the Information Superhighway is becoming a reality. The modes and purposes of work-related travel are undergoing a fundamental transformation. At the same time, there are initiatives in regional pockets throughout the State to exploit the advanced information and telecommunications technologies to ensure a competitive advantage as we enter the 21st Century. It is critical that the intersection, the nexus, of these two phenomena is carefully orchestrated so that we enhance the progress being made, not inhibit it.

Risk of Reinventing the Wheel

However, these efforts are largely being conducted independent of, and often in competition with, one another. They each -- as do efforts that have not yet begun -- run the risk of duplicating the efforts of those who have gone before them, of re-inventing the wheel. The Governor's Council on Information Technology recognized this in recommending that a clearinghouse be established for state and local agencies on information technology "best practices" both in and outside California.

Caltrans is uniquely positioned to become this clearinghouse, to take a leadership role in encouraging the necessary collaboration to forge State responsibilities and leadership in joint partnerships with such regional alliances as the Cities of the Future, Smart Communities, N2R, Smart Valley, SCAG Cluster, Blue Line TeleVillage and WorkSmart programs. Such policies can lead to more livable communities -- communities rich in choices and responsive to the needs of highly diverse populations so that as we enter the 21st century we may prosper through the implementation of initiatives that will promote:

- ◆ Telecommuting/telework
- ◆ Telehealth/telemedicine
- ◆ Tele-education/distance learning
- ◆ Decentralized government

Telecommuting/TeleWork

The challenges organizations are facing today are daunting: pressures to reduce costs, to obtain mobility in a congested transportation environment, to improve the quality and speed of service, to speed the product development cycle, to attract and retain the most productive workers, to comply with increasingly stringent air quality and transportation regulations, and to accommodate an increasingly

diverse workforce in terms of age, gender, ethnicity and lifestyle.

In addition, as detailed in the Situation Analysis, there are a set of pressures specific to Southern California. The traditional employment patterns of the region have allowed for increasing density of employees in concentrated employment areas with the dispersion of residences throughout the suburbs. Our transportation infrastructure has been barely able to accommodate this type of corporate structuring and development. It is not clear that it will be able to do so for much longer.

Therefore, the business community must come to grips with these conditions and begin to think about new opportunities -- a new paradigm -- that have the potential to help organizations use their scarce resources more creatively and productively. Through cheap computers and cheap communications, the technological capability now exists for creating a far more diverse set of work patterns and location options than existed even five years ago. Companies that want to have the people they will need a few years hence must now begin to develop innovative new integrated workplace strategies.

The WorkSmart Project revealed that many existing transportation and public policy initiatives are not well-suited to support the emerging ways of working. Yet, organizations must explore and then implement new ways of working as they seek to provide better products and services at lower prices to an increasingly discerning customer base.

It is important that public programs and policies support these emerging workplace strategies. After all, isn't the goal, from the perspective of transportation system management, simply to reduce commuting by automobile and the associated traffic congestion and air pollution? The short answer, of course, is, "Yes." However, compliance with federal, state and local regulations may undermine or constrain how organizations believe they need to operate to gain competitive advantage. Ultimately, firms may fail as businesses -- or relocate. Neither outcome is desirable. Transportation and public policy initiatives and funds can simultaneously support new ways of working, and contribute to a reduction in traffic congestion and an improvement in air quality.

Statewide Perspective Needed

Caltrans must continue to provide vision and initiative in the exploration and application of technology -- especially in the development of telecommunications and allied technologies as a transportation alternative. A statewide perspective provides a more global view of opportunities for -- and obstacles to -- the development of a broader information infrastructure. Without statewide leadership and vision, each region of the State faces the prospect of reinventing key aspects and components of the information infrastructure.

Business Competition

Although the WorkSmart Project analysis did not reveal a widespread, uniform transition to new ways of working, all the organizations studied recognized the need for change, and were actively considering new ways of working. Much of the dialogue about the changing nature of the workplace has focused on technology. In most cases, information technology plays a major role in addressing the above issues -- but as an enabler, not the driver of change. A broad-based understanding of the dynamics of change is essential.

The WorkSmart Project identified a variety of workplace strategies that are helpful in meeting these challenges. For the most part, these strategies incorporate aspects of the following:

- ◆ Flexible work
- ◆ Remote work
- ◆ Teamwork

To an extent, these emerging workplace patterns have already been recognized by developers of public policy. For example, the SCAG Regional Mobility Element noted:

Recent and future technological advances have the potential to significantly mitigate the demand for travel within the region.... During the past decade, the percentage of people telecommuting within the region at least one day per week has increased to 3.9 percent. As remote offices become more accessible [either work-at-home arrangements or telework centers], this trend can be expected to continue.⁷²

⁷² Southern California Association of Governments, Regional Mobility Element (May, 1994). *The Long-Range Transportation Plan for the SCAG Region*, Volume 2 of 3, section 3, p. 8

This is further reflected in Objective D of the *California Transportation Plan: Develop the Electronic Highway Alternative*, cited earlier. However, as public policy and government regulations evolve, specific measures tend to become widely promoted, even institutionalized. It's important that public policy agencies avoid being trapped by these measures into perpetuating practices that are no longer appropriate, applicable or cost effective. Indeed, one of the conclusions of the National Research Council's *Transportation Telecommunications* report is that a key deficiency in adapting telecommunications as a form of transportation is the "limited consideration of available alternatives before system design decisions are made."

Public Policy Must Be Ahead of the Curve

As we approach the 21st century, methods appropriate in the 1970s for the mitigation of work-related traffic congestion and air pollution may have become essentially outdated. It is important that public policy continually strive to be ahead of the curve. The need to remain flexible and open to emerging opportunities is especially critical in relations to technological recommendations and policies.

The SCAG *Regional Mobility Element* recommended the following actions:

- ◆ Develop the "Electronic Highway"
- ◆ Adjust state regulations that limit new telecommunications technologies
- ◆ Encourage telecommuting, teleconferencing and teleshopping services⁷³

Virtually identical recommendations were made by *San Diego's City of the Future* report, and are being implemented by the Smart Valley project in the San Francisco Bay Area.

The focus of these recommendations on the potential of new information technologies is on target. However, conventional telecommunications technology should not be overemphasized at the risk of missing important developments in the cable industry, satellite communications, wireless communications and other forms of technological innovation. Increasing technological capacity should be taken as a given; the focus should shift to possible applications.

⁷³ Southern California Association of Governments, Regional Mobility Element (May, 1994). *The Long-Range Transportation Plan for the SCAG Region*, Volumes 1 & 2.

In an attempt to reduce overall demand for physical transportation, TSM initiatives have been developed. These should be re-examined -- not just in light of the potential of information technology, but also considering the kinds of emerging workplace strategies and work patterns revealed in the WorkSmart Project analysis, and other studies, including those by Becker & Steele,⁷⁴ Johansen & Swigert,⁷⁵ Handy,⁷⁶ and Rheingold.⁷⁷

Policy Implications of Emerging Workplace Strategies

Many policy initiatives have focused on modifying travel behavior. But a demand-side orientation suggests that initiatives might more profitably focus on supporting new ways of working. If, as the WorkSmart Project found, the business community views these new ways as strengthening competitive advantage, the resulting initiatives will simultaneously and significantly address TSM concerns.

In building their assumptions relating to service demands, public policy planners need to consider this new distributed, unpredictable work pattern. For example, the SCAG Regional Mobility Element states: "Office teleconferencing facilities are beginning to become a standard part of the office environment. As technology to support this type of remote interaction continues to develop, the implications for reducing work-related meeting trips are substantial."⁷⁸ The problem is that this is only partially true. In fact, there is evidence that videoconferencing sometimes *increases* the number of trips. Often, for example, people meet each other virtually, via a videoconference, and subsequently decide that they need to meet face-to-face. Moreover, media such as e-mail and videoconferencing are conspicuously well-adapted to some ends -- for example, project coordination and the broadcasting of information. However, they are less effective at supporting other activities, such as brainstorming, collaborative activities and assistance to teams in the early stages of formation.⁷⁹

⁷⁴ Becker, F., & Steele, F., (1995). *Workplace by Design: Mapping the High-Performance Workscape*. San Francisco: Jossey-Bass.

⁷⁵ Johansen, R. & Swigert, R. (1994). *Upsizing the Individual in the downsized Organization*. Reading, Mass.: Addison-Wesley.

⁷⁶ Handy, C. (1994) *The Age of Paradox*. Cambridge, Mass.: Harvard Business School Press

⁷⁷ Rheingold, H. (1993). *The Virtual Community: Homesteading on the Electronic Frontier*. Reading, Mass.: Addison-Wesley.

⁷⁸ SCAG (May, 1994).

⁷⁹ Becker, F., Tennessen, C., & Young, D. (1995). *Information Technology for Workplace Communication*. Ithaca, N.Y.: Cornell University International Workplace Studies Program.

A tremendous amount of excitement has been generated by the envisioned development of small centers dispersed within communities to provide alternatives to working in central offices or at home. Most of the centers created to date have been subsidized through a variety of governmental resources, with additional sponsorship by the private sector, including GTE, Xerox, IBM and Pacific Bell. These centers have not yet become self-supporting, and many organizations have been overwhelmed by difficulties in equipping, supplying and supervising telework centers. However, the WorkSmart study concluded that the lack of financial success to date does not diminish the intrinsic value of more "office-like" alternatives to home telecommuting.

Dedicated Company Telework Centers

None of the four companies studied in the WorkSmart Project indicated a strong interest in using public facilities. Some of the study participants did express interest, however, in setting up dedicated company telework centers. A niche clearly exists for a more "professional" alternative to standard home-based telecommuting. Kinko's, among other enterprises, obviously has chosen to respond to the demand for "offices for rent by the hour." It is time to re-evaluate how such centers are financed, equipped, marketed and positioned in the virtual office marketplace. From a public policy perspective, the fundamental question involves the best allocation of public dollars.

The WorkSmart project concluded that a number of items should be considered in the ongoing debate over how public policy can or should influence how, where and when organizations convene workers:

- ◆ The emphasis on increasing AVR may have led us down the wrong path. The ridesharing component of the future of work is only one small element of the whole picture. A campaign aimed at altering public perception of the entire workplace system might make a lot more sense.
- ◆ Agencies such as Caltrans may discover that they make the greatest impact by modeling the revised business practices themselves.
- ◆ Governmental agencies should not identify changing the behavior of the general public as their primary objective. Rather, their most critical mission is to understand the changing

⁸⁰ Sproull, L., Kiesler, S. (1986). "Reducing Social Context Cues: Electronic mail in organizational communication." *Management Science*, 32(11), 1492-1512.

⁸¹ Kiesler, S., Siegel, J., & McGuire, T. (1984). "Social psychological aspects of computer mediated communication." *American Psychologist*, 39, 1123-1134.

needs of the public -- and to encourage positive trends.⁸²

Telehealth/Telemedicine

Eid, in his article "Roadblocks on the Information Superhighway," concludes that reform within the medical and legal professions must proceed at both the federal and state levels. "Failure to address this challenge today will further delay the widespread use of tele-medical services in the United States and undermine the leadership role that U.S. physicians and medical institutions have traditionally played at home and in the international medical community. Difficult though it admittedly is, we must narrow the gap between law and technology," Eid stated. He stated further that:

Government can and should become a catalyst for creating the Information Economy -- not by building or running the NII, or by controlling its use and development, but by eliminating the legal and regulatory roadblocks that have confined many promising new applications to the drawing board.

Health care is a case in point. On September 20, 1994, the NIIT successfully demonstrated a transnational tele-medical system using the latest high-performance telecommunications and computing technologies. end note 11 From an engineering standpoint, the NIIT system could be made available today on a local, regional or national basis as part of a comprehensive medical information infrastructure. Unfortunately, the law does not permit this. Our response should not be to continue denying tele-medical services to the vast majority of Americans, but to change the laws, and change them now.

Fortunately, this message has finally struck a chord with some lawmakers. Speaking at the NIIT demonstration, U.S. Representative Pat Schroeder (D-Colorado) joined Members of Congress from the bipartisan Medical Technology Caucus in praising the potential of telemedicine to serve more Americans better and at less cost. Listing some of the legal barriers that impede commercial telemedicine in the United States, Schroeder urged Congress, the Clinton Administration and the states to close the gap between technology and law. "Once these [legal] barriers are gone," she predicted, telemedicine "is going to go like gangbusters."⁸³

⁸² PonTell, S., et al. (1995).

⁸³ Troy A. Eid (January, 1995).

"It's Because of the Laws"

Schroeder should know. As chair of the Subcommittee on Science & Technology of the House Armed Services Committee, she has jurisdiction over telemedicine in the U.S. military, where such applications are becoming increasingly common. The armed forces already use satellite connections to provide medical education, diagnosis, triage (the selection of cases that need further attention) and treatment to more than 70 remote locations throughout the world.

However, the relative pervasiveness of telemedicine in the U.S. armed forces differs dramatically from the civilian sector. While civilian telemedicine projects are currently underway in at least 35 states, only 2,000 non-military tele-medical consultations were performed in the entire United States last year. Of these, the ten most extensive projects conducted a mere 750 consultations lasting more than a few minutes. By comparison, a single clinic in Norway conducted more than 600 such consultations during the same period. Many other countries are pushing ahead with ambitious civilian telemedical applications while the United States concentrates on technology testbeds and demonstration projects.

In the final analysis, the disparity between military and civilian telemedicine in the United States is more a function of law and policy than of technology. Understanding these differences is the first step toward bringing telemedicine to the civilian world, providing a catalyst for shifting the emphasis from cure to prevention.

A first step would be the creation of a non-profit health-care information utility, which could standardize patient information, and create central medical databases that are more complete and accessible than the present system. Such an agency would gather a minimum clinical dataset of patient information that would be made available to ambulance operators and other emergency medical care providers. Long term, the concept can be broadened to implement the use of interactive databases, informational television programming and other multimedia products to begin the process of educating the consumer. When the consumers become more educated, they can become their own "primary care" physicians.

Tele-Education/Distance Learning

Education is facing similar issues in its attempts to adapt these emerging technologies to the classroom. The technology exists to implement tele-education

and distance learning programs, but there are legal and policy issues to resolve before it becomes widespread.

This was addressed by the Governor's Council on Information Technology. In its final report, the GCIT stated that California's schools and colleges will reap more rewards from homegrown information technology industry by using information technology not just as a tool, but as a catalyst for a reassessment of mission and a resetting of goals:

By incorporating information technology into education, educators will be able to create new opportunities for learning -- and in doing so, create new opportunities for students to excel in their courses. Schools must also focus on the skill of learning in order to prepare our children to excel in a world where workers must be as flexible as the companies for which they work -- a world in which Californians may need to change careers four or five times during their lives.

Information technology should also be used to promote the most important part of education that takes place outside of the classroom: Parental involvement. The creative use of even the most basic technologies -- such as voice mail and e-mail -- facilitate parental involvement in what teachers are teaching and how their children are learning.⁸⁴

The GCIT further recommended that information technology be used to share expertise and teaching resources between campuses and school systems (i.e., enable increased opportunities for distance learning), and to ensure that "students acquire the ability to use technology to create, store, find and transmit information."⁸⁵

Again, it is going to take a change of attitude by government officials and agencies to make this happen. The states of Texas, Iowa and Washington are leaders in this regard, interlinking schools and government agencies via the Internet and World Wide Web. These programs were greatly assisted in Texas by legislative action that allowed funds earmarked for textbooks to be expended on computers, software and the rewiring of schools with fiber-optic cable. Prior to the change in the state's laws, the schools were restricted to spending such funds only on textbooks.

⁸⁴ Governor's Council on Information Technology (1995).

⁸⁵ *ibid.*

We support the GCIT recommendation that the public school system work to remove existing state restrictions on technology-based courseware -- which currently allow the purchase of course material only in textbook form. California should adopt policies that will permit the allocation of funds toward the integration of advanced information technologies into its schools.

Decentralized Government

Successful companies today are focusing on their core competencies and buying the remainder of their required products and services from industry leaders in any given market. This approach reduces costs, and can also reduce numerous risks by "contracting for performance"; that is, insisting that vendors provide goods and services that solve specified business problems, or they do not get paid.

The GCIT report is a call to action in this regard. It concluded that "getting government to emulate the private sector in its successful use of information technology" is the key element to how government agencies can make the best use of information technology:

Californians want more convenient and lower-cost access to government information and services. They want the right answers, as quickly as possible, without regard to which agency or department may be responsible. Fortunately, technology offers a number of tools to make this outcome readily achievable, but only after government makes a commitment to present itself in a customer-friendly way -- by adopting the concept of topic-driven access. Thereafter, the Internet and other publicly accessible networks can offer a one-stop, user-friendly, electronic gateway to State information and services from wherever there is a computer -- at home, work, school, the public library or private service center. The Info/California kiosk system offers another gateway. Each of these tools also offers opportunities to increase access for all Californians to a growing array of information resources and to help promote local and virtual communities of interest -- regardless of geography or income.⁸⁶

The implications of this approach are clear. A statewide initiative to coordinate the integration of advanced telecommunications into the workplace,

⁸⁶ *ibid.*

health care and education should include our State agencies as they move toward a greater reliance on private industry for certain products and services. This process is known as "outsourcing." Working with the director of the newly formed Governor's Office of Technology, Caltrans can incorporate the goals established in the GCIT report into new statewide initiatives aimed at enhancing the mobility of people and information throughout the State of California, as detailed in the Strategic Action Plan below.

Caltrans Well-Suited to Assume Leadership Role

There is no State agency more well-suited to assume the necessary leadership role than Caltrans. Why? Because as the manager of the statewide transportation system, Caltrans has experience and competency in infrastructural matters. The agency also has a great deal of experience in the movement of people and goods, and following the Northridge earthquake, it realized the critical importance of the movement of information. Caltrans previously recognized the value of advanced telecommunications and information technology through the support and implementation of its "smart road" concepts and telecommuting as a means of relieving traffic congestion and improving air quality in the State's urban areas. In addition, it has established its own statewide telecommunications network to further these goals. Expansion of this network is critical to provide additional value to existing systems such as SmartTraveler and SmartOperations. However, this expansion need not completely fall upon the shoulders of Caltrans. Rather, Caltrans should explore *shared resources*, that is, linking public and private information networks together to create a seamless State Information Infrastructure.

Caltrans has taken an early lead in recognizing the critical role advanced telecommunications and related technologies will play in our future. In its 1994 *Transportation Plan* is a call for the development of the electronic highway alternative. Caltrans has also supported a number of demonstration and research projects in an attempt to determine how advanced telecommunications can:

- ◆ Become a substitute for physical trips
- ◆ Be used for traffic surveillance and control
- ◆ Be used to inform travelers of alternate routes or transportation modes
- ◆ Be utilized by transportation planners and TSM specialists

Thus, Caltrans is a likely candidate to coordinate the regional development of smart communities, of cities of the future, so that the State's limited resources are employed efficiently and effectively. This will ensure that California remains at the forefront of global economic competition, while at the same time working toward the achievement of its own TSM goals.

This is not to say Caltrans should develop infrastructure or directly administer new programs revolving around the deployment of advanced information technologies. It should not. Nevertheless, the local communities need a common direction, and Caltrans can play a critical leadership role by becoming an "expert agency" that coordinates the regional initiatives throughout the State. Caltrans could become a model agency by incorporating the use of advanced information technologies and integrated workplace strategies within its own statewide organization, including the "distribution" of its surveys, studies, etc., on the Internet and the World Wide Web. Additionally, Caltrans could oversee a public-private organization, a "Smart Communities" Institute, with the specific mission of bringing together all the information infrastructure initiatives and demonstrations projects currently floating around the state. This collaboratory could facilitate the public-private nexus and ensure that maximum personal, local, regional and state benefits are attained from all that information technologies have to offer.

Strategic Plan for Action

Caltrans is positioned to provide the leadership needed to further explore these pivotal issues, and develop a statewide strategy for the implementation of solutions that will incorporate the use of advanced information and telecommunications technology in the development of an effective TSM program that not only improves traffic conditions and air quality, but at the same time ensures the economic vitality of the State of California.

The states and local communities that do not follow this path will be left behind. To paraphrase the conclusion of the 1994 *San Diego: City of the Future* report, California has a choice: to let the future arrive as it will, shaped by events and circumstances, or to take on a leadership role and focus its public and private sector energies on the challenge of creating a vibrant and vital State of the Future.

While there are a number of recommendations that the team felt were important, they seemed to occur in three broad areas that are pertinent to a re-invigorated strategic plan for enhancing mobility in California:

1. Acceleration of the use of advanced technology into transportation applications.

Specific projects include:

- ◆ Become a model agency by incorporating the use of advanced information technologies (e-mail, video conferencing and departmental home pages on the Internet) and integrated workplace strategies within its own statewide organization, including the "distribution" of its surveys, studies, etc., on the Internet.
- ◆ Demonstration project regarding the "distribution" of State resources and services on the Internet as an alternative to travel.
- ◆ Demonstration project utilizing the concept of integrated workplace strategies to reduce travel by employees of targeted businesses.
- ◆ Reevaluate how telework centers are financed, equipped, marketed and positioned in the virtual office marketplace and devise a revised plan for integrating these centers into today's evolving workplace strategies.
- ◆ Digitization of existing and future blueprints to increase the availability and broaden the distribution of these documents.
- ◆ Study the potential for adapting control systems currently used for air traffic and maritime vessel movements to create a traffic management system for the State's urban highways.

2. Coordination of the inevitable transportation/telecommunications nexus.

Specific projects include:

- ◆ Review of governmental needs to support the establishment of a statewide infrastructure tying together such projects as Smart Valley, InfoSanDiego, telework centers, etc.
- ◆ Implementation of the use of electronic document interchange (EDI), using established standards, for the issuance and acceptance of bids and procurements.

- ◆ Development of specific public policy initiatives focused on adopting legal, regulatory and tax codes that encourage, rather than stifle, the development of a statewide information infrastructure. This would include support for public policy initiatives that would remove existing state restrictions on technology-based courseware in our public schools, and that would accelerate an increasing reliance by government agencies on the private sector for the procurement of goods and services.
- ◆ Study and development of specific policies that would encourage the development of information infrastructure along state roads, particularly in rural areas.

3. Development of State, local and regional initiatives to create guidelines and programs for the development of " smart communities" in California.

Specific projects include:

- ◆ The drafting and distribution of guidelines on the development of smart communities in California to ensure a coordinated statewide effort.
- ◆ "Bordernet," an effort by private industry, local government and the INS to facilitate border crossings, trade, dissemination of information and law enforcement through the use of the Internet.
- ◆ Healthcare Information Utility, a non-profit agency that would gather a minimum clinical dataset of patient information that would be made available to ambulance operators and other emergency medical care providers.

Understandably, it would be wise to involve industry and community leaders through the formation of an advisory committee that would submit recommendations regarding the implementation of these initiatives.

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