MOBILITY PLAN 2035 IS FATALLY DEFECTIVE FOR FAILURE TO STUDY REASONABLE RANGE OF CEQA ALTERNATIVES

I.
SYNOPSIS
Mobility Plan 2035 is Fatally Defective Due to Omission of Reasonable CEQA Alternative

1. The City is Aware of the Omitted CEQA Alternative:

Although the City has been previously advised about the need for Mobility Plan 2035 to study all Reasonable Alternatives, the City has failed to do so. The most recent City publications is the Findings of Fact, Mobility Plan 2035, Los Angeles, California dated July 30, 2015 released July 31, 2015 [City's Fact Findings].

The City's Fact Findings, Section 5, starting on page 21, lists and discusses five (5) alternatives, none of which mention the major Transportation Alternative; it is known by different names, e.g. Virtual Presence, TelePresence ©, Telecommuting (City of Los Angeles), Telework (US Government), but the names describe the form of transportation. These comments use Virtual Presence as its preferred term.

The City's Fact Findings do not mention of other alternatives which were considered by rejected as a reasonable CEQA Alternative. *Laurel Heights Improvement Association v. Regents of the University of California* (1988) 47 Cal.3d 376, 399-407, 253 Cal.Rptr 426

Ironically, The FEIR itself lauds the benefits of Virtual Presence as one of the tools by which it was able to increase citizen participation in MP 2035's preparation.

> Online Town Hall: As an experimental effort and new way of expanding the number and diversity of stakeholders, the MP 2035 contracted the services of MindMixer and introduced an online town hall through ideas.la2b.org. This online format provided an opportunity for community members to share thoughts and opinions about the streets of Los Angeles. The **virtual town hall** has allowed for a wider range of citizens to participate outside of traditional workshops and focus groups. The largest participant group was in the 25 to 45 age range. In addition, participants were represented from 79 of the 108 (73 percent) zip codes associated with the City of Los Angeles, as well as additional participants from Culver City, Long Beach, Pasadena, Santa Monica, and the South Bay. The online format also allowed staff to identify geographical areas where there was limited participation and focus additional outreach efforts in those communities. *MP 2035, FEIR page 2-19*

The City cannot claim ignorance of a mode of transportation which it actually used to prepare Mobility Plan 2035. Furthermore, The City has ignored its first study on Virtual Presence, i.e., its own *City of Los Angeles Telecommuting Project Final Report*, March 1993 by JALA International, Inc. [*1993 Los Angeles Study]*

Because the City cannot deny that it knows about Virtual Presence as a mode of Transportation and that the City omitted VP from the DEIR, FEIR, Findings of Fact, The Staff Report, the entire MP 2035 is fatally defective.

The fact that Virtual Presence is a developing technology which will be significantly enhanced in the coming decades is no reason to exclude it from study as a reasonable alternative. CEQA Guidelines, § 15125.6(a), *Mira Mobile Community v City of Oceanside* (4th Dist. 2004) 119 Cal.App.4th 477, 489

> Although the City ultimately rejected these alternatives as "infeasible," this conclusion does not imply these alternatives were improperly included for discussion. Alternatives included in an EIR need only be "potentially feasible" (CEQA Guidelines, § 15126.6, subd. (a)), meaning they are "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors." (§ 21061.1.) *Mira Mobile, supra,* 119 Cal.App.4th at 489

2. Unique Nature of Virtual Presence Makes it Applicable to All Other Alternatives

As is shown below, Virtual Presence is applicable to each of the five (5) CEQA Alternatives and the studies of each of those alternatives is based on fatally flawed data and wishful thinking, making each alternative unacceptable under CEQA. A Statement of Overriding Considerations does not cure the omission of a CEQA alternative nor does it allow an alternative which is based on materially flawed data to be adopted.

3. Statement of Overriding Considerations Does Not Cure Flawed Data or failure to Study CEQA Alternatives

Because MP 2035's Statement of Overriding Consideration must be supported by substantial evidence, its failure to consider Virtual Presence as a separate CEQA Alternative or as a significant component of the CEQA Alternatives which MP 235 studied makes MP 2035 fatally defective. *Koster v. County of San Joaquin* (3rd Dist. 1996) 47 Cal.App.4th 29, 32, 54 Cal.Rptr2d 565, *Sierra Club v. Contra Costa County* (1st Dist. 1992) 10 Cal.App.4th 1212, 1222-1224, 13 Cal.Rptr.2d 182.

The CEQA challenge to Mobility Plan 2035 can be made without a Petitioner's waiting for any new project to be approved under MP 2035. *Koster, supra,* 47 Cal.App.4th at 32

II.
Mobility Plan 2035 Excludes Virtual Presence, a Known Alternative Form of Transportation

The Mobility Plan 2035 [MB 2035]has the duty to set forth and examine all reasonable alternatives. [1] MB 2035 excludes a known, reasonable CEQA alternative which has official city documentation going back to 1993. For some, this alternative mode of transportation is called Tele-commuting, for others it is Telepresence© (Cisco), the federal government uses Telework, but for these comments, the term is **Virtual Presence**.

4. Virtual Presence (VP) is a form of Transportation which has been officially recognized both by the federal government (see www.telework.gov) and Los Angeles County as well as the City of Los Angeles Telecommuting Project Final Report, March 1993 by JALA International, Inc. (copy submitted herewith) VP is the marriage of Telecommuting and Social Networking made possible by the technological advances in the last two decades. The improved

[1] *San Bernardino Valley Audubon Society v. County of San Bernardino* (4th Dist. 1984) 155 CAl.App.3d 738, 750-751, 202 Cal.Rptr 423 When a long range plan is under consideration, the range of reasonable alternatives includes those options which are reasonably likely to be a major factor in the future. While this Project aims towards the year 2035, its implementation will significantly impact the city of Los Angeles for at least one hundred years and most likely for a longer period of time.

technology allows for two-way visual, written and oral communication on life size monitors. With the 3-D monitors along with the ability for multi-way televised communication between people miles apart, Virtual Presence is a form of transportation which the Mobility Plan 2035 may not legally ignore.

Virtual Presence's full functionality requires a greatly upgraded Internet capacity and that presence an excellent economic opportunity for Los Angeles and its so-called Silicon Beach mentality. Presently, the idea of bringing such technological industries to Los Angeles lives in the realm of political hype. If, on the other hand, Los Angeles took the lead in further development and support of Virtual Presence, then Los Angeles and environs could become a Silicon Beach.

Presently, we are immersed in the small and mobile applications of communications. Soon, however, the large and stationary application will be the dominant feature of the new technology. While the technology presently exists to create the Virtual Presence network, the upgrades, modifications, new efficiencies and dependent new industries are waiting around the corner.

Directional mics are one example. One facet of Virtual Presence are directional mics which can pick up a person's voice from anywhere in the room. They are necessary as Virtual Presence does not tie people to a small monitor. With wall size screens, people can move about a room and still see the other person/s. That requires enhanced microphones which can pick up the voice from any part of the room. In return, these mics require more sophisticated software as they need to screen out the unnecessary and the distracting ambient noise.

An analogy would be to the early monochromatic monitors. They were adequate to launch the computer age, but who would think of buying a

monochromatic monitor today? No one would propose that office and home computers remain off the market and not considered until color monitors had become cost effective.

An obvious dependent industry will be Virtual Stores. With Virtual Presence, Virtual Stores will become financially feasible. Rather than shopping on line from lists, people will visit Virtual Stores using their avatars. They will be able to stroll down aisles of merchandise, take it off the shelf (no matter how much it weighs) and examine it very closely.

One significant advancement will be the ability of two, three or more people from different parts of the globe to go virtual shopping together at the same time with their avatars, while communicating with each other. For example, two sisters, one who is in Van Nuys and the other who is in Atlanta, can shop for a Mother's day gift together at a Paris Salon. On the other hand, two other sisters who live in West LA could virtually shop at May Company.

The economic opportunities for Los Angeles to become the hub of Virtual Presence are beyond anything the City has imagined – because it refuses to fallow the law and study all CEQA Alternatives.

5. The Business Benefits of Virtual Presence

The number of manhours and the reduced air pollution that Los Angeles could gain from Virtual Presence is hard to calculate, but the 1993 City report on Telecommuting (Part 2 Potential Impacts) attempted. Rather than repeat what one may read for themselves, we will give one business example.

People probably do not realize that every day thousands of lawyers crisscross Los Angeles County from San Pedro to Granada Hills from Santa

Monica to Pomona, attorneys are traveling to have a 5 minute status conference. While some attorneys use Court Call and participated as an disembodied voice, most attorneys know that face-time with the judge is important.

With Virtual Presence, a huge percentage of today's physical trips can be more easily accomplished while at home (or at an office). Virtual Presence not only allows, the judge to see each person with picture inserts on her large screen, but also to focus primarily one person with whom she is conversing. Each attorney would have the same electronic capability to watch the judge but also opposing counsel. If any document should be necessary, there are high speed scanners which can send a relevant document to the judge and the other attorneys just as fast as a bailiff can come over to take it to the bench.

With attorneys charging $650 per hour, reducing a 2 hour trip to court to 5 to 10 minutes is a huge savings for the client. It also means all those cars are not on the road, that gasoline is not being burned, and everyone has face time with the judge. Try that with a subway.

With a Virtual Presence system, a business man in Encino can meet with his attorney in Century City without fighting the 405 congestion. Virtual Presence will also allow the business partner in Paris to participate in the meeting, and if they need some data from an expert located in Tel Aviv, she too can join the Virtual Presence meeting.

6. For over Twenty Years, We Have Known About this Approach to Transportation

As noted above, The 1993 City of Los Angeles Telecommuting Project identified and discussed in detail the transportation alternative of Tele-

commuting. Mayor Bradley commissioned the study in 1989 and the project was run during 1992 and the Study was published in 1993. Thus, the drafters of the Mobility Plan 2035 had to be aware of the efficacy of this form of transportation, yet the Mobility Plan 2035 fails to consider it. Furthermore, the federal government has published since 2002 (Annual Status of Telework in the Federal Government).

Because Virtual Presence is not confined to the workplace, but is becoming part of social networking, VP will be used for a significantly larger share of transportation in the upcoming years. The vastly enhanced technology makes extended family interactions over a few miles or over thousands of miles far more feasible than a few years ago.

While a lot of VP will be used for national and international business and socialization, it works just as well *within* an urban area. The speed of VP is one feature that is making it the preferred mode of transportation.

Another aspect of VP is that it promises to reduce the resistance which many managers have to telecommuting, i.e., the fear that their employees are beyond their grasp when engaged in telework. With pre-VP telework, the employee was at home on his computer and pretty much unavailable to the boss except via phone or e-mail. With VP, the boss can now go to the employee's "office" by opening the VP channel. Opening the VP channel is as easy as walking down the hallway to speak to an employee. Because the *2009 Status of Telework Report* (p 2) found management resistance as an obstacle to increasing the amount of Telework, VP reduces that resistance as the employees are more accessible than they were with 1990's technology.

With VP, the manager is not as out of contact. Many employee may find more contact with the boss is not a good thing. Right now, however, all the

studies show that productivity goes up with more telework. To what extent that is due to being out from beneath the boss' thumb is not known. Nonetheless, VP does allow the manager to confer one employee or simultaneously with several employees in different departments in different locations for 5 or 10 minutes and then everyone goes back to their projects.

> If all of these telecommuters were to perform exactly according to the estimates, the net result would be an annual effectiveness impact of $75,794,175 (constant 1992 dollars) or more than $93 million by 1998, assuming average salary escalation of 4.3%. *1993 Los Angeles Study, p 50*

> The direct economic impact of the effectiveness changes in the year 2000 ranges from at least 2.3 billion to as much as 3.5 billion dollars annually, depending on the scenario the future most resembles. These figures are in constant, **1988 dollars** and are based on the area's 1988 per capita salary income. Since information workers — or at least those who are likely to be telecommuters — are more likely to have higher than average salaries, the information in Figure 15 are likely to be doubly understated. *1993 Los Angeles Study, p 52*

$3.5 billion in 1998 dollars is $7.2 Billion in 2015 and that positive economic impact was based upon 1990's technology.

The efficacy of VP as a form of transportation will only increase with technological improvements. No other form of transportation allows people to be in Westwood as quickly they are in Singapore or to be in both Singapore and Westwood simultaneously.

Because the Telecommuting is a viable CEQA Alternative mode of Transportation, **Virtual Presence** in 2015 is the most viable Alternative Transpor-

tation. As the 1993 Study noted, traffic congestion will dramatically drop and the need for more offices in dense population areas like DTLA, Hollywood, and the Century City - Santa Monica - Westwood Triangle will significantly decrease, and that was based on 1992 technology.

As will be seen, Virtual Presence satisfies all of the transportation goals of The Mobility Plan 2035 with no adverse environmental impact and with no drain on tax dollars and without the *eminent domaining* of a single piece of property. VP requires no aboveground or underground easements beneath private property, nor does it require higher housing density in order for it to be cost-effective. It does not cause pollution nor does bring people into more contact with polluted air as do VENs and BENs.

7. The Purpose of The Mobility Plan 2035

The so-called Blue Print for the Transportation of the City of Los Angeles omits the most prevalent form of transportation. Transportation is not limited to people's physical presence in a specific location. Nonetheless, the Mobility Plan 2035 is stuck back in the early 1900's. Metro [2] plays a dominant role in MP 2035, b ut it is predicated on concepts which the City discredited in its 1915 Study of Traffic Conditions in Los Angeles (copy attached)

> The MP 2035 (formerly the Transportation Element) is the transportation blueprint for the City of Los Angeles. Last updated in 1999, the MP 2035 is being revamped to reflect the policies and programs that will give Angelenos a full range of options to meet their mobility needs, including bicycling, car pooling, driving, transit, and walking. The MP

[2] As used herein, Los Angeles County Metropolitan Transportation Authority is abbreviated Metro.

> 2035 will lay the policy foundation for safe, accessible and enjoyable streets for pedestrians, bicyclists, transit users, and vehicles alike. *DEIR Section 3. Project p 3-1*

Virtual Presence is as effective to shop in Tokyo as it is to shop in Hollywood – the whole world Fed Ex's packages. Virtual Presence is as effective to commute to a meeting in West Hollywood as it is to commute to a meeting in Moscow. VP allows four members of a rock band to synchronize their playing no matter where they are located: Long Beach, Woodland Hills, Covina, and West Hollywood are all one location in Virtual Presence. (*See Time-Warner TV advertisement*)

Virtual Presence has a feature which no subway or bicycle or car can match. It travels at 186,000 miles per hour. Why would a businessman waste a hour traveling from Santa Monica to Glendale to meet with his lawyers, when he can be there in a blink of any eye?

Why would an entrepreneur from Newport Beach drive to L.A. for a conference when most the other attendees will be there via VP?

Who wants to pay their lawyer $650/hr to drive downtown for a five minute hearing, when the lawyer can attend via VP and reduce his bill by $550?

Why would anyone want to walk or take a bus to a subway station, walk down into the earthquake prone Underground and then ride a noisy, dirty, dangerous subway only to have to emerge from the depths and walk another 5 or 6 blocks to reach his/her destination when he/she can be there is less than one second?

8. Virtual Presence Accomplishes the Goals Transportation When Actual Physical Presence is not Required

As will be seen, the *1993 Los Angeles Study* made clear that Virtual Presence satisfies the ostensible purposes and needs for which mega-developers propose fixed-rail transit and extreme population density near subway stations. The goals which MB 2035's DEIR and FEIR previously set forth were designed to favor fixed-rail transit systems. Many of the goals are illusory; like the Hollywood Community Plan Update, they are based on wishful thinking and the one which are real can be more economically satisfied by Virtual Presence.

> That clearly is a post-hoc rationalization of City's failure to recognize that the HCPU was unsupported by anything other than wishful thinking - and a demonstration of an effort to avoid further analysis in key planning documents. *January 15, 2014, Judge Goodman Statement of Decision in La Mirada (and related petitioners) v City of Los Angeles, fn 14, page 18*

More crucial that Judge Goodman's finding that the city had nothing but wishful thinking was this conclusion that the City was determined to avoid analysis. That is the same situation one finds passim in all the Mobility Plan 2035 documents, *an effort to avoid analysis*.

After the City cherry picked lofty sounding purposes, needs and goals, it then systematically distorted the data in order to satisfy the economic greed of developers and political whims of politicians.

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9. Mobility Plan 2035 is Highly Harmful to Los Angeles's Future

The only thing Virtual Presence will not do is provide a justification for construction of extraordinarily dense population areas which will create arterial blockages in our transportation system. To be blunt, it takes an easily deceived person not to realize that when one adds thousands of people to a very small geographic area, they are adding thousands of cars. It is mathematically impossible to make traffic flow smoother by increasing the number of cars per block by 3 fold. Yet, in some areas the combination of Mobile Plan 2035 and the equally flawed Sustainability Plan will increase car ownership by 10-fold.

A population which lacks the analytical ability to understand that more density brings more cars brings more traffic congestion is headed for an urban disaster. When the metropolitan area is over 5,000 square miles, no fixed-rail system can provide access. Any form of transportation whose finances depend increased population density brings disaster upon the City.

The only way to increase the population density to the extent the City desires is to have a concentration of people too poor to own cars and who will be content to be Urban Serfs tied to their own small Transit Oriented District. Taking a trolley or subway anywhere will be much more time consuming than driving.

The 1915 Traffic Los Angeles Study identified the root cause of the densification which Mobility Plan 2035 and the Sustainability Plan promote - corruption. As City knew in 1915, Transit Oriented Districts artificially cram too many people into small areas for one reason – to enhance the per square inch land value of a very few landowners.

> . . . but, on the other hand, no municipality is justified in adopting a policy which would tend to retard the removal of business centers to their natural geographical location. Such a policy would be nothing less than a **deliberate exploitation of civic resources for the benefit of the limited number of property owners enjoying abnormal incomes** from rental privileges; [**bold** added] *1915 Traffic Study, page 38*

Hollywood is a perfect example of what Angelenos knew a century ago. When she first came to Los Angeles in 2006, former Director Planning Gail Goldberg said that Garcetti's allowing developers to set zoning was leading to disaster and disaster has struck. http://bit.ly/cRH37r 2-27-08 *How Density Hawks Changing LA*, Steven Leigh Morris, LA Weekly, (mentions Gail Goldberg's disaster prediction)

Garcetti's council district, #13, lost so many people and businesses due to his catering to the mega developers that by 2010, his district ceased to qualify as a legal council district. The only reason Garcetti's CD 13 was not absorbed by the surrounding council districts is that a 1925 law requires the City of Los Angeles to have fifteen (15) council districts. Thus, people and land had to be taken away from Koreatown and CD 4 and added to CD 13.

When the courts looked at Garcetti's Update for the Hollywood Community Plan, it issued a Statement of Decision in January 2014 finding that Garcetti's Plan was based on "fatally flawed data" and "wishful thinking" to such an extent that it subverted the law. The same fatally flawed data and wish-ful thinking underlay Mobility Plan 2035. The city and Metro refuse to consider Virtual Presence while falsely claiming the need for more dense population.

As the City warned itself in 1915, need for density and fixed-rail transit is a scam where one segment of the mega-construction industry sets forth false

data to support the other component of the mega-construction industry. International construction companies make trillions of dollars constructing subways and light rail transit [LRT] all over the globe. Fixed-rail transit will bankrupt any city unless the city can greatly increase it population density along the rail lines. And, then it has to guarantee that the people living in the Transit Oriented districts [TODs] use the subways and LRT.

Thus, developers of high-rises like Bunker Hill, DTLA, Century City, etc. press for more subways and LRT under the belief that those transportation systems will make their highly dense projects financially viable. Subway contractors support huge increases of population density along their routes, TODs, knowing that fixed-rail transit is a horrendous financial liability for cities which lack the population concentration of Manhattan. Thus, the public is faced with a vicious cycle of mass transportation - urban density propaganda which lead to extraordinarily harmful plans like Mobility Plan 2035 and Mayor Garcetti's Sustainability Plan.

10. People Move Away from Density

The trend has been undeniable for decades. The vast majority of Americans move away from extremely dense areas. This exodus is most true for Millennials who reach child-rearing age. Like all Americans before them, they want a single family home, with a yard, good schools, and an easy way to get to work. When faced with DTLA, Hollywood, and a generally decaying Los Angeles, they are choosing to leave Los Angeles for Austin, Texas, for the Carolinas, and for places in the Snow Belt.

Improve Study Area mobility and travel reliability:

Not only does Virtual Presence improve mobility within the travel Study

area, it improves it worldwide. In order fora subway to cover the very limited area of Los Angeles County will require a $2 Trillion Dollar investment – and you are still stuck in L.A. VP takes you worldwide. On the other hand, MP 2035 harms mobility and travel reliability. http://bit.ly/1St9WQa August 1, 2015, NewGeography, *Special Report: Maximizing Opportunity Urbanism with Robin Hood Planning,* by Tory Gattis

Improve transit services within the Study Area;

Virtual Presence will also improve the surface physical transportation by the dramatic reduction in the use of physical transportation. The transit times on buses and cars from downtown to the sea will be significantly reduced due to the 30% (or more) demand for physical transportation. The City admits that it will decrease traffic congestion by no more than 1%. 1% is not an improvement. The transportation modality that reduces congestion by 30% (or more) is clearly superior to the system that may reduce traffic congestion by 1%.

MP 2035, however, costs a fortune with no net transportation benefit http://bit.ly/1St9WQa August 1, 2015, NewGeography, *Special Report: Maximizing Opportunity Urbanism with Robin Hood Planning [Max Urban Opport],* by Tory Gattis

> What about increasing fixed transit, like rail? Multiple studies have found the cost-benefit from most recent rail investments outside legacy cities like New York (fn xxii) and a few very high-density routes - like Houston's original Red line connecting downtown to the world's largest medical center - to be dubious at best. Generally speaking, they cost far too much for the number of people moved, and they have failed to materially increase the overall percentage of commuters using transit. *Max Urban Opport* page 11

Improve access to major activity and employment centers

Subways and above-ground fixed rail systems do not improve access to so called major activity and employment centers. In fact, as the City has known since its own 1915 Traffic Study [http://bit.ly/cJh5BP], fixed-rail transit is impossible in a huge circular urban area like Los Angeles. It is a matter of mathematics. The worse possible future design is to increase population density in "activity centers," e.g. DTLA, the Century City-Santa Monica-Westwood triangle. Now is the time to stop all additional density in these areas.

Virtual Presence which moves at 186,000 mph provides much faster access to businesses and homes within the Study area than any subway, while at the same time it also provides instant access to the entire globe. There is no congestion as hundreds of thousands of people can go to the same destination at the same time from anywhere in the world and its take about one second.

The False Goal of "Improve opportunities for transit supportive land use policies and conditions;"

These are code words for **mega-density**. Population density is causing people to depart from Los Angeles. For two decades, excessive density has caused Los Angeles County to experience an exodus of the middle class to less dense countries, e.g. Riverside, and to less dense states. Trying to cram more and more people into less and less space is a hideous condition to be avoided. As the words imply, these "*transit support land use policies*" refers primarily to fixed-rail transit systems. The only thing the support is a deficit philosophy that we need to squander hundreds of billions of dollars on vast subway and LRT projects and constructing more mixed-use properties which are making Los Angeles unlivable.

11. The Folly of the Bicycle Approach

More recently, The City thinks that bicycles will make their mega-dense projects profitable, when density itself of the problem. In brief, this goal means billions of dollars for land developers in an area filled with some of Los Angeles most significant R-1 neighborhoods. They promote it as InFill development.

http://bit.ly/1cPdZCR March 25, 2015, Zwartz Talk, *Power Corrupts; Corruption Destroys – Power and Corruption at Los Angeles City Hall*, by Scott Zwartz

http://bit.ly/1KIITL2 April 29, 2015, Zwartz Talk, *Garcetti's Sustainability pLAn is Based Fatally Flawed Data* – By Scott Zwartz

To the extent the CRA/LA was involved and now the City is simply giving away hundreds of millions of tax breaks to increase population density in certain areas, e.g. Hollywood, LA will see an additional erosion of the City's tax base, making it impossible for the city to provide basic services to anyone.

New employers do not re-locate to areas with decayed infrastructure. They know that an atrocious infrastructure where water mains burst virtually daily indicate a poorly run city. They know that a city which cuts paramedics to give money to developers is corrupt. They know that a city that has been caught falsifying crime rates is untrustworthy.

Employers follow employees and employees desire areas which are conducive to raising a family. For Americans that means, a single family home with a yard, and decent schools. The very aspect of Los Angeles culture on which prior Mayor Villaraigosa and present Mayor Garcetti have declared war. The policies in MB 2035 are attempting to destroy Los Angeles's greatest asset,

that is, its vast expanse of single family homes with yards. When they cannot find it in Los Angeles, employees move away, often far away. And, employers follow them.

Mobility Plan 2035 needs to take account of the fact that population density is likely to become a huge liability with the advent of VP. The dense housing which the Mayor Garcetti contemplates cannot compel people to live in high rise tenements. If this were Siberia and not Southern California, the population might like the idea of huge dense population centers all under a huge dome to protect them from the terrible weather. People, however, do not come to Los Angeles to live as if they were in the frozen tundra.

The False Goal of Improved "Transportation Equity;"

The city promotes the concept of Transportation Equity. This term has no meaning. Perhaps its refers to de Tocqueville's idea that many people would prefer the tyrannical equality of slaves, where everyone is forced into the same reduced circumstances, while a special few enjoy the good life.

Creating a system where the poor are relegated to dirty, dangerous and time-consuming mass transit while the wealthy speed along freeways in air-conditioned comfort is not Transit Equality. The vat majority of voters who approve mass transit projects do so under the false impression that the mass transit will take thousands of cars off the streets and freeways so that they – the voters – will have less traffic congestion. Very few people who own cars plan to use the subways.

The great equalizer has been the Internet, web-based data bases, Social Networking. Virtual Presence will become as ubiquitous as color TV. That is the Transportation modality which must be studied. Without an intense study

of Virtual Presence and the plans were need to make in order to bring it to fruition should be the basis of Mobility Plan 2035.

Fixed-rail transit does not provide a fast, reliable, and environmentally-sound transit alternative;

The fixed-rail systems will be fueled by coal burning plants in the Arizona desert making the Subway environmentally harmful. The horrendous increase in population density which the subway needs in order to be financially viable will make more demands on our power grid. The Subway compounds adverse environment impacts. Higher population density results in high social pathology. The City tried to conceal this fact by intentionally under reporting crime data. Now that they LAPD has been compelled to (temporarily) increase the accuracy of their crime data, we see a huge spike in crime.

Subways compel people to expose themselves to people with colds and other viruses. Forcing people into areas which significantly increase the spread of illnesses is not environmentally sound.

Meet Regional Transit Objectives through SCAG's [3] Performance Indicators of mobility, accessibility, reliability, and safety

The goal of the Subway should not be to satisfy the objectives of special interest groups who are financially tied to international corporations that push fixed-rail, which is a 19th Century solution to 21th Century problems.

[3] No serious land use planner should give any credence to anything coming from SCAG. It's only consistency is in its being wrong.

Although SCAG's Performance Indicators appeared to have been designed for the benefit of the developers, Virtual Presences satisfies each indicator, except for the unstated Indicator, i.e., to make trillions of the dollars for fixed-rail transportation conglomerates and their associates in the high-rise housing industry.

Virtual Presence satisfies the indicators by providing a form a transportation that makes all their fixed-rail technology obsolete.

12. The DEIR Ignored The World

The DEIR ignored the real world when it ignored Virtual Presence. A cynic would say that the DEIR ignored what one sees everyday around him/herself, because the authors were paid to be blind. Mega-corporations like Siemens have invested billions into fixed-rail transportation, only to see fixed-rail to become obsolete. The Los Angeles County market alone had the potential to be a $2 Trillion market (2010 dollars).

In order to be financial feasible, fixed-rail transit requires a densely concentrated population. To be economically feasible it needs to operate often at high volume. The high rises housing projects meant billions more public dollars for densely populated skyscrapers near the subway stations.

At the Wilshire-Fairfax Station, the Subway to the Sea DEIR, for example, contemplated an additional 3,719 housing units. If these new units were R-1 homes sitting side by side in single file, they would stretch over 42 miles. The 5,788 new housing units near Wilshire-26th Station would stretch almost 66 miles. The DEIR contemplates cramming the equivalent of 100+ linear miles of homes within a 1/4 mi radius of two subway stations.

Because all the land within a 1/4 mi radius of the subway stations already has homes, someone has to Kelo all that property. What politician thinks developer dollars will outweigh public's ire at another attempt to Kelo people's homes?

The DEIR needs to acknowledge the real world:

(I) VP is upon us as a mode of transportation for work, shopping and social networking.

(ii) The public hates Kelo. Without Kelo, the private developers around the subway stations will be unable to condemn the property for their high rise projects.

Even in its earliest phase of Telecommuting, Virtual Presence merited inclusion as a form of Alternative Transportation. In its 2010 to 2020 incarnation, VP will be the most widely used form of transportation.

III.
Legal duty to Consider Reasonable Alternatives:

● Each project needs to be evaluated on the basis of the reasonable alternatives to that particular project. Citizens of Goleta Valley v. Board of Supervisors, (1990) 52 Cal.3d 553, 566, 276 Cal.Rptr, 410

The DEIR cannot deny that Virtual Presence in the form of Telecommuting was a reasonable alternative mode of transportation which it had to consider. The foregoing has amply demonstrated that truth. That study alone rebutted the population premises of the DEIR and showed that another form of transportation was far more efficacious.

● The DEIR had the duty to formulate the reasonable alternatives. Citizens of Goleta Valley v. Board of Supervisors, (1990) 52 Cal.3d 553, 568, 276 Cal.Rptr, 410

The DEIR has no duty to read the minds of the commentators, but it does have the duty to read other official publications that directly bear on the reasonable alternatives. It strains the bounds of credulity to believe that the authors of the DEIR were unfamiliar with this 1993 landmark Telecommuting Study.

● The Alternative need only be "potentially feasible." CEQA Guidelines, § 15125.6 (a),

While older people may be so accustomed to older ways and fail to grasp the implications of newer technologies, that is not a basis to exclude a reasonable alternative from the DEIR. Although Virtual Presence has in essence arrived, its habitual application has not. Nonetheless, the DEIR had a duty to make an exhaustive study of the **potential feasibility** of this technology. Mira Mar Mobile Community v. City of Oceanside (4th dist. 2004) 119 Cal.App. 4th 477, 489, 14 Cal.Rptr 3d 308

When the EIR fails to include a complete analysis of all reasonable, known, and potentially feasible Alternatives, it destroys the factual basis for approval of the EIR. For that reason, omitting Virtual Presence will make the EIR subject to de novo review. (See below)

● Unless rectified, the DEIR's procedural failure merits review de novo. California Native Plant Society v. City of Santa Cruz (2009) 177 Cal. App.4th 957, 981, 984.

> Courts must "scrupulously enforce all legislatively mandated CEQA requirements." (Goleta II, *supra*, 52 Cal.3d at p. 564.) To do so, "we determine **de novo** whether the agency has employed the correct procedures" in taking the challenged action. [Cite omitted] California Native Plant Society v. City of Santa Cruz (2009) 177 Cal.App.4th 957, 984.

● One could characterize the DEIR's omission of Virtual Presence as a **premature approval** of Mobility Plan 2035, which is CEQA procedural violation that merits de novo review.

> The CEQA Guidelines define "approval" as "the decision by a public agency which commits the agency to a definite course of action in regard to a project." (Cal. Code Regs., tit. 14, § 15352, subd. (a).) The problem is to determine when an agency's favoring of and assistance to a project ripens into a "commit[ment]." To be consistent with CEQA's purposes, the line must be drawn neither so early that the burden of environmental review impedes the exploration and formulation of potentially meritorious projects, nor so late that such review loses its power to influence key public decisions about those projects.
>
> Drawing this line raises predominantly a legal question, which we answer independently from the agency whose decision is under review. While judicial review of CEQA decisions extends only to whether there was a prejudicial abuse of discretion, "an agency may abuse its discretion under CEQA either by failing to proceed in the manner CEQA provides or by reaching factual conclusions unsupported by substantial evidence. (§ 21168.5.) Judicial review of these two types of error differs significantly: while we determine ***de novo*** whether the agency has employed the correct procedures, 'scrupulously enforc[ing] all legislatively mandated CEQA requirements' (Citizens of Goleta Valley v. Board of Supervisors (1990) 52 Cal.3d 553, 564), we accord greater deference to the agency's substantive factual conclusions." (Vineyard

Area Citizens for Responsible Growth, Inc. v. City of Rancho Cordova, *supr*a, 40 Cal.4th at p. 435.) **Save Tara v. City of West Hollywood** (Waset, Inc.) (2008) 45 Cal.4th 116, 130-131

The DEIR's failure is not only a factually incorrect conclusion, but also it is a manifest failure to apply the correct procedures which require that all reasonable alternatives be analyzed. CEQA Guideline, § 15126.6(a), (f) Unless there is a full analysis of Virtual Presence and its potential place in society within ten years, MP 2035 will have made a procedural violation subject to de novo review.

It is legally necessary for the MP 2035 to look to the next ten years and beyond, as ten years is the shortest time frame to complete the Subway. The FEIR may not ignore Alternatives that are potential feasible, and thus, it may close its eyes to the development of Virtual Presence in a time frame comparable to completion of the Subway.

The City cannot ignore a CEQA alternative until after the DEIR and the FEIR have been written and then act as if it has successfully evaded its duty to perform an adequate CEQA review. The DEIR is fatally defective, the FEIR is fatally defective, and City knows that Mobility Plan 2035 is fatally defective. CEQA requires the City to go back and make a serious study of Virtual Presences as a mode of Transportation. Approving this grossly flawed Plan invites litigation, but it means the City will squander millions of dollars in legal fees and what will be worse, it means that Los Angeles will have no viable Mobility Plan for another five to ten years.

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IV.
The DEIR's Additional Material Violations

The DEIR makes other material violations

- The DEIR Violates the 1994 Consent Decree, Bus Riders v MTA, 263 F.3d 1041 (9th Cir. 2001)

Under the Consent Decree the MTA has to provide more consideration to buses than this DEIR provides. When the EIR takes into account the 30% (or more) reduction of traffic congestion which makes more buses a much better option than a subway.

Going back to the 1915 and 1924 Transit studies conducted by the City of Los Angeles, subways are viable only if they significantly decrease the travel time. With dramatically less traffic congestion due to VP, buses can use the 10 Freeway for Santa Monica and a better system of Express and Limited bus route can operate on surface streets which won't be crowded.

The DEIR failed to provide buses the full exploration of feasibility as the Consent Decree requires.

- The Inability to Construct the Additional Housing and Employment Units Within 1/4 Radius of the Subway Stations Makes the Subway an Economic Drain on the Taxpayer. Veto of AB 2531

Throughout the Draft EIR, the project is evaluated on the basis of the population and land use within ½ mile of the subway. One exception is the housing and employment density near the Subway Stations. For the Subway Station, the Draft EIR used 1/4 mi radius.

Going back to Los Angeles transportation studies in 1915 and 1924, the City has historically used ½ mile within a subway stop as the maximum range at which people will use a Subway when there is alternate transportation. If anything, people today are less accustomed to walking, and thus, there is no fact and no rational reason to believe that people will be willing to walk farther than ½ mile to the Subway Station.

Unless the Subways are to be a huge, constant drain on the taxpayers for decades to come, the ridership has to be very high. That requires that the population density within ½ mile of the stations must be very high in order to provide the required population density for riders.

:

13. The ½ Mile Limit for Subway Usage Applies to Both Start Locations and Destinations

A person who lives within ½ half miles of a subway station will not use the subway when his destination is substantially farther than ½ mile from a subway station.

This fact is not discussed. In order to know ridership, the EIR must provide a factual basis to know how many trips will originate and will also terminate within ½ mile of sub way station.

When calculating traffic congestion, the EIR must also have a factual basis to determine the additional street traffic which the Subway will generate if the projected housing is constructed. In this regard, the EIR must take into account

the 2001 San Jose TOD study. The San Jose study [4]showed that people who live within TOD's still need cars. As the San Jose Study showed and as the early Los Angeles Traffic studies, which the draft EIR impermissibly ignores, also showed, in circular cities like Los Angeles, the effective range of subways is extremely restricted. Thus, people within TOD's also need cars.

There are two logical results of the additional density which the subway needs to be financially viable.

(A) There will be a dramatic increase in street traffic near each of the subway stations

Due to the very restricted range of the subway, these additional 3,719 housing units and 9,073 jobs near Fairfax-Wilshire will need parking for their cars and they will use those cars for all the non-subway trips. For example, if you live near Wilshire and Rossmore and you need to go near Wilshire and Doheny, the subway is no good. There is no subway station within ½ mile of your start or you destination. Even with slow street traffic, it will take less time to drive 6th Street and Burton way along the sub way route than it will take to walk to a station, go down underground to wait for a train, and then walk to your destination.

The draft EIR fails to study this aspect of the Subway, despite the fact that this phenomenon was identified as early as 1915 in L.A. Transit study and was confirmed by the 2001 San Jose Study.

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[4]In May 2015, The San Jose Mineta Transportation Institute released a study of the Metro Line and the Gold Lines, showing the factual errors on which the subway and LRFT component of MP 2035 rest. That report is subject to a upcoming HELP - CCLA review.

(B) The areas within 1/4 mile of the stations will attract Default Tenants

Default tenants are people who are too poor to live elsewhere. They cannot afford a car and are too poor to travel far from home. They also cannot afford the luxury lofts which the developers find most attractive to construct.

- **The Draft EIR Does Not Discuss the Danger it Causes Angelenos**

Next to travel congestion and parking problems, Angelenos are most concerned about crime and a high percentage are more worried about crime than traffic. The draft EIR fails to discuss the likelihood of increased crime.

What are the statistics for a woman's being mugged while driving a car from Rossmore to Doheny at night alone as compared to the statistics of her being mugged if she walks to a subway, descends underground to wait for a train and then has to walk a mile or so to her destination.

The draft EIR has to discuss the fact that more subway use results in more crimes against persons. The draft EIR cannot ignore this significant aspect. Our environment is everything around us, including criminal thugs.

The Metro cannot pretend it does not know about the additional crime that comes with subway stations. There have been community protests over the crime at the Hollywood-Western station.

What will be the extra cost to have more patrol men both down in the subway and along the routes that subway users will have to walk. As it is now, once someone emerges from the Hollywood-Western station, they are un protected. If they want to walk to the 1900 block of North Serrano, they are

vulnerable to the gangs in the area. If they drove their car, the chance of a mugging decreases.

The EIR has to discuss the additional crimes against persons which the subway will cause. What will he the cost to ameliorate this danger? If EIR ignores the problem, the victims of crime cannot pretend they were not mugged. To what extent will the threat of gang violence deter subway use, especially at night?

The City tried to hide these crime statistics, but it was caught. Thus, in 2015 we are getting more reliable crime data and they show what HELP and CCLA have been claiming for years. The City has been experiencing a significant increase in violate crime.

- **The draft EIR does not discuss the interaction of the different factors**

The draft EIR ignores the interaction between many factors and thus it conceals the real environmental impact. As the subway requires more housing density to be financially viable, the EIR has to discuss the traffic and additional CO2 emissions if the 225 linear miles of additional housing units are build within a 1/4 mi radius of the subway stations. The EIR cannot merely assume that there will not no adverse consequences.

What is the impact on the safety to citizens if more are persuaded to use subways? What impact will more subways have on police budgets? The EIR can start with the statistics for the Hollywood Western Station. Experience with the Hollywood subway shows an increase in crime and thus an increase need for police presence on a strained city budget.

Because people who live in TOD's still own cars, how much extra off street parking space will be required for the 3,719 housing units? Base on the San Jose Study, there will be an increased demand of at least 3,719 off street parking space for people who live near the station and people who visit them.

> A benefit-cost ratio for the TOD paradigm that is superior to other investments that increase transit market share may not be an a priori possibility in every metropolitan region. Regions differ greatly from each other in their existing land use pattern, travel pattern, transit corridor availability, topography, political culture, and govern-mental structure. One size does not fit all. *San Jose TOD study, Executive Study* p 4

In brief, the draft EIR cannot assume that there will not be significant adverse environmental impacts by ignoring prior research. Because each Subway TOD is within one the nation's largest circular cities, the draft EIR has to discuss the Subway in relation to the real factors where the Subway is actually located. Furthermore, it has to analyze the interaction between all these factors.

For example, the strong likelihood that the subway stations will result in much worse traffic congestion means that the air quality will deteriorate near the subway stations and the EIR has to study the increased risks of asthma and other respiration illnesses. The draft EIR ignores the health risks.

Furthermore, each one of the additional risk have to be assessed not only in relation to their cumulative effects but they have to be assessed in relation to Virtual Presence.

- Virtual Presence reduces air pollution in the city and in the desert where our coal burning generators are located.

- Virtual Presence keeps people safer as they are not subject to muggings

- Virtual Presence protects people from air pollution as it results in few trips, especially when LA has an inversion layer;

- Virtual Presence requires no tunneling and risk no loss of lateral support of buildings along Wilshire Boulevard as occurred with the Hollywood subway;

- Virtual Presence require no easements beneath residential properties as the subway requires;
- Virtual Presence does not run the risk of increasing traffic congestion around subway stations (as there will be no subway stations and because Virtual Presence reduces automobile trips by 30% or more)

- Virtual Presence does not waste people's time slowly taking them from one place to another as Virtual Presence moves at 186,000 mph.

- Virtual Presence allows people to be at more than one place at a time; (being on the subway is essentially being in purgatory – neither here nor there as you are stuck on the subway breathing in the flu gems of the people near you. See 2009 *Telework in the Federal Government Report, Message from Director* re influenza pandemics)

- Virtual Presence cannot bury you alive in the event of a major earthquake;

- VP will have a paradoxical impact. It will allow Angelenos to move farther from the Basin, but to the extent there is no further population density over the next decade and L.A.'s historic neighborhoods are not destroyed, VP also allows people to remain in R-1 homes within Los Angeles. That will contribute to a vital city.

- VP will so greatly reduce subway ridership that it will be a horrendous drain on the public treasury.

V.
Summary

The Mobility Plan 2035 is based on fatally flawed data, wishful thinking, a desire to avoid analysis of its inadequacies and the omission of a major component of all transportation, Virtual Presence.

All the CEQA alternatives are significantly impacted by Virtual Presence, thereby making the study of each CEQA Alternative fatally flawed.

The City's omission of its own 1915 Study of Street Traffic Conditions in the City of Los Angeles is inexcusable. That gigantic omissions is one of the reasons that the Hollywood Community Plan Update was rejected as being based on fatally flawed data.

The City's omission of its own *City of Los Angeles Telecommuting Project Final Report*, March 1993 by JALA International, Inc is likewise inexcusable in light of the fact that it undermines all the City' conclusions in MP 2035

In March 2012, Hollywoodians Encouraging Logical Planning wrote to the

City of Los Angeles explaining the reasons that the Hollywood Community Plan Update [HCPU] was fatally flawed and that it needed to be re-done in order to corrects its errors, but a few members of the City Council demanded that it be passed, and it was unanimously approved. As a result, there is no Update to the Hollywood Community Plan.

Mobility Plan 2035 is many times more defective than the Hollywood Community Plan Update. MP 20354 cannot withstand a CEQA challenge.

VI.
Conclusion

The Mobility Plan 2035 needs to be withdrawn without any delay and the City needs to send it back to the beginning to conduct a proper CEQA analysis.

JALA International, Inc.

City of Los Angeles Telecommuting Project

Final Report

March 1993

Jack M. Nilles

This report was prepared as a result of work sponsored by the Department of Telecommunications. It does not necessarily represent the views of the Department of Telecommunications, its employees, or the City of Los Angeles. The Department of Telecommunications, the City of Los Angeles, its employees, contractors and subcontractors make no warranty, express or implied, and assume no legal liability for the information in this report. Opinions expressed are those of the author unless otherwise noted.

Note that JALA changed its name from JALA Associates, Inc. to JALA International, Inc. in mid-1992 to more accurately reflect the scope of its activities.

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Contents

Executive Summary

History

The City of Los Angeles Telecommuting Project started in early 1989 with a planning project. The project culminated in a formal plan that was submitted to the Mayor and the City Council in August, 1989. The plan recommended implementation of a formal test project that was to include 18 months of active telecommuting and involve 250 telecommuters and a comparable number of members of a control group. The Mayor subsequently requested that the number of telecommuters be raised to 500.

The implementation portion of the project began in April, 1990, with a series of briefings on the project plans to senior City executives. The remainder of 1990 was spent in briefing prospective participants in the project and in selecting the initial set of participants for training.

By the end of 1990, 426 City employees had applied or had been identified by their supervisors for possible inclusion in the project. As part of the selection process, both prospective telecommuters and their immediate supervisors are required to complete background questionnaires. By 1991, 298 employees (and their supervisors) had completed all of the necessary forms. Of these, 279 were recommended by JALA Associates for training and subsequent telecommuting. Although JALA Associates recommended specific individuals, all final selection decisions were made by the management of the participating departments.

Training of the telecommuters and their telemanagers began in January, 1991 and continued through March, 1992, by which time 541 telecommuters had been recommended for training by JALA and 441 telecommuters had been trained, together with their supervisors. Active telecommuting was to begin shortly after the initial training sessions. The rule is

that, once a telecommuter and his/her direct supervisor have attended the training sessions and have signed an agreement on their respective roles and performance expectations, they may begin telecommuting. A few of the participants had already been "guerrilla" telecommuters before they received formal training but most were neophytes. Of the 441 telecommuters trained, only 242 had returned written telecommuting agreements to the project office by December 1992. As of March, 1993, 203 telecommuters were still active.

The formal, data collection portion of the project was completed for most of the telecommuters by July 1, 1992. The data collection period was extended to November 30 for the dozen telecommuters who were trained after January 1, 1992. Therefore, the lengths of individual telecommuting experience range from a few months to more than two years.

Goals and Objectives

The following material, in a smaller typeface, is taken directly from the project plan as submitted to the Mayor and Council.

Telecommuting has become steadily more desirable and practical in the past two decades as the number of information workers has increased and as computer and telecommunications technologies have continued their spectacular advances.

There are a number of reasons to actively explore telecommuting at this time. Here are a few:

- *Air Pollution. Automobile commuting constitutes the major non-stationary contributor to air pollution. The Southern California Air Quality Management District's Regulation XV requires medium to large employers to quickly take positive steps to reduce commuting. The Air Quality Management Plan calls for a 20% reduction in commuting via telecommuting by 2010.*

- *Cost Effectiveness. Experience with telecommuting in the private sector and by the State of California has shown significant and lasting increases in the productivity of telecommuters — averaging from 5% to 20%, decreased rates of turnover, space and energy savings and other net cost reductions.*

- *Traffic Congestion. It is reaching unmanageable levels in the downtown area — and in many other Los Angeles locales. It is slowing work and frustrating commuters. Just in Los Angeles millions of hours of potential productivity — and billions of dollars in economic output — are being lost annually from congestion.*

- *Energy Dependency. Commuting continues to account for almost half of the automobile transportation energy use in California, making us increasingly susceptible to fuel shortages and supply interruptions.*

- *Office Space. The City is running low on affordable office space in central Los Angeles. Costs of parking space are rising as well.*

- *Information Technology. Computers are showing up on more and more desks of City workers. Computers connected to telephone lines provide a significant opportunity to make many forms of information work partially "location independent" and ideal for telecommuting.*

- *Attracting/Retaining Personnel. Telecommuting as a work option has been found to be an effective tool for helping to attract and retain qualified personnel in a competitive market.*

- *Access to Jobs. The mobility disadvantaged, whether it's a result of physical impairments, inadequate transportation, or other factors, can have easier access to jobs via telecommuting.*

The objective of the project outlined here is to test those claims with a group of telecommuting City employees.

According to the City's consultant, preliminary cost benefit forecasts point to substantial advantages of telecommuting. For example, if the performance of the telecommuters in the pilot project just equals current experience with the State's project, the costs of the project will be recovered in about one year. If the City telecommuters' performance approaches the higher end of private sector experience to date, the pay-back period could shrink to a few months. After that period, hard economic benefits could significantly outweigh operating costs, unlike other approaches to traffic congestion reduction.

The pilot project has five phases: orientation, participant selection, training, active telecommuting and evaluation. In the orientation phase the prospective managers and telecommuters will be briefed on the project. During the participant selection phase the specific participating departments and telecommuters, and the sites at which they will work will be selected. Next, both managers and telecommuters will be trained and active telecommuting will begin. Finally, the results will be evaluated to answer the questions: should telecommuting be expanded beyond the pilot project; and, if so, in what forms?

Although some details of the project design have changed during its course, the overall goals and objectives have remained the same.

Results

Each of the goals enumerated above has been met by the telecommuters in the project.

- **Numbers**. Our analysis suggests that almost 16,000 City of Los Angeles employees could telecommute at least part time, either from home or from a satellite telework center closer to home that their primary office.
- **Air Pollution and Traffic Congestion**. Automobile use by the telecommuters has been reduced in direct proportion to the extent of their telecommuting. The result is both reduced air pollution and reduced traffic congestion — their cars are off the rush hour roads while they are telecommuting. The average City telecommuter reduces annual air pollution production by 276 pounds of carbon monoxide and 17 pounds of NO_X. If all of the 16,000 potential City telecommuters were telecommuting from home at the rates we think are feasible, annual air

pollution production would be reduced by 6.2 million pounds of carbon monoxide, 1.2 million pounds of unburned hydrocarbons, 380,000 pounds of NO_X, and 26,000 pounds of particulates.
A critical factor is the effect of this on Average Vehicle Ridership (AVR), as monitored by the South Coast Air Quality management District. If all the potential City telecommuters were to telecommute from home, averaging 1.4 days per week, the Civic Center AVR goal of 1.75 would be met without further changes in ridesharing or compressed work schedules. Our analysis indicates that this is feasible.

- **Cost Effectiveness**. The effectiveness of the telecommuters has increased by an average of 12.5% — according to their direct supervisors — relative to their non-telecommuting co-workers. Individual effectiveness increases range from no change to 100%. At this point, the annual economic impact of this improvement alone is about $6,100 per telecommuter. Other annual benefits can add $2,000 per telecommuter, for a total of about $8,000 each. If all the potential City telecommuters were telecommuting, the annual net benefits could be as high as $140 million, at least $80 million of which would be in individual effectiveness improvements.
- **Energy Dependency**. The average telecommuter currently saves energy to the tune of about 4000 kilowatt-hours per year, largely from reduced fuel consumption. Not only is the energy saved, the saving accrues to our most important and vulnerable energy resource — petroleum. If all the potential telecommuters were telecommuting 1.4 days per week, the annual energy savings would be about 60 million kilowatt-hours (the equivalent of 1.6 million gallons of gasoline).
- **Office Space**. We estimate that the demand for office and parking space could be reduced by as much as 30% for City telecommuters.
- **Information Technology**. Personal computers are becoming vital tools for almost all City information workers. About 73% of City telecommuters now own their own personal computers and use them for telecommuting. The average telecommuter personally invested $1400 in telecommuting-related technology in the past year. Some eligible City employees were kept out of the project because they needed personal computers to telecommute but did not have them at home.
- **Retaining Personnel**. Telecommuting is important in retaining the skills of trained City employees; 18% of the telecommuters said the ability to telecommute was a moderate to decisive influence on their decision to stay with the City rather than take a job elsewhere. We estimate the

1992 benefit of that aspect of telecommuting to be at least $200,000.
Related to this — and to the effectiveness improvements — is the fact that telecommuting clearly enhances the quality of life of the telecommuters.

- **Access to Jobs**. Because of the hiring freeze during the project, we were unable to test the ability of telecommuting to create jobs for the mobility handicapped. However, telecommuting clearly made life easier for those telecommuters who had mobility impairments.
- **Modes of telecommuting**. The figures above are based primarily on the assumption that the telecommuters would be working from home. In reality, we do not expect that all telecommuters would want — or be able — to work from home. A significant number, possibly as much as 60%, would work from satellite offices closer to their homes than their primary offices. These satellite offices could be either City facilities or facilities owned/operated by other public agencies. We would expect that the number of telecommuting days for satellite centers would be higher than those for home-based telecommuting so that the net energy and air pollution impacts would be comparable to those stated above, even though many telecommuters might drive to the satellite offices.

Recommendations

The success of the project leads to the following recommendations.

Continue Existing Telecommuting. Of the 20 departments active in the project, only 2 (employing a total of 5 telecommuters) discontinued telecommuting after the nominal end of the active phase. The rest are continuing telecommuting, for those employees who were involved in the project, until a final decision is made by the Mayor and Council. We recommend that all the present or formerly active telecommuters be allowed to continue/resume telecommuting until that decision is made.

Integrate Transportation Demand Management Strategies. Telecommuting has proven itself to be an effective rideshare strategy. Promotion and expansion of telecommuting should be a formal part of an integrated strategy for managing the use of transportation by City employees.

Create Specific Incentives and Disincentives. Although the project has been successful, it is abundantly clear that there is still significant resistance to telecommuting — not to mention downright hostility — on the part of many City managers. A system of incentives (recognition, factors in promotion/salary decisions, etc.) and disincentives (such as minimum telecommuting quotas) should be devised to overcome that resistance.

Expand Telecommuting. The results of the project clearly indicate that the use of telecommuting should be expanded. Our analysis suggests that at least 15,934 City employees — one-third of the City's permanent staff — could successfully telecommute. Since a possibly large portion of them would be best suited for telecommuting from a satellite office, it is important to begin further testing of satellite operations as soon as possible.

Increase and Expand Training. It is also clear that training in the management methods of successful telecommuting is important to telecommuting's success. Both initial, pre-telecommuting training and follow-up reinforcement are called for. All of the City's telecommuters and telemanagers should receive training.

Improve Access to Information Technology. There is no question that access to personal computers is a major factor in improving effectiveness of City information workers, whether or not they are telecommuters. A number of telecommuting-trained City employees were prevented from participating in the project because they didn't have personal computers at home or were unable to get access to the City's mainframe computer. Our focus group sessions and personal interviews indicated many cases where City employees have invested their own funds in computer equipment that is superior in performance to that in their principal office. It appears that the City is incurring major opportunity costs because of the freeze on computer equipment. It is extremely important that this issue be resolved soon.

Develop TeleService Program. The City has already developed regional City Halls in San Pedro, Van Nuys and West Los Angeles. Telecommuting could be used to further distribute City services all over the City. This may be of particular importance in areas affected by the recent riots. Mini- or micro-City Halls could be developed, staffed by telecommuters living locally, to provide most City services to local residents.

Provide Area-wide Leadership. There are many ways in which the City can show leadership in Southern California. For example, the City should publicize the results of the telecommuting project to other cities and to area businesses. Zoning ordinances should be rewritten to encourage telecommuting (while discouraging potential urban sprawl made possible by telecommuting). The City should cooperate with other Cities and public agencies to share facilities for telecommuters so that public sector employees all over the region can begin telecommuting from satellite offices near their homes.

Action Plan

As a means of implementing these recommendations, the following specific steps are proposed.

Telecommuting Implementation Group. The first step in the expansion process is the appointment by the Mayor of a proactive Telecommuting Implementation Group (TIG) whose primary task is to ***motivate*** **and coordinate** the expansion process. Members of the TIG should be proactive senior managers from every department of the City that has, or is likely to have, active telecommuters. The TIG should also include representatives from all of the affected unions. The Chairperson of the group should be someone who is directly concerned, because of the nature of his/her job, with traffic reduction or with productivity improvement. We suggest that the City Rideshare Program Administrator accept this responsibility. The first action item for the TIG should be the development and coordination of uniform telecommuting guidelines.

Telecommuting Expansion Project. The Telecommuting Expansion Project is a larger scale version of the Pilot Project. The process is quite similar.

- First, the Mayor and Council should address the issues of the necessary policies and infrastructure: personnel work site assignment rules; administrative procedures; telecommunications, computer and satellite office requirements.
- Second, a new series of briefings and/or informal meetings with department General Managers and senior managers should be made, focusing on the key policy issues and the specific experiences in their own departments. No department should be left out of this process. Each General Manager should be asked to develop a telecommuting implementation plan and schedule. The plan should include technology, training and space needs as well as emergency preparedness issues.
- Third, a series of familiarization briefings to mid-level managers and supervisors should be held, on a department by department basis.
- Fourth, all potential telecommuters should be given briefings on telecommuting, including clear descriptions of the work options and responsibilities of telecommuters, and should be given an opportunity to volunteer to become telecommuters.
- Fifth, the volunteers and their supervisors should go through a formal selection process that serves as a means for identifying possible problems with telecommuting.
- Sixth, the selected telecommuters and telemanagers should be given formal training in telecommuting management techniques.

Steps three through six need not be completed for all of the telecommuters at once. A better strategy for large departments

may be to implement telecommuting on a division by division basis, or even in smaller increments, as dictated by operational considerations. The overall schedule may be dictated by the requirements of the SCAQMD.

TeleService Pilot Project. Given the severe constraints on the City's budget, it is not likely that a series of conventional local City Halls will be built any time soon. However, it seems entirely feasible to do "reverse telecommuting:" to use existing City facilities that are turned into multi-purpose operations for disseminating a variety of information and completing routine City-citizen transactions. Applicants would be able to go to a local City facility and be in contact with the required experts regardless of the actual location of the experts.

As is the case with telecommuting, the benefits derived from a TeleService program may significantly exceed operating costs. However, until a more thorough analysis is made of the opportunities, issues, potential benefits and costs, it is not possible to gauge the total impact. Therefore, we propose that a pilot TeleService project be planned and developed to explore the opportunity.

Interagency Facilities Sharing Project. Sponsored by the Institute for Local Self Government,[1] a project is currently under way to develop and demonstrate office space sharing arrangements among local governments. The central concept of the project is that local governments can develop satellite office telecommuting arrangements without necessarily leasing new office space elsewhere. A City of Los Angeles employee living in, say, Rialto could telecommute part time from the Rialto Civic Center rather than commuting to downtown Los Angeles — and vice versa. The City should participate in this or a similar project. Our analysis of the residence and work locations of a sample of 580 prospective City telecommuters indicates that only 4 now work at the City (or other public agency) facility nearest their homes.

[1]The ILSG is a non-profit, non-partisan reserach and education organization affiliated with the League of California Cities. Its mission is to promote and strengthen local self government.

Part 1: Project Description

Introduction and Overview

The City of Los Angeles Telecommuting Pilot Project began with a planning project in 1989. The project culminated in a formal plan that was submitted to the Mayor and the City Council in August, 1989. The plan recommended implementation of a formal test project that was to include 18 months of active telecommuting and include 250 telecommuters and a comparable number of members of a control group. The Mayor subsequently requested that the number of telecommuters be raised to 500.

Participant Selection

The implementation portion of the project began in April, 1990, with a series of briefings on the project plans to senior City executives. The remainder of 1990 was spent in briefing prospective participants in the project and in selecting the initial set of participants for training.

By the end of 1990, 426 City employees had applied or had been identified by their supervisors for possible inclusion in the project. As part of the selection process, both prospective telecommuters and their immediate supervisors were required to complete background questionnaires. Of the total number of people identified in 1990, 298 (and their supervisors) had completed all of the necessary forms. Of these, 279 were recommended by JALA Associates for training and subsequent telecommuting. Although JALA recommended specific individuals, final selection decisions were made by the management of the participating departments. Eligibility to join the project was held open through March, 1992, in order to accommodate departments that were slow in making acceptance decisions.

Training

Training of the telecommuters and their telemanagers began in January, 1991 and continued through March,

1992, by which time 540 telecommuters had been recommended for training by JALA and 441 telecommuters had been trained, together with their supervisors. Active telecommuting generally began shortly after the initial training sessions. The rule proposed by the consultant is that, once a telecommuter and his/her direct supervisor have attended the training sessions and have signed an agreement on their respective roles and performance expectations, they may begin telecommuting. A few of the participants had already been "guerrilla" telecommuters before they received formal training but most were neophytes. Some trainees' telecommuting was postponed because of problems in securing equipment necessary to make their telecommuting fully effective. Of the 441 telecommuters trained, only 242 had returned written telecommuting agreements to the project office by December, 1992. The agreements indicated that they were officially sanctioned by their departments as telecommuters.

The Fire Department withdrew from the project, at the order of the Chief, immediately after Department personnel were trained. The reason given for the withdrawal was that the Department could not afford the cost of the projects, although at no time was the Department told it would be liable for any costs related to the project other than the time required by participants in completing survey forms.

Evaluation

Evaluation of the project began with the selection phase and continued through 1992. Details of the evaluation philosophy and process are given in Appendix 2.

The formal, data-taking portion of the project was scheduled for completion as of June 30, 1992. However, because of the late entry of a number of telecommuters, data collection continued through November, 1992 for the 39 telecommuters who were trained after January 1, 1992. This additional time was to ensure the inclusion of meaningful data from their telecommuting experience in the final evaluation.

Participation

Twenty-two City departments have been actively involved in the project at some point. The final status is shown in Table 1. The table shows, for each department, the total number of:

- applicants of all sorts;
- completed sets of applications;
- positive recommendations, by JALA Associates, for some form of telecommuting;
- telecommuters actually trained;

- telecommuting agreements signed and returned to the Project Manager
- baseline and mid-term evaluation questionnaires returned.

Table 1: Participating Departments

Department	Total Applications	Forms Completed	JALA Approved	TCers Trained	Agreements Received	Baseline Evaluation	Midterm Evaluation	Final Evaluation
Building & Safety	44	37	37	41	21	11	16	13
City Attorney	60	30	29	22	14	14	21	15
City Clerk	44	38	35	0	0	0	27	16
City Planning	57	48	45	28	22	15	27	16
Community Development	10	8	8	9	5	3	5	5
Controller	13	11	9	11	11	2	10	7
Employee Relations Board	3	3	3	3	3	0	0	0
Environmental Affairs	3	1	2	3	3	0	1	1
Fire	37	30	30	11	1	0	6	0
General Services	10	10	10	10	5	5	7	1
Harbor	5	5	5	5	3	3	4	2
Information Services	100	65	55	48	21	24	43	34
Library	42	21	21	29	3	0	18	10
Mayor's Office	2	0	0	0	0	0	0	0
Pensions	9	9	9	7	7	4	6	4
Personnel	24	22	21	14	12	9	15	14
Police	208	141	140	115	82	67	95	54
Public Works	23	21	21	15	9	9	15	12
Recreation and Parks	23	22	19	8	8	7	18	11
Telecommunications	7	4	4	5	3	1	2	2
Transportation	22	21	21	12	9	6	14	7
Water & Power	49	23	17	45	0	0	12	11
TOTALS	**795**	**570**	**541**	**441**	**242**	**180**	**362**	**235**

Note that some of these departments did not actively participate in telecommuting. For example, the Fire Chief decided not to have his employees participate after they had completed training. The City Clerk, because of staffing constraints, did not approve training for any of his employees, although they were allowed to be members of the control group. Some recommended (by JALA) employees in both of these departments volunteered to serve as members of the control group for the mid-term and/or final evaluations.

In general, the remaining departments approved only their very best people for the project; both the telecommuters and the members of the control group were rated by their supervisors as being in the upper third of those employees with similar experience. Consequently, although JALA recommended more than the target of 500 telecommuters for training—and trained almost 90% of the target group—only about 75% of the number trained seem to have been approved by their department management (as estimated by the number of agreements received by the Project Manager). Of those who were trained, 55 had retired or transferred to non-participating units by the end of the project. Of the remaining 321 trainees, 156 (64% of those who had signed agreements to complete the questionnaires) had returned the final evaluation questionnaires by

December 1st. "Questionnaire fatigue" is a common problem in evaluation studies. In this case the resolve of the participants was further tested by the length of the final questionnaire — more than 500 items.

Table 2: Department Status in Early 1993

Department	Trained	Currently Active	Never Started	Transferred/ Reassigned	Promoted	Left Department	Voluntarily Quit Telecom-muting	Supervisor Terminated Telecom-muting	Comments
Building and Safety	41	14		11	3	6		7	Needed 7 for public counter service
City Attorney	22	11		1	1			9	Participation cancelled at nominal end of project
City Planning	28	14	6	3		2	3		
Community Development	9	4	1	2		1		1	Not enough to do at home
Controller	11	4	7						
Employee Relations Board	3	2	1						No computer available for employee
Environmental Affairs	3	1					2		
Fire	11	0	11						Participation cancelled by Chief Engineer and General Manager
General Services	10	0						10	Participation cancelled at nominal end of project
Harbor	5	0						5	Participation cancelled at nominal end of project
Information Services	48	26	22						
Library	29	13	5	2		3	5	1	Too difficult to carry books around; face-to-face needs
Pensions	7	5		1			1		Long term medical leave
Personnel	14	4	2	3		5			
Police	115	66	23	22		3	1		Medical leave
Public Works[2]	15	16		2	1			2	End of project; insufficient task definition
Recreation and Parks	8	6			1	1			
Telecommunications	5	3		1			1		Long term medical leave
Transportation	12	2	1	5	2			2	Daily face-to-face meeting schedule
Water and Power	45	12	30	2		1			
TOTALS	**441**	**203**	**109**	**55**	**8**	**22**	**13**	**37**	

This failure of departments to "activate" trained telecommuters is a serious issue since telecommuting's highest City priority is as a transportation demand management tool. If telecommuting is to become a significant means of reducing traffic congestion, then a fairly large percentage of City employees will eventually have to become at least part time telecommuters[3]. The Telecommuting Project was a primary way of giving

[2]Public Works added 6 telecommuters, using the training materials provided by JALA during the formal sessions.

[3]Our analysis of City job titles indicates that about 16,000 permanent City employees could become at least part-time telecommuters. See the chapter on impacts.

City managers the opportunity of honing their management skills. Yet entire departments missed that opportunity. Others took only very tentative steps.

The final status of the telecommuters in the project is given in Table 2. Overall, 338 participants telecommuted at some point in the project, with 203 still active as of February, 1993. Note that some departments, and some organizational units of departments, elected to discontinue telecommuting at the nominal end of the project, affecting 25 telecommuters — all of whom wished to continue telecommuting.

Types of Employees

First, as a test of the breadth of the selection process, Table 3 shows the breakdown by the type of work reported by the participants.

Table 3: Reported Types of Jobs

Job Type	% of Telecom-muters	% of Non-Tele-commuters
Architect	1.9	3.9
Policy Analyst	1.3	1.3
Finance	1.3	1.3
Research & Development	1.3	1.3
General Administration	7.7	3.9
Public Safety	20.0	7.9
Customer Service	1.3	1.3
Field Service	0.0	2.6
Office Services	1.3	5.3
Office Systems	1.9	0.0
Engineering	9.7	13.2
Accounting	3.9	2.6
Legal	7.7	3.9
Human Resources	5.2	10.5
Information Services	16.1	22.4
Program Management	3.2	2.6
Planning	7.7	1.3
Other	8.4	14.5

Telecommuters and Controls

As of 1 December, 1992, we had received completed final evaluation questionnaires from 156 active telecommuters and 79 non-telecommuters in this group of respondents. This is a sufficient number to get a reasonable idea of the differences, if any, between telecommuters and non-telecommuters after more than a year of telecommuting.

Of the telecommuter group, 5.2% considered themselves to be primarily managers, 66.7% considered themselves to be primarily professionals, 19.0% claim both managerial and professional roles, 6.6% are paraprofessionals or secretaries, and 2.6% classify themselves in the “Other”

category. Clearly, *it would have been more revealing if significantly larger numbers of paraprofessional, secretarial and clerical workers had been included in the project,* since the City employs fairly large numbers of people at these levels. Nevertheless, there is clearly a broad spectrum of job types represented in this group. The distribution of control group members differs slightly, with 2.6% managers, 58.4% professionals, 24.7% as combined manager-professionals, 13.0% as paraprofessionals or secretaries, and 1.3% as "Other."

The average telecommuter is 38.9 years old[4], has worked for the City 13.6 years, for his/her Department 5.1 years, in his/her particular job 4.0 years and has a gross annual salary of about $50,600. The average size of the unit in which the participant works is 12.3 people; the median work unit size is 8. Most, 84.2%, of the telecommuters in this sample work in or near downtown Los Angeles.

The telecommuters do not take much sick leave, except for maternity leave; the median annual number of sick days taken in 1989 was 6, with 5 days in 1990 and 4 as the median in 1991 during telecommuting. The telecommuters decreased the average number of sick days taken between 1989 and 1990 by 1.2, and between 1990 and 1991 by 1.8. Most of the overall reduction in the most recent year was a result of an average 3 day reduction[5] by female telecommuters, presumably related to the telecommuting advantage in the care of sick children.

Most of the telecommuters own their own homes, averaging 1849 square feet. Their average electricity bill is $98, the gas bill is $23 and telephone charges average $73 per month. The apparent telephone bill increase[6] for telecommuters, since most departments are not paying for home telecommuters' phone charges, is only $3.59 per month. Even this $3.59 difference may be misleading, since the telecommuter data include one very large telephone bill ($860). The median telephone bill for the telecommuters was $51, making their bill $7.50 less than that of the control group. Therefore, we conclude that there is no significant difference in the telephone costs between the two groups. Yet, telephone bills are generally thought to constitute the largest operational cost element for telecommuting.

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[4]The average age for males is 39.8, for females it is 38.2 years.

[5]The reduction was more than 5 days per year, compared with female members of the control group.

[6]As compared with the bills for the control group.

The average control group member is 41.0 years old[7], has worked for the City 14.5 years, for his/her Department 5.7 years, in his/her particular job 4.7 years and has a gross annual salary of about $47,800[8]. The average size of the unit in which the control group member works is 12.9 people; the median work unit size is 9. As with the telecommuters, almost all, 94.7%, of the control group members in this sample work in or near downtown Los Angeles.

Also like the telecommuters, the control group members do not take much sick leave; the median annual number of sick days taken were 6 in each of 1989 and 1991, 5 in 1990. On the other hand, the average telecommuter took 2 sick days (or 33.3%) less than the average non-telecommuter during the telecommuting period.

Most of the control group members own their own homes, which are slightly larger than the telecommuters', averaging 1918 square feet. Their average electricity bill is $94, the gas bill is $28 and telephone charges average $69 per month, with a median telephone charge of $58.50. In short, the members of the control group match the telecommuters fairly closely in their general characteristics. The major difference is a utility bill (including telephone charges) of about $3.09 per month more for the telecommuters.

Men have a slight majority among the participants, 53.3% of the telecommuters and 57.9% of the control group. About two-thirds, 66.7%, of the telecommuters and half, 51.3%, of the control group members live in dual earner households.

Forty seven percent of the telecommuters and 22.1% of the control group members are on a traditional work schedule: five 8-hour days per week. Only 5.8% of the telecommuters and 3.9% of the control group members work on the 4-10 schedule (four 10-hour days per week), while 45.5% and 74.0%, respectively, are on a 9-80 schedule (five 9-hour days one week; three 9-hour days and one 8-hour day the next week).

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[7]The average age for males is 41.2, for females it is 40.4 years. In 1990, male and female federal workers averaged 43.6 and 40.5 years, respectively. as compared with 37.3 years for both male and female employees in the private sector. Hence, City employees are roughly comparable in their age demographics to other information workers.

[8]Men in the control group average $51,600 while women receive an average of $42,800 per year. The salary gap between male and female telecommuters is not as large, with males averaging $52,300 and females averaging $49,000 per year. Either way, however, the male-female salary gap is statistically significant at the 0.0016 level.

Accomplishments

In this report, the overall accomplishments of the project are summarized. For more detail, the reader is advised to examine one or more of the individual project reports.[9]

Commuting Data

A primary goal of the Telecommuting Project is to reduce commuting. Hence, the commuting patterns of the participants are very important. As was mentioned earlier, most of the participants who have responded to the evaluation questionnaires commute to City Hall or the general downtown Los Angeles area.

Residence Location

There is no particular pattern of residence locations for City employees. One hundred forty different residence zip codes were identified by the 235 employees who returned the final evaluation questionnaires.[10] The two most "intensely" populated zip code areas have 5 employees living in them. This acts to complicate the problem of satellite telework center selection since there are no obvious, unequivocal locations that pop out of the data.

Commute Distances and Times[11]

The average one-way commute distance for the active telecommuters is 22.8 miles[12]; the median commute is 20.0 miles. The minimum one-way commute for a telecommuter is 3 miles, the maximum is 67 miles and the mode (the most common distance) is 15 miles.

The non-telecommuters' average one-way commute is 23.1 miles; the median and the mode are 23 and 26 miles, respectively. Their reported commute distances range from 7 to 60 miles.

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[9]There are three cost-benefit analysis reports; two focus group summary reports; and special reports on departmental impacts; area-wide impacts; labor, managemant and legal issues; and barriers to telecommuting. These reports are available from the Department of Telecommunications.

[10]As contrasted to the 161 different zip codes, with a maximum of 8 in a single zip code, identified by the 304 employees who returned mid-term evaluation questionnaires.

[11]Note: the commute times and distances are taken from the mid-term evaluation and trip analysis data. Through a clerical error, the commuting data portion of the final evaluation questionnaire was omitted from all but 40 of the questionnaires; only 15 of these were returned by the reporting deadline. However, since household moves were reported in a different section of the questionnaire, the mid-term data should be applicable to the final situation.

[12]The 31.9 mile average found in the baseline survey implies that the first group of telecommuters was biased toward those applicants who lived at greater than average distances. The mid-term survey had an average one-way commute of 24.9 miles and a median of 21 miles. The mid-term maximum was 170 miles.

Commute times from home to the office average 48.3 minutes for the telecommuters and 44.8 minutes for the non-telecommuters. The median morning commute times are 45 minutes for both groups. Afternoon commutes are significantly longer for both groups, averaging 58.1 minutes for the telecommuters and 57.4 minutes for the non-telecommuters, respectively. That is, the telecommuters average 106 minutes per day commuting, when they commute, and the non-telecommuters are on the road an average of 102 minutes per day, not much difference. ***If these people were to commute 220 days per year, each of these group members would spend about 9.6 work weeks (24 waking days) per year on the road***[13]**.**

Commute Modal Choices

Three of every five (61.4%) of the telecommuters drive their own cars to work at the rate of least four days per week when they are commuting, a slightly higher proportion than the 58.7% of the non-telecommuters who do so. Seventy-one percent of the telecommuters and 70.7% of the control group members do not belong to a car- or van-pool (ridesharing). Similarly, 26.7% of the telecommuters and 34.7% of the non-telecommuters do not drive their own cars at all to work. The average number of days per week each group drives to work is 2.6 days and 2.8 days per week, respectively for the telecommuters and non-telecommuters. Twenty-nine percent of the telecommuters carpool at least one day per week, versus 20.7% of the non-telecommuters. On average, the telecommuters carpool 1 day per week, as contrasted to 0.82 days per week for the non-telecommuters. The average days per week taking the bus are 0.31 and 0.63, respectively.

Of those who rideshare, 34.1% of the telecommuters and 52.4% of the non-telecommuters drive to their pickup point. Since each of these trips involves an engine cold start, the pollution reducing advantage of ridesharing is significantly diminished. The average trip time to the rideshare pickup point is 8.4 minutes for the telecommuters and 9.5 minutes for the non-telecommuters.

In short, telecommuters live slightly farther from work than do the non-telecommuters and they are about as likely to drive alone when they do commute. Overall, the commuting patterns of both groups are similar. Note that significant numbers of those using carpools and vanpools in both groups report driving their cars to the pool pickup

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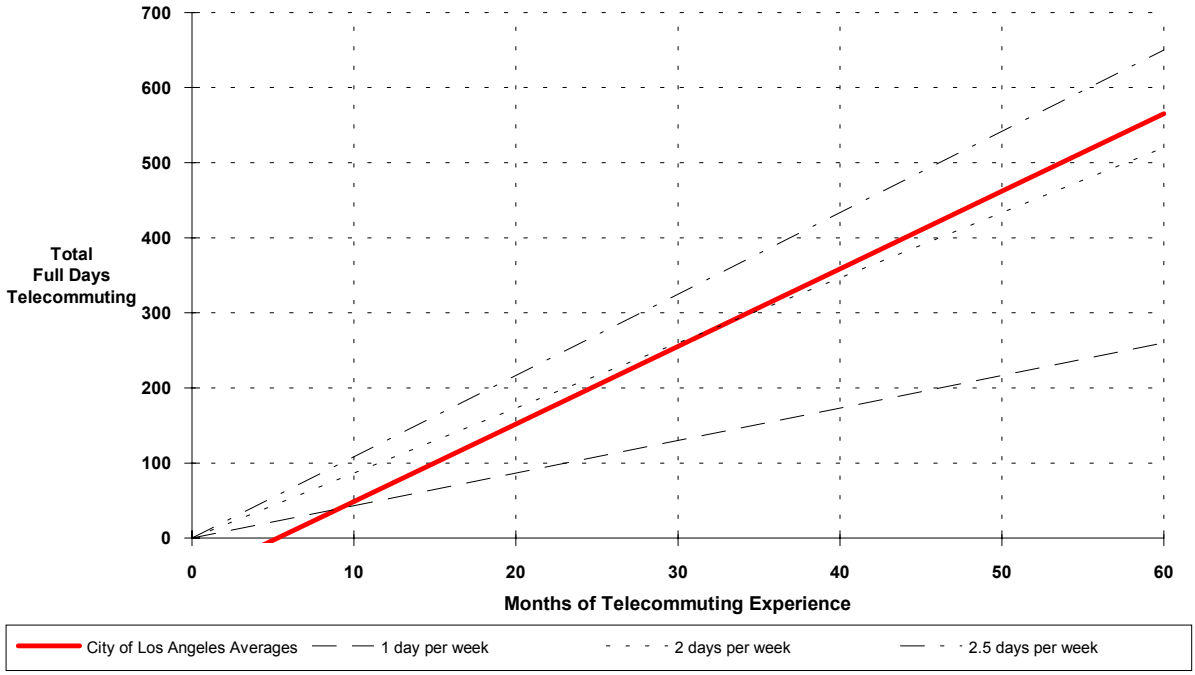
[13]A work week is taken as 40 hours; a waking day is 16 hours, under the assumption that most people get about 8 hours sleep per day and that this does not occur while they are commuting. Waking days constitute potential disposable time for the telecommuters. Work weeks constitute potential productive time for employers.

location. Therefore, a high percentage of their telecommuting will result in real net trip savings and air pollution reduction.

Level of Telecommuting Achieved

Of the 325 individuals who had responded to our final survey by December, 156 were active telecommuters. Of the active telecommuters, 62.2% have been telecommuting more than 1 year, with only 7.7% who have been telecommuting less than 6 months.

Figure 1: Projected Telecommuting Rates



The nominal goal for the project was to have participants telecommuting at least one day per week, on average, with a nominal maximum average of two days per week. Some jobs are suitable for almost full-time telecommuting, in our experience, while others might encounter difficulty reaching the one-day-per-week goal. Some of the telecommuters found that they could not continue telecommuting at the same rate that they tried the first month. Others found that they could increase their rate of telecommuting. Still others have maintained their original rate. The overall average for the first month of telecommuting was 4.0 days, with median and mode also at 4 days and the range going from 1 to 23 days. For the first month of their telecommuting, 99% of the telecommuters worked at home 8 days or less.

In practice, the number of telecommuting days per month tends to increase over time. An analysis of the historic data for the project shows an expected average of 4.2 days per month for those who have been telecommuting for a year.

Telecommuters with two years of experience are likely to be telecommuting about 8 days per month. For comparison, the State of California Telecommuting Pilot Project showed an average of 5.2 days per month at the end of the first year of telecommuting and 6.5 days per month at the end of the second year. A linear regression analysis[14] of the Los Angeles telecommuting frequency data indicates that the telecommuters will tend to telecommute about 2.4 days per week as they gain experience with telecommuting. Figure 1 shows the regression line. Note that the line begins only after a few months of telecommuting. This is indicative of the fact that beginning telecommuters tend to telecommute one or fewer days per week.

Although the training sessions for the telecommuters stressed that only full days of telecommuting would count, since the primary objective is to eliminate car trips, some partial day telecommuting was expected. In fact, 27 of the telecommuters also did some part-day telecommuting, one of them for 10 days in the most recent month before the survey. Half of the part-day telecommuters left home for the office between 7:00 and 9:00 a.m., the center of the time span proscribed by the SCAQMD in Regulation XV. Hence, this telecommuting had essentially no positive impact on the air quality problem.

One concern with telecommuting is whether it will increase car use, since an "extra" car may be available when the telecommuter is working at home. Twenty-three percent of the telecommuters said that the car was indeed used by themselves or someone else in their household when they worked at home (the remaining 76.9% maintained that it was not in use). **Of those who stated that their car was available, 23.1% (5.8% of all the telecommuters) stated that there was an overall decrease in non-commuting car use in addition to the decrease due to telecommuting!** To counter this, 23.1% (5.8% of all the telecommuters) stated that there was some additional car use, but not enough to counteract the telecommuting reduction. An additional 5% of the car-available group (1.3% of all telecommuters) said that their added non-commuting car use acted to cancel the reduction from telecommuting. In summary, only 8.4% of the telecommuters reported any erosion of the car use savings.

[14]Linear regression is a statistical procedure that fits a straight line to a set of data points. In this case the data points are length of time telecommuting and the number of telecommuting days during that period.

Analysis of the detailed trip logs[15] that were administered in March, 1992, showed that some of this additional car use was the result of telecommuters performing chores that otherwise would have been carried out by other family members. Hence, the slight additional use of their cars by some telecommuters may be overstated, since many of the "new" trips replace trips that would have occurred anyway. The net result of the actual trip measurements was an overall reduction in car use over and above the telecommuting reduction. ***At this point, to be conservative, we conclude that telecommuting produces exactly the car use reduction that equals the reduction in commute trips. Therefore, it completely satisfies the primary goal of the project: telecommuting-eliminated trips are not replaced by other trips.***

The most popular locations for the telecommuters' home offices are the den or study (20.8%), a spare bedroom

Table 4: Activities Performed While Telecommuting

Activity	% who engage in it
Thinking/planning	69.2
Reading	68.6
Writing (without a computer)	55.1
Text/word processing	58.3
Research	55.1
Coordinating by telephone	44.9
Record keeping	17.3
Computer programming	20.5
Working with data bases	22.4
Other	20.5
Graphics/layout	10.9
Coordinating via computer	8.3
Having meetings	2.0

(29.9%) and the dining room (13.0%). The average space used for telecommuting is 173 square feet (about 9% of their total floor space), with an average of 133 square feet used exclusively for telecommuting. Eighty-three percent of the telecommuters own their own detached-structure homes, 6.5% live in apartments and 7.7% live in condos or townhouses. The median home has 7 rooms.

The average telecommuter allocates about 37% of his/her weekly work tasks for the telecommuting period. *Given the overall average of 0.9 days per week telecommuting, that works out to 37% of the work being accomplished in 18% to 23% of the work week; possibly an average 100%*

[15]Cf. the project report: *Telecommuting Travel Impact Analysis: Los Angeles Telecommuting Pilot Project*, July 1992, by JALA Associates.

productivity increase per telecommuting day. Table 4 shows what the telecommuters are doing when they telecommute. While 17.5% of the telecommuters view telecommuting as a temporary or occasional thing, 82.5% (up from 77% at the mid-term survey) consider it to be a permanent change to their working ways.

Performance Changes

An important criterion in assessing the desirability of telecommuting is its impact on employee effectiveness. As a minimum acceptance criterion, overall work performance should not degrade from its pre-telecommuting values. As is the case with the quality of life factors, we have concentrated on assessing ***changes*** in, rather than absolute values of, worker effectiveness. Several indirect measures of effectiveness factors are included in our evaluating survey questionnaire. However, the most numerically clear test is a direct question asking each respondent whether, and how much, their effectiveness changed since telecommuting began.

Quantitative Estimates

Of the group of telecommuters, the range in their self-estimate responses ran from no change (twenty cases) to increases of 100% (five cases). The average response for all the reporting telecommuters was an increase of 29.9% with a median response of a 25% increase. In the case of the non-telecommuters, the range in responses ran from a decrease of 50% (one case) to an increase of 100% (three cases)[16]. The average response for the non-telecommuters was an increase of 23.8%, with a median response of 20%. The difference between the telecommuters' and non-telecommuters' average self-estimates of effectiveness change is 6.1%. The difference is significant at the 0.09 level.[17] About 13% of the telecommuters and 25% of the non-telecommuters indicated no change in their effectiveness since telecommuting began.

Note that the above figures are derived from the *employees'* responses. Typically, supervisors' estimates of employee effectiveness are lower than those of the employees themselves. Consequently, a parallel survey was made of the participants' supervisors. The supervisors' estimates of the telecommuters' effectiveness changes averaged 21.8%; their estimate of control group members' effectiveness changes averaged 9.3%, a difference of 13.5%. In this case,

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[16]Non-telecommuters can increase their effectiveness through such means as more experience or training, fewer interruptions from (telecommuting or other) co-workers, greater maturity in work attitudes, etc.

[17]That is, the odds are 10 to 1 that the difference is meaningful.

the difference is significant at the .008 level.[18] Twenty-five percent of the telecommuters' supervisors and 48% of the control group members' supervisors indicated no change in effectiveness. Hence, **the telecommuters are showing clear effectiveness improvements relative to the members of the control group, *particularly* in the estimation of their supervisors**.

There are some clear differences of opinion between supervisor and employee concerning effectiveness change. The telecommuters' self estimates tended to agree more closely with that of their supervisors. Nineteen percent of the telecommuters and supervisors agreed exactly on the effectiveness changes; 8% of the supervisors and control group members agreed. Twenty-six percent of the telecommuters received higher ratings from their supervisors than they gave themselves. Twenty-one percent of the control group members received higher than their self-ratings from their supervisors. The most interesting aspect of these results is that the supervisors' estimates have a much greater difference between telecommuters and non-telecommuters than do the individuals' self-estimates.

Qualitative Estimates

A more qualitative view of the impact of telecommuting was obtained in the focus group meetings that were held at intervals during the project. These views are more indicative of attitudes, rather than of measurements made during the project.

Supervisor/Subordinate

One supervisor, commenting on the attitude toward telecommuting of other managers in the organization, quoted them as saying: *"Why commit to it when it'll go away?"* In another department, the perceived attitude of upper management was more actively hostile. In most departments, a mixture of pro- and con- attitudes was perceived. In all of the focus group sessions requests were made for more publicity about the project, particularly directed at upper management.

On the positive side, all of the supervisors attending the sessions felt that telecommuting should be continued after the end of data-taking. Some supervisor's comments:

> *"It's [succeeded] to the point where you have to make a case NOT to telecommute;"*
>
> *"This is not a benefit; it's management deciding where work is to be done—as needed;"*

[18]Here, the odds are 127 to 1 in favor of a meaningful difference.

"I can count the hours gained by one of my female telecommuters with child care problems; it's a major improvement;"

"You just can't keep up with required reading without telecommuting."

Telecommuting has proved to be a communication enhancer for both telecommuters and supervisors/subordinates*: "I like to call you when you're telecommuting because I know I have your undivided attention"* or *"It's the only time when I know that I can get in touch with you."* Note that this works both ways; the first quote is by a telecommuter about his supervisor. This enhanced communication, coupled with the increase in decision making by telecommuters, has allowed at least one manager to cope with a growing staff.

This combination of enhanced communication and increased telecommuter responsibility was a recurring theme of the focus groups. In contrast, some managers' apparent preoccupation with control was also a recurring theme. One supervisor commented on the non-participation of one of the City departments in the project: *"The mini-micro-management mentality of [the department] will keep them from taking advantage of telecommuting."* Several telecommuters in one department noted that the products of their telecommuting days were given far more scrutiny than their in-office work:

> *"I have to turn in my [telecommuting day's] work for inspection as soon as I come in to the office on the following day. If I'm not finished, I have to personally explain to the division manager; this doesn't happen on non-telecommuting days."*

This is a common phenomenon at the outset of a telecommuting project. It tends to diminish or disappear as telemanagers gain more experience. Some of the longer-term telecommuters in the groups, and several in the 1992 groups, said that their supervisors relaxed noticeably once they saw the improved, on-time output from the telecommuters.

Nevertheless, the continued demonstration of these attitudes led to the recommendation, in almost every one of the 1992 meetings, that mid- and upper-level supervisors, as well as direct supervisors, be given telecommuting training. Appendix 3 includes quotes from the final supervisors' evaluation questionnaires.

Two supervisors stopped their employee's telecommuting because of performance drops. In one case, the employee could not assemble enough work to telecommute entire days at a time. In the other case, the employee was simply

unable to adequately identify deliverables, set up a schedule and set priorities.

Colleagues

As expected, the primary reaction of non-telecommuting colleagues of telecommuters was felt to be envy. A frequent remark in the sessions was that neither colleagues nor supervisors thought that telecommuting was "real" at first. Once they discovered that telecommuting was actually happening, they felt left out. In some cases, outright hostility was perceived*: "One person won't even talk to me anymore."* In most cases this initial friction has diminished or even turned into support.

The requirements for telecommuting are being disseminated informally among the telecommuters' colleagues. One telecommuter remarked: *"The rest of the people in my group know who the slackers are. They would really complain if any of [the slackers] were selected for telecommuting."*

The question of reduced casual interaction among co-workers remains. Some individuals felt that their interaction was reduced, while others felt it had increased, although often on the phone instead of face-to-face.

We regularly asked focus group attendees whether their co-workers would be disposed to telecommute. Several participants mentioned that their colleagues originally declined to participate in the project because of its pilot status. They [the colleagues] felt that it would be too much of a risk/disappointment *"to get all fired up about telecommuting, then have it turned off suddenly."* A certain amount of *"I told you so"* commentary was received by Harbor Department telecommuters after they were told to stop telecommuting after June 30, 1992.

A different view of colleagues' attitudes was offered by another telecommuter: *"When they [the co-workers] found out they had to be accountable for their work, their enthusiasm went way down."* This from co-workers who were accusing the telecommuters of goofing off.

These and similar incidents led several telecommuters to suggest that telecommuting training be given to non-telecommuters as well as to the telecommuters.

Training Influences

One of the elements of the analysis is to see whether the initial training sessions for the project had any influence on the effectiveness outcomes. Table 5 shows the effectiveness estimates as a function of who was trained. A direct reading of the table can be slightly misleading, since there are only a few cases among the telecommuters where either no one or only the supervisor was trained. The overall

evidence is that it is particularly important that supervisors receive training.

Table 5: Estimates of Effectiveness Increases by Level of Training

Training Received by:	Supervisors' Estimates		Self-Estimates	
	Telecommuters	Non-Telecommuters	Telecommuters	Non-Telecommuters
Neither	21.4%	6.0%	33.3%	21.3%
Telecommuter only	14.7%	11.0%	31.8%	21.2%
Supervisor only	38.3%	8.8%	30.7%	33.0%
Both	23.3%	12.5%	28.9%	26.9%

Quality of Work Life Changes

Aside from the quantitative effects of telecommuting, there is the issue of the socio-psychological effects of telecommuting. What is the impact of telecommuting on the telecommuters and their families? We do not develop direct evidence of the effects on the families, rather we asked the telecommuters about the impacts. We included a section in our evaluation questionnaires specifically oriented toward these impacts.[19] Common factor analysis of the questionnaires allows us to break a number of the work/social impacts into 11 categories, as follows:

1. *General Work Life*. This relates to changes in the individual's relationships with his/her supervisor, self assessment of job skills, feelings of job responsibility, influence, versatility and scope.
2. *Personal Life*. This factor includes changes in quality of family relationships, discretionary time, feelings of control of one's life, ability to separate work and home life, success in self discipline, coordination of family and work time, and knowing when to quit work.
3. *Visibility*. Do telecommuters feel out of their supervisor's and co-workers' minds when they're out of sight? This factor includes changes in one's influence on organizational strategy, understanding of what others are doing, how well one's suggestions are received and self assessment of visibility in the organization.

[19]We developed this component (as well as the other components) of the questionnaire in studies of telecommuters and other information workers carried out over the past 16 years. It contains 50 questions about the extent and importance to the respondent of any impacts.

4. *Environmental Influences*. This includes changes in home office space, stress from environmental noise, ability to match work and biorhythms, and feelings of self empowerment.
5. *Belonging*. Do telecommuters feel themselves to be loners? Here we have changes in involvement in office social activities, amount of job-related feedback, career advancement, job stability and relationships with fellow workers.
6. *Creativity*. Changes in: creativity in one's work, the amount of flexibility in job performance and feelings of self empowerment, are in this factor.
7. *Stress Avoidance*. Changes in work related costs, ability to bypass physical handicaps and avoidance of office politics are grouped here.
8. *Liberation*. This factor includes changes in ability to concentrate on crucial tasks, the need to cope with traffic, and the ability to get more done.
9. *Apprehension*. Changes in uneasiness about equipment failure and feelings of guilt about "not really working" constitute this category.
10. *Interdependence*. This factor relates to changes in the quality of meetings with colleagues and dependence on others to help perform one's job.
11. *Continuity*. The final factor calibrates changes in freedom from interruptions.

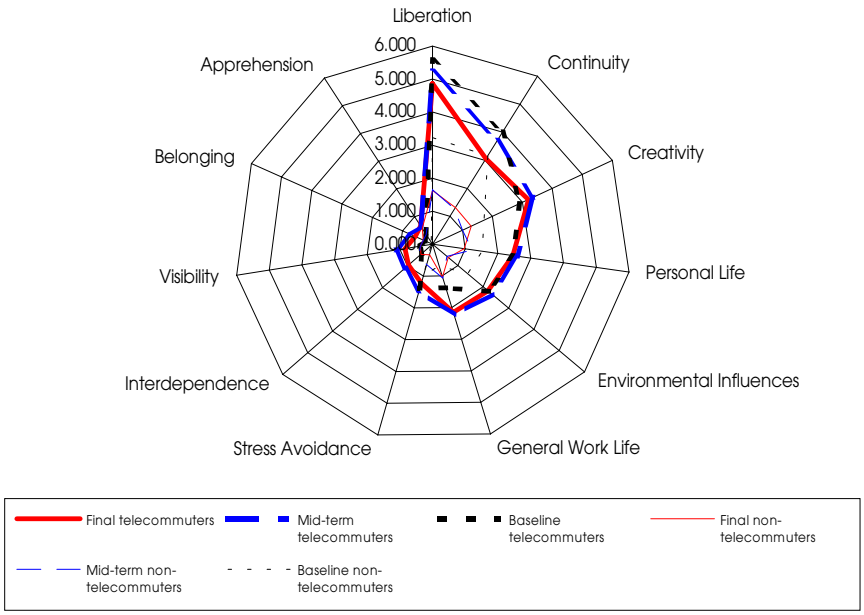
Table 6: Work/Social Factor Changes

Factor	***Telecommuters***	***Non-Telecommuters***	***Difference (T - non-T)***
Liberation	4.9	1.6	3.2
Continuity	3.1	1.3	1.7
Creativity	3.2	1.3	1.9
Personal Life	2.5	1.0	1.5
Environmental Influences	2.2	0.6	1.6
General Work Life	2.2	1.0	1.1
Stress Avoidance	1.2	0.3	0.9
Interdependence	1.0	0.5	0.5
Visibility	0.9	0.4	0.5
Belonging	0.6	0.3	0.3
Apprehension	0.7	0.6	0.1

Note that the emphasis is on *changes* in these categories. We asked the participants what had changed since telecommuting began, whether or not they were telecommuters. We asked how much, if any, change there was and how important each issue was to them. We have developed composite values (amount of change multiplied

by importance to the participant) for these factors, as shown in Table 6. The scales for *amount* of change are from -2 to +2, with -2 signifying much worse, 0 meaning no change, and +2 signifying much better. Importance ranges from 0 (not important at all) to 4 (extremely important to the participant). Thus, the composite factor can range from -8 (i.e., -2 × 4) to +8 (i.e., +2 × 4).

Figure 2: A "Radar" View of the Quality of Life Changes

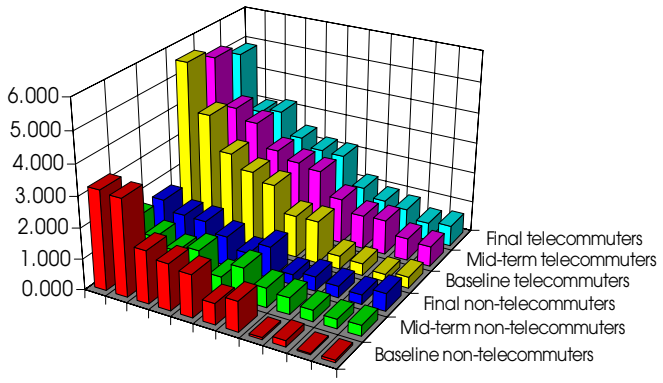


The surveys show clear differences between the telecommuter and non-telecommuter groups. There are three areas in which we might expect to see negative impacts from telecommuting: Visibility, Apprehension and Belonging. Yet, this group of telecommuters, on average, shows net positive changes for all three, although there are some individual negative responses.

Figures 2 and 3 show two different views of the elements of Table 6 as well as the comparable results from the mid-term and baseline surveys. Note that, with the exception of the liberation and continuity factors, both groups at mid-term appear to be more positive than they were during the baseline survey; then both groups tended to decline slightly from the mid-term to final surveys. In two of the key factors — continuity and creativity— the telecommuter group switched rankings between the mid-term and final surveys, while the non-telecommuters stayed about the same. This could arise from a possible increase in interruptions to the telecommuters as more people get used to contacting them while they are at home, coupled with a decrease in interruptions in the office as the on-site office population decreases. Interestingly, the telecommuters' responses to the liberation and continuity factors declined

after the baseline measure, showing the effects of reality slightly modifying expectations.

Figure 3: Comparative Quality of Life Changes



In any case, the telecommuters show quality of life changes that are more positive in every respect than those of the non-telecommuters.

Energy Use

Direct Usage

Telecommuting *uses* more energy to the extent that it increases the use of telecommunications over what would occur without telecommuting. For example, if more phone calls are made by telecommuters than by non-telecommuters, or if the phone calls are over longer distances or last longer than would be the case otherwise, then there is a net increase in energy use proportional to the energy costs of the additional calls. Furthermore, if telecommuters work at home, they may use more energy — in lighting, heating and cooling — than they would if they were not at home. This is particularly true if no one would be at home otherwise (thus, the lights and furnace or air conditioner would be turned off or down).

Telecommuting *saves* energy to the extent that it reduces gasoline consumption or reduces building heating, ventilation, air conditioning and lighting in the offices no longer occupied by the telecommuters. The latter is the reverse of the increase in energy use produced by a home telecommuter.

Indirect Usage

There are indirect energy effects as well. For example, if telecommuting increases the use of computers, it also

increases the energy put into the computer industry. to the extent that telecommuting causes changes in the *form* of energy used, as from gas to electricity, or in the *efficiency* of energy use, there is an impact on energy resource demand.

As another example, if telecommuting reduces automobile use, then it also has a ripple effect on the amount of energy expended in automobile manufacturing and maintenance, highway construction and the information infrastructure supporting those sectors of the economy.

Results

It was not possible to directly measure the direct usage, or even to estimate the indirect energy usage. Further, because of the already high load of questionnaires and meetings requiring the telecommuters' time, we limited the energy assessment to indirect methods. Specifically, we estimated telecommunications, electrical and natural gas energy use by asking the participants to note their telephone and utility bills. Gasoline energy use was estimated by factoring an assumed average fuel mileage (24 miles per gallon of gasoline) for the participants' cars with their known commute distances and commuting patterns.

As the demographic data given earlier indicate, there is no statistically significant difference

between the telecommuters and the non-telecommuters in telephone or home utility use. The fundamental difference is in fuel use. The difference amounts to a net saving of 4018 kilowatt-hours per telecommuter-year at the 1992 average telecommuting rate of 1 day per week. For comparison, the 1988 average annual energy consumption per capita in the US. was about 31,700 kilowatt-hours.[20] *Therefore, the average City of Los Angeles telecommuter in 1992 was reducing his/her total energy use by about 13%.*

As the rate of telecommuting increases, the resulting energy saving can also be expected to increase. Further, although we did not calculate the indirect energy impacts, it appears plausible that any increases in telecommuting-related infrastructure use are more than compensated for by energy reductions in the transportation infrastructure.

Air Quality

The effect of telecommuting on air quality is directly the result of decreased automobile use. Automobile-produced air pollution is often characterized as consisting of two phases: the cold start and hot running phases. The term *cold start* refers to the fact that an internal combustion

[20]The actual calculation is: 327 million Btu's per capita divided by 10,331 Btu's per kilowatt-hour equals 31,652 kilowatt-hours per capita.

engine that is at ambient temperature produces significantly more pollutants than an engine that is running at its nominal operating temperature. The cold start period, although somewhat dependent on the ambient temperature, is from 10 to 15 minutes under typical operating conditions. The SCAQMD rules concentrate on cold starts, generally ignoring the hot running phase. If a car has been idle for more than 8 hours, its next start is assumed to be a cold start.

The current version of Regulation XV, in order to make the necessary calculations fairly simple, gives full credit, for a trip not taken, to carpool and vanpool riders. However, the formula for satellite telecommuters is more complicated. Full credit is given only for telecommuters who reduce their one-way commute by at least 20 miles.[21] Half credit is given to telecommuters who reduce their commute by at least 50%, even if the one-way commute distance saving is less than 20 miles.

Paradoxically, our analysis of the travel patterns of City employees indicates that 52% of those who participate in car- or van-pools drive their cars to the pickup point. The average trip time for that drive is 9.5 minutes. Thus, at least half of the car- and vanpool activities involve as many cold starts as if the participants were driving their cars all the way to work. Home-based telecommuting, according to our data, completely eliminates the cold starts associated with commuting. Satellite office telecommuting, if the commute distance is longer than a few blocks, probably does not reduce cold starts. Yet satellite office telecommuting, as well as car- and vanpooling, can materially reduce the total vehicle miles traveled (which is not counted under Regulation XV). Hence, there is considerable strain between Regulation XV and the realities of automobile-induced air pollution. That is, the rule is biased in favor of rideshare participants and against satellite office telecommuters.

Our air pollution calculations are based on the hot running rate of pollution production for cars, in accordance with the *Mobile 4* specification from the Environmental Protection Agency. Therefore, because they miss the cold start period, they understate the impact of telecommuting. We calculated the air pollution that would have been produced by each telecommuter's car, had they not been telecommuting. The results are as follows, in terms of the

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[21] Our analysis of a set of 580 potential telecommuters, together with a set of 36 possible regional satellite office locations, indicates that 91% of the telecommuters would save less than the required 20 miles one-way by commuting to the center closest to their home. However, the remaining 9% produce more than half of the overall VMT savings.

annual level of pollutants *not* produced by the average City telecommuter:

- Carbon Monoxide: 275.6 pounds
- Nitrogen Oxides: 16.9 pounds
- Unburned Complex Hydrocarbons: 51.5 pounds
- Particulates: 1.2 pounds

Technology Requirements

One of the common misconceptions about telecommuting is that it requires intensive computer use; that it is not possible to telecommute unless access to a computer is available. While this can be true for computer programmers and some other professionals, it is not necessarily so for many other people. The dilemma for computer professionals is illustrated by the composition of the non-telecommuter group of our sample; a large fraction of this group consists of individuals who either lack access to the mainframe or who otherwise need computers but do not have their own personal computers at home.

Part of our inquiry deals with the extent to which various forms of technology are useful to City employees. There are two aspects to this inquiry. First, what are the minimum technology requirements for **any** form of telecommuting? Second, what is the effect of availability of a particular form of technology on *increasing the amount* of telecommuting?

We include in our list of "technologies" face-to-face meetings and other traditional forms of communication, since the effectiveness of telecommuting depends on the ability of some of the more electronic technologies to substitute for those traditional ones. Of the more "high-tech" technologies (computers, teleconferencing systems, etc.) 94.3% of the telecommuters and 93.7% of the non-telecommuters said these technologies greatly helped their work. We conclude that computers and sophisticated telecommunications are important to at least nine of every ten (up from four of every five at the mid-term evaluation) City information workers.

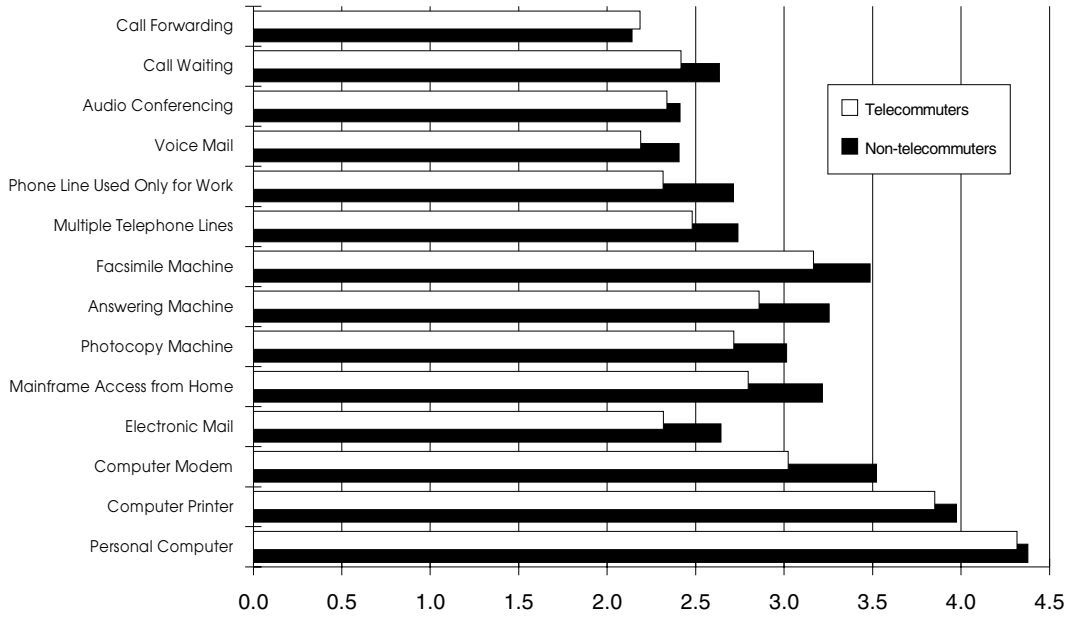
Personal Ownership

A test of what technology products are personally important is that of personal ownership. Although this obviously has some cost considerations, Table 7 gives the breakdown of personal ownership of technology among the two groups. Over the period of active telecommuting, a significant difference has developed in technology ownership in the two groups, particularly in the ownership of personal computers and related equipment. It is interesting to contrast computer ownership by the participants of the survey, a 67.7% overall average, with the 46.2% personal computer ownership claimed by the

Table 7: Technology Owned at Home by the Participants

Type of Technology	Telecommuters	Non-telecommuters
Personal Computer	73.7	58.2
Computer Printer	67.3	46.8
Computer Modem	39.7	19.0
Electronic Mail	10.3	6.3
Mainframe Access from Home	12.8	7.6
Photocopy Machine	9.0	7.6
Answering Machine	89.1	73.4
Facsimile Machine	18.6	12.7
Multiple Telephone Lines	30.1	19.0
Phone Line Used Only for Work	9.0	8.9
Voice Mail	3.2	1.3
Audio Conferencing	7.1	1.3
Call Waiting	42.9	25.3
Call Forwarding	14.7	7.6

Figure 4: Relative Power in Making Work Easier



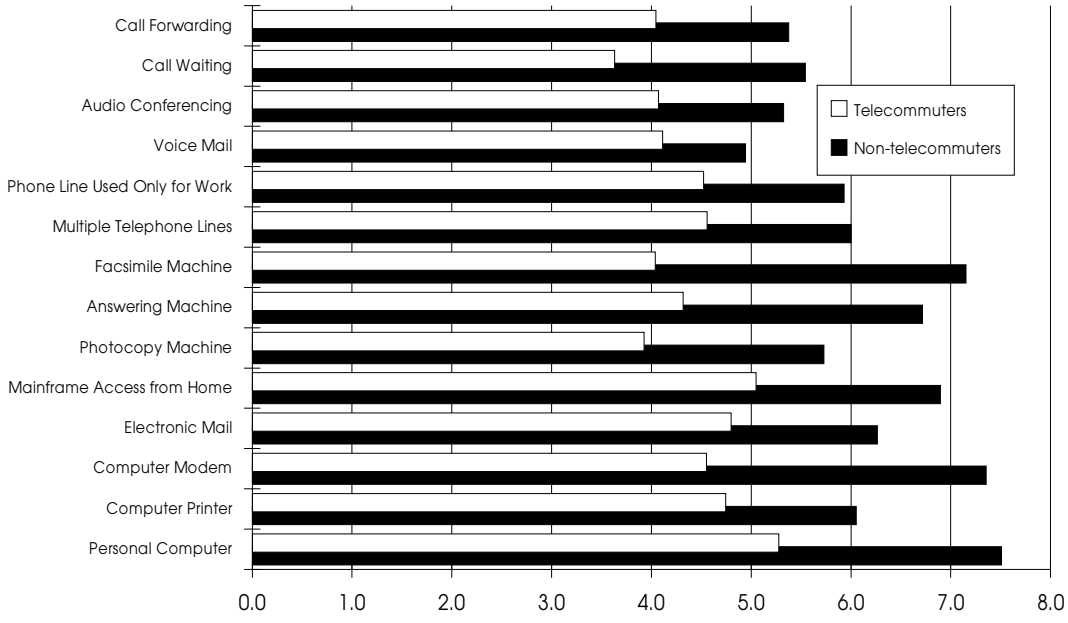
applicants to the project.

Table 8: Average Answers to:
How Much Easier Does This Technology Make Your Work?
(from 1 = No Effect to 5 = Very Great Effect)

Type of Technology	Telecommuters	Non-telecommuters
Personal Computer	4.3	4.4
Computer Printer	3.9	4.0
Computer Modem	3.0	3.5
Electronic Mail	2.3	2.6
Mainframe Access from Home	2.8	3.2
Photocopy Machine	2.7	3.0
Answering Machine	2.9	3.3
Facsimile Machine	3.2	3.5
Multiple Telephone Lines	2.5	2.7
Phone Line Used *Only* for Work	2.3	2.7
Voice Mail	2.2	2.4
Audio Conferencing	2.3	2.4
Call Waiting	2.4	2.6
Call Forwarding	2.2	2.1

One possible explanation for this disparity in computer ownership between telecommuters and members of the control group is that many of the telecommuters may have been on the verge of buying personal computers and their acceptance into the project triggered the purchase. Another possibility is that the internal departmental selection decisions were biased against prospective participants who did not own computers. As to the disparity in computer ownership between original applicants to the project and the members of the control group, it is possible that, since the project began, another 10% of City employees have purchased their own personal computers.

Figure 5: Power to increase Telecommuting (average days per month)



We also asked the participants how much *easier* various technologies made their work. Table 8 shows the results to date. It is clear that personal computers (with printers) and answering machines are key technologies for both groups. Interestingly, the non-telecommuters seem to prize technology slightly more than do the telecommuters. Figure 4 shows the same relationships in graphical form.

In addition to the questions on the general power of each of these technologies, we asked the participants to estimate what effect the availability of the technologies might have on their ability to telecommute. Figure 5 shows those estimates, given as the average additional telecommuting days per months made possible by the technology. Note that, for both of these questions, the non-telecommuters gave higher average estimates than did the telecommuters. This is particularly striking for the estimates of the ability of the technologies to increase the amount of telecommuting. Apparently, the telecommuters have a less optimistic (although still very positive) view of the ability of technology to increase the amount of telecommuting they do. In both cases, if all the estimates were added together they would total more days per month than are available.[22] Therefore, the estimates must be taken with a grain or two of salt. In either case, the highest ranked technologies are personal computers, their peripherals, and multiple telecommunications lines.

[22]More than double the available days for the telecommuters, triple that available days for the non-telecommuters.

Table 9: Perceived Availability of Various Technologies

Technology	Percent Availability	
	Telecommuters	Non-Telecommuters
Full-Motion Teleconferencing	2.7	0.0
Slow-Scan Teleconferencing	2.7	1.3
Computer Conferencing	9.5	18.2
Voice Mail	11.4	7.8
Cellular Phone	17.6	11.7
Outside Database Searching	22.6	13.2
Electronic Paging	25.9	14.3
Electronic Mail	26.2	32.5
Call Forwarding	31.8	36.8
Phone Conferencing	55.6	63.9
Express Mail	63.5	61.8
Database Development	64.4	66.7
Computer Graphics	65.8	65.8
Spreadsheet Analysis	66.4	72.4
Text Processing	67.3	62.3
Facsimile	73.6	77.9
Internal Mail	73.8	77.9
Specialized Computer Programs	78.1	74.0
Answering Machines	79.9	61.0
Regular Mail	85.1	81.8
Personal Computing	86.3	85.5
Meetings	96.1	87.0
Face-to-Face Conversation	96.8	94.8
Telephone	100.0	100.0

Use At Work

We also tested the relative importance to the participants' work of a broad array of technologies. We included traditional "technologies" such as mail, meetings and face-to-face conversation, as well as a variety of electronic and computer technologies. Since many fairly exotic technologies are included in our survey, the first task is to see how available the technologies are to the City employees participating in the project. Table 9 shows the results, listed in decreasing order of perceived availability. Note that these results depict the employees' *perceptions* about whether the technology is available to them at the workplace. Their perceptions may differ from reality to some extent. In general, there is little difference between the telecommuters and non-telecommuters. Apparently, a few employees believe that neither face-to-face conversation nor meetings are available to them!

Table 10: Overall Importance or Leverage of Technologies to the Respondents

Technology	Telecommuters	Non-Telecommuters
Full-Motion Teleconferencing	4.75	0.00
Slow-Scan Teleconferencing	2.50	3.00
Computer Conferencing	3.50	2.00
Voice Mail	7.00	9.83
Cellular Phone	6.96	10.25
Outside Database Searching	4.34	4.90
Electronic Paging	9.29	9.00
Electronic Mail	8.05	9.18
Call Forwarding	3.57	3.75
Phone Conferencing	3.58	2.78
Express Mail	2.64	2.58
Database Development	6.19	4.98
Computer Graphics	4.45	4.39
Spreadsheet Analysis	5.56	5.48
Text Processing	11.60	13.09
Facsimile	8.25	8.38
Internal Mail	11.78	12.58
Specialized Computer Programs	11.07	11.65
Answering Machines	9.66	11.35
Regular Mail	7.78	8.56
Personal Computing	14.52	13.84
Meetings	8.47	8.73
Face-to-Face Conversation	12.81	13.55
Telephone	16.71	17.47

We also asked the participants how often they used a particular technology and how important the technology was to performing their work. From these answers we derived a composite factor, we call *leverage,* that is a linear product of the other factors. Leverage values can range from 0 (meaning that the technology is either of no use or is not used) to 20 (meaning that the technology is used at least daily and is of immense importance to one's work).

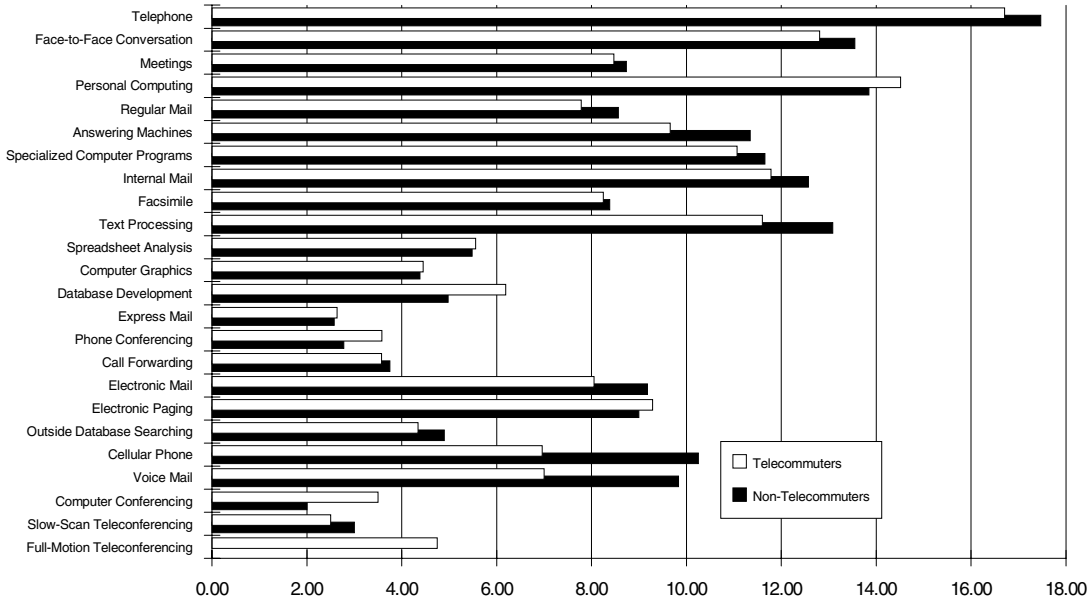
The leverage is computed only for those respondents who have the technology available to them. Therefore a technology that is not widely available can still appear as having high leverage if those few people who use it feel that it is important. Table 10 shows the rankings.

Although there are differences between the telecommuters and the members of the control group, none of the differences now appears to be statistically significant.[23]

It is noteworthy that personal computing ranks a close second in importance to the telephone for both groups, with text processing and internal mail alternating for fourth and fifth place. Although face-to-face conversation comes in third in both groups, it (and the telephone!) may be less important to the telecommuters than to the non-telecommuters. Figure 6 shows these results in graphical form. This leads us to conclude that personal computers, although not necessary for every job, have grown in importance for most City employees, whether or not they are telecommuters. Note that meetings occupy ninth place in importance for the telecommuters and twelfth place for the non-telecommuters.

[23]The idea of statistically significant differences between groups reflects two factors: size of each group and the differences in their means and variances. Two small groups, with a difference in means comparable to, or larger than, that of a pair of larger groups, may not show that difference as being statistically significant because the expected variance of a smaller group is higher. There were statistically significant differences between the two groups in the baseline and mid-term surveys.

Figure 6: Relative Leverages of Various Technologies



Voice mail, although not perceived as available to many participants, ranks higher than some of the computer capabilities in its leverage. On the other hand, some of the often touted "musts" for widespread telecommuting, such as computer, video and telephone conferencing, score near the bottom of the leverage scale. Full motion video conferencing is the most important of the three for those telecommuters who are aware of it or who have used it. However, most City employees are unfamiliar with either of these teleconferencing technologies.

One interesting relationship that shows up in the non-telecommuter group is the growing importance of electronic mail (computer-based messaging) to telecommuters. In our baseline survey, the non-telecommuters felt that electronic mail was significantly more important, by almost a factor of five, than did the telecommuters. By the mid-term survey, the ratio of perceived importance had diminished to 1.5. It slipped to 1.1 by the final survey. The difference between the two groups was statistically significant at the 0.0002 level[24] for the baseline survey, but was significant only at the 0.0994 and 0.6117 levels in the mid-term and final surveys, respectively. In our opinion this, reflects considerable convergence in attitude of the two groups as they increased in size and diversity, and in knowledge and

[24]That is, the probability is 0.0002 that the difference between the two groups is meaningless. To put it another way: the odds are 4999 to 1 against the difference being meaningless. By the mid-term survey, the odds against the difference being meaningless were reduced to 9 to 1. By the final survey, the odds had fallen to 0.6 to 1.

experience of electronic mail. We repeat our baseline forecast that electronic mail grows to be of comparable importance to the telecommuters as, and if, they gain experience with it.

Personal Investments

Ninety-six (62%) of the 156 telecommuters who responded to the final survey had made some sort of investment in work-related hardware and/or software during the past year. Of these investors, the average spent $2200 in computer hardware, of which $1800 was specifically for telecommuting. Software purchases accounted for $552, on average, of which $338 was telecommuting-specific. Maintenance costs accounted for $161 and $76, respectively; furniture costs averaged $385 and $253; and office machines took $775 and $353, respectively. Extra telephone services averaged $118, of which $88 was telecommuting-specific for 27 of the telecommuters. Total investments ranged from $5 to almost $15,000, with an average of just over $1400. Telecommuting-specific investments ranged from $10 to almost $8500, with an average of $668.

Part 2: Potential Impacts

The fundamental goal of the project was to demonstrate a method for reducing traffic congestion and improving air quality. That goal has been met. The next question is: what could be the long term impacts of telecommuting?

Impacts Explored

We have examined these issues at both the local —City of Los Angeles government — and regional levels. The examination included economic and energy issues as well as the air quality and traffic impacts. As part of the area-wide investigation we have developed a set of forecasts of the range of impacts likely to be produced by the expansion of telecommuting in the Los Angeles Consolidated Metropolitan Statistical Area (CMSA) comprising Los Angeles, Orange, Riverside, San Bernardino and Ventura counties.

City Employees Impact Assumptions

The group of City employees most likely to be directly affected by telecommuting comprises the 15,934 we have identified as prospective telecommuters. Telecommuting will indirectly affect all 45,000+ City employees. One key question is: although we have identified almost 16,000 City jobs that are likely to be telecommutable, how many will really work out to be so in practice?

To help assess that issue, we repeatedly asked the participants in the project — both telecommuters and telemanagers — to estimate how many of their co-workers could reasonably be expected to telecommute under the technology and work rule conditions of the project (that is, largely home-based telecommuting with do-it-yourself computer support). The requests were made both informally, during the focus group sessions, and formally, during the final questionnaire round.

The informal responses by the supervisors, in a group setting, tended to run around 50%. These estimates were strengthened by the formal questionnaires, in which the average response was also 50%, with the upper quartile starting at 75%. The telecommuters informal and formal responses also tended to match, although the telecommuters' estimates were higher: about 60% as the average reply, but with 42% of the telecommuters saying (in the final questionnaire) that almost all of their colleagues could telecommute at least two days per month.

In the following set of estimates we are assuming that *all* of the identified job classifications are telecommutable, either from home or from a satellite telework center. These estimates are based on the nature of the work required for each particular classification.

However, even if the job allows it, individual characteristics and desires may preclude telecommuting for some people. Therefore, we also assumed that there will be individual differences in telecommuting rates — including some individuals who will not telecommute at all. The latter group may be as high as 50% for some job types. The telecommuting rates used for the estimates are thus composite rates, based on the combined assumptions that some people will not telecommute at all; others will only telecommute from satellite centers; still others will only telecommute from home; some will do both.

The only way to estimate the City (or the regional) impacts more accurately is to continue evaluation of the experiences of an expanding number and types of telecommuters. Meanwhile, most of the estimates below for City employees are made for the assumption that most telecommuting will be from home or will be to telework centers that are close enough to home so that the telecommuters will not drive their cars to the centers. This situation may take several years to develop. Hence the estimates should be considered as goals to be reached by the year 2000, rather than immediate objectives.

Regional Impact Assumptions

The following scenarios for the impact of telecommuting on the Los Angeles CMSA are all based on a common set of assumptions about the basic population of the area and size of the work force. Table 11 shows the basic set.

These figures are derived from census data, our own surveys[25] and analyses of the composition of the work force.

[25]Surveys of State of California and City of Los Angeles information employees.

All of this is incorporated in a mathematical model that was originally developed by JALA in the late 1970's and has been refined several times since. The model includes more than 25 independent variables, describing the many factors associated with the changes in acceptance of telecommuting.

Each of these factors can change in value from year to year. For example, the fraction of the total work force that comprises information workers slowly increases over the 1992 to 2030 period. So, too, do the commuter modal selections; distribution of passengers between single occupant cars and higher occupancy vehicles; energy efficiencies of the vehicles; and the various factors in telecommuting (distribution between full-time home-based to full-time telework center-based; average hours per week telecommuting; full-commute and telework center commute distances).

Table 11: Los Angeles CMSA Impact Assumptions

Total population:	15,187,000
Population annual growth rate	2.346%
Total area work force:	6,828,000
Total information workers:	3,988,000
Commuters	6,691,000
Commuters using private vehicles (including car/van pools):	90.4%
Commuters using mass transit:	8.6%
Average information worker daily commute (round-trip miles):	39

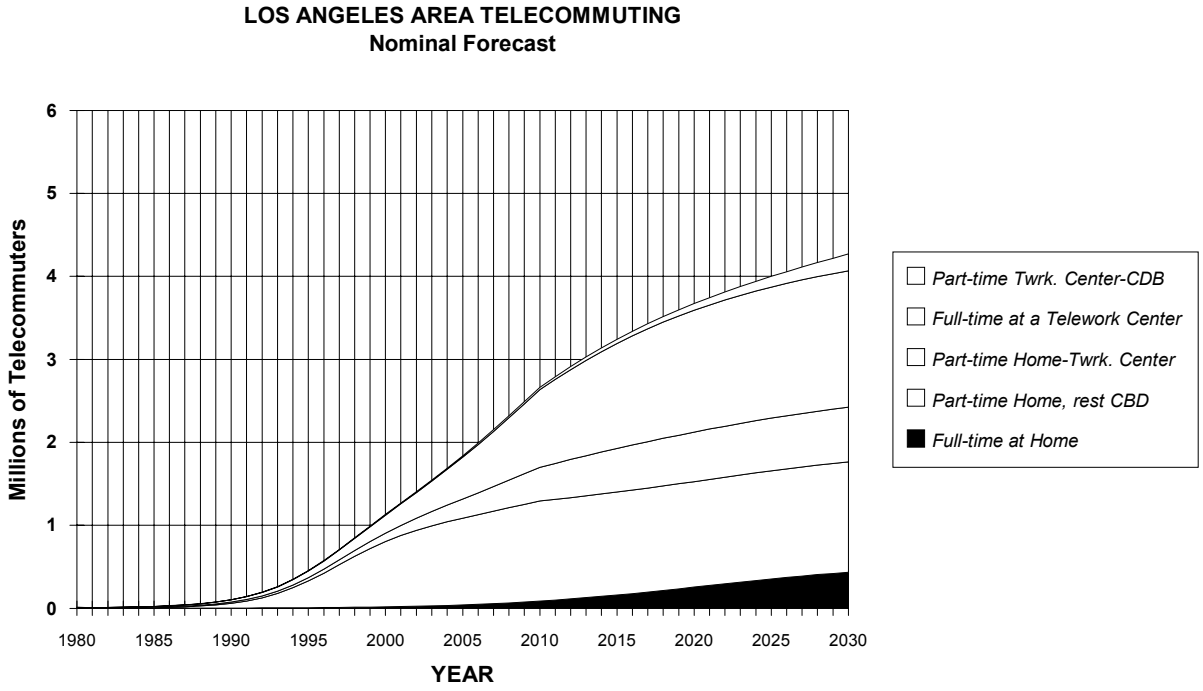
Both of the scenarios include several independent trend estimates. For example, automobile fuel efficiency is assumed to increase at a rate comparable to EPA total fleet standards. The number of telecommuting hours per week increases with time. The average distance to telework centers decreases as the assumed number of center increases. Nevertheless, as population grows, so does traffic congestion (and commute times) together with average commute distance.

Baseline Scenario

Figure 7 shows the distribution in the five major variants of telecommuting for the nominal model.

This scenario estimates that the five-county area has 194,000 telecommuters of all sorts by the end of 1992. Most of these (144,000) work part time at home, typically less than 1.25 days per week. The rest either work full-time at home (about 5,000) or at a regional center of some sort. When one considers that the governments of the City and County of Los Angeles jointly have more than 2,000 known telecommuters, and that the area total includes university professors, writers, etc., this seems to be a reasonable figure.

Figure 7: Nominal Telecommuting Forecast.



One of the problems with estimating the real extent of an innovation at an early stage is that of counting what is a sparse population component; 1.3% of the population in this case. As the number of telecommuters grows, and particularly as the number of formal telecommuting programs increases among area employers, it will be easier to get more exact numbers of the actual growth.

High Growth Scenario

The high growth scenario assumes that the "normal" rate of growth of telecommuting is boosted by a combination of regulatory and competitive pressures, improvements in technology and consequent attitude changes on the part of potential adopters. Figure 8 shows the results of that analysis.

Table 12: Growth Limits by Form of Telecommuting

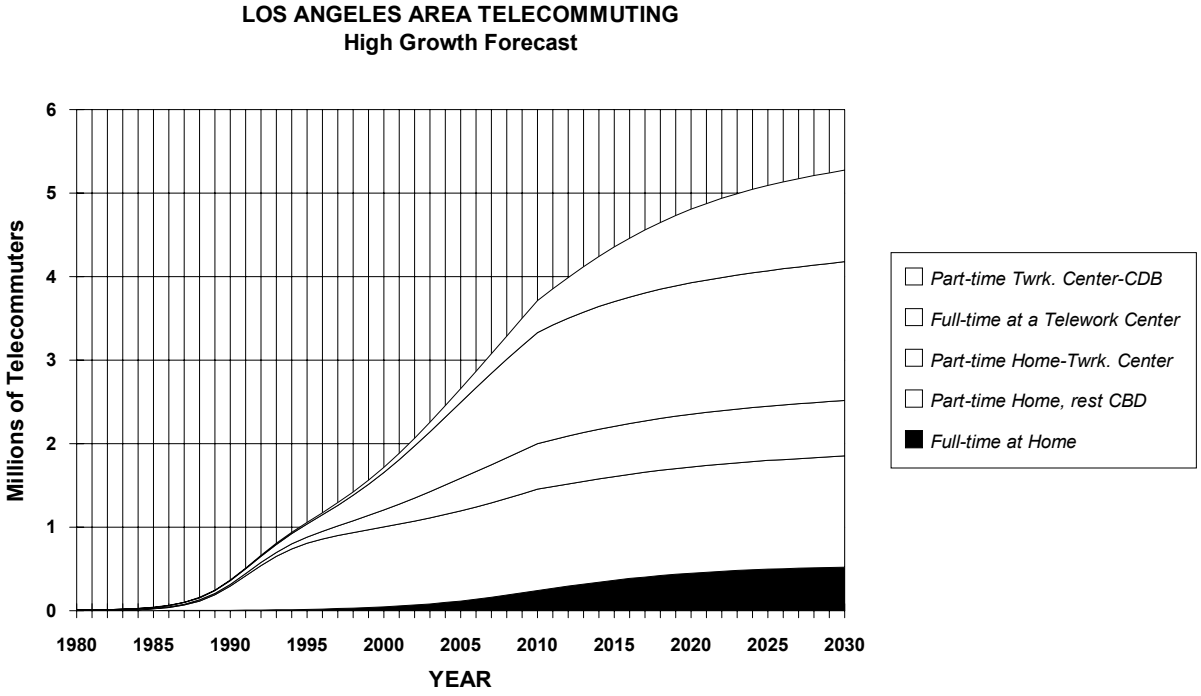
Type of Telecommuting	Maximum % of Infoworkers
Full-time home	8
Part-time home/CBD	20
Part-time home/LC	10
Part-time LC/CBD	17
Full-time local center	25

As a check to the validity of the scenario, the 1992 State of the Commute report from CTS reports that 9.1% of its survey respondents claimed that they worked at home an average of four days per month. This amounts to 619,000 home-based telecommuters in the region. The High Growth

Scenario of Figure 8 gives a value of 663,000 telecommuters of all types for 1992, comparable to the CTS estimate. If the CTS survey is correct, the region is at present near the high growth scenario.

Both scenarios have the same assumptions as to the ultimate limits of telecommuting. That is, both assume that telecommuting will peak at 80% of the information workforce, sometime in the mid-21st century. The scenarios also include the same assumptions about the distribution of modes of telecommuting. Table 12 shows the assumptions. The term *CBD* in the table refers to Central Business

Figure 8: High Growth Scenario



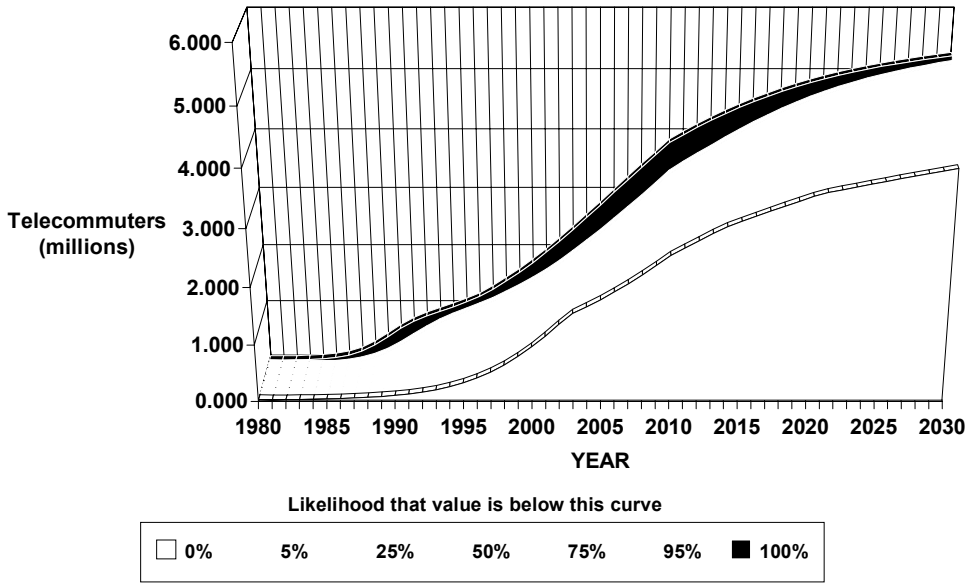
District. In this context it simply means the "traditional" office center where the telecommuter would be working otherwise. Similarly, *LC* refers to any one of the forms of regional telework center mentioned earlier. Both scenarios also assume a decreasing distance to the local center over the years, as the number of centers increases.

The Scenario Spectrum

These nominal and high growth scenarios generally cover the upper and lower limits of telecommuting in the region, as estimated by our demographic and economic analyses. Neither of these scenarios will actually unfold exactly as shown here. Reality is always different from long term forecasts.

To get an idea of the range of possibilities we performed what is known as a Monte Carlo analysis of the scenarios. For this process, we estimated the likelihood of the various rates of growth of each of the five types of telecommuting, providing a probability distribution function for each. We then ran 1000 scenarios, each time with a different combination of growth rate assumptions, as governed by the probability distributions.

Figure 9: Likelihood Distribution of Telecommuting Scenarios



The results of that analysis are shown in Figure 9. The graph shows the range in expected value of the total number of telecommuters for each of the years from 1980 to 2030. The lowest (0%) curve represents the minimum number of area telecommuters that we expect to see, while the top (100%) curve represents the maximum number we expect to see. the intermediate curves represent the probabilities that reality will be at or below that curve. The CTS survey value of 619,000 telecommuters for 1992 is at about the 85% likelihood point of the analysis. This, too, supports the conclusion that we are presently nearest to the high growth scenario.

Traffic Congestion and Air Quality

City Employees

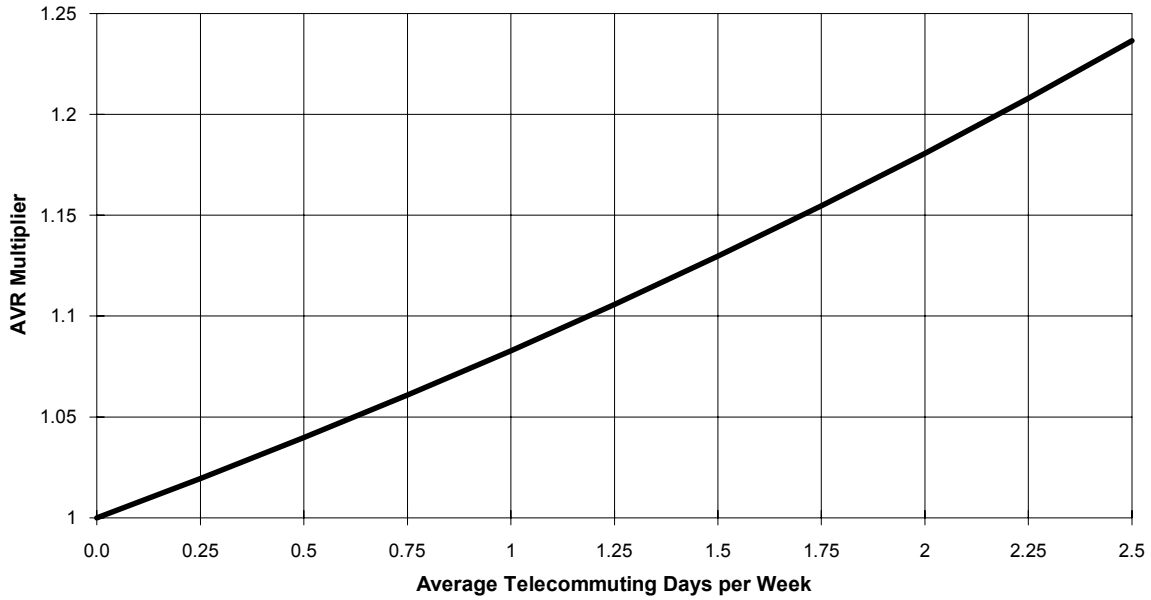
The City of Los Angeles has 49 sites that are subject to the requirements of Regulation XV. By far the most populous of these are in the Civic Center. Therefore our analysis has been made under the simplifying assumption that all of the

City's employees work in the Civic Center. Distances of a few blocks between sites have no appreciable effect on the results. The department-level computer model, developed as part of this project task, can be used to get more accurate estimates.

For purposes of the analysis, we assumed that City employee still have the ridesharing behavior evidenced by a survey completed by the City Administrative Office in 1991. In that survey, 29% of City employees were on compressed work schedules. Our analysis assumes that the 29% figure continues to hold and that the distribution of types of compressed schedules matches that of the final evaluation survey of the Telecommuting Project; that is, 91% using 9-80 and 7% using the 4-10 schedule.

If the City continues its pattern of ridesharing and compressed schedules, then what is the impact of telecommuting? The City has 49 facilities that are subject to the rules of Regulation XV. These are scattered throughout the City, but the primary concentrations of City employees are in or near the Los Angeles or the Van Nuys Civic Centers. The target Average Vehicle Ridership (AVR) rates for City facilities are either 1.5 or 1.75, with the 1.75s primarily in the Los Angeles Civic Center region.

Figure 10: Telecommuting AVR Multiplier Factor for the City

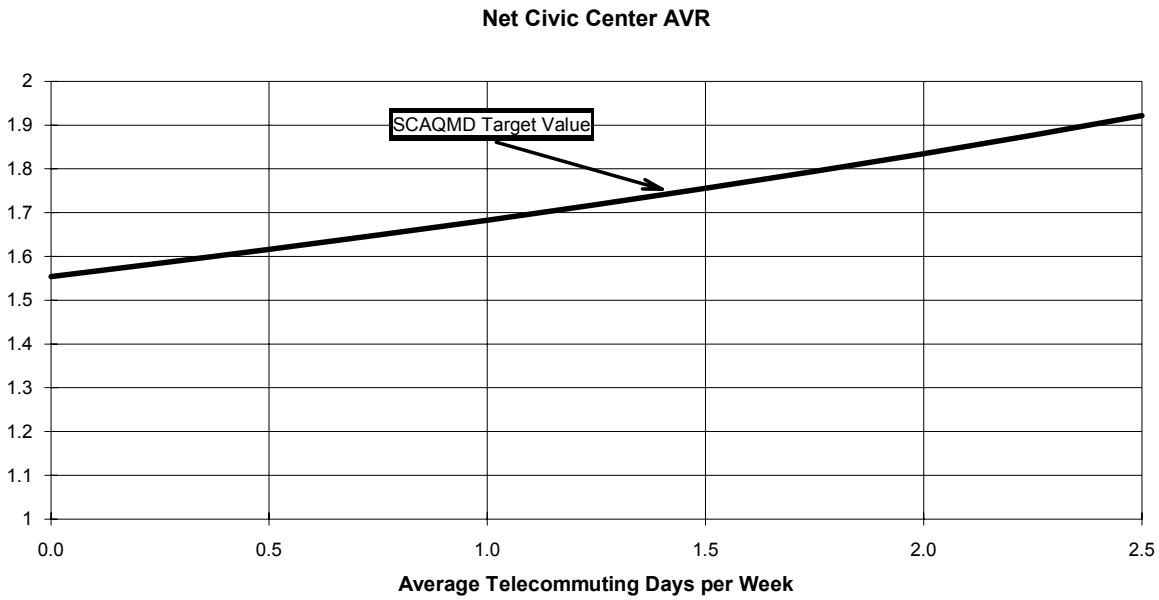


Our analysis indicates the impact of telecommuting on AVR by means of an AVR multiplication factor that is a function of the average level of telecommuting among its 15,934 potential telecommuters. If none of these employees telecommute, the multiplication factor is 1.0; that is, no effect (since 1.0 × the current AVR = the current AVR). If all of them were to telecommute 5 days per week — an

extremely unlikely situation, then the multiplication factor would increase by more than 60%. Figure 10 shows the relationship, with average telecommuting days per week ranging from 0 to 2.5.

Since the Civic Center area provides the most stringent case of the AVR target we can ask what amount of telecommuting would be required to increase the AVR from its 1992 level of 1.554 to the target level of 1.75. Figure 11 shows the relationships of Figure 10 applied to the current Civic Center AVR. As can be seen from the Figure, the AVR target would be met, without any other AVR-related changes, if the average level of telecommuting were increased to about 1.4 days per week. This is quite an attainable figure. Our analysis of City employee jobs gives an estimated average of 1.46 telecommuting days per week.

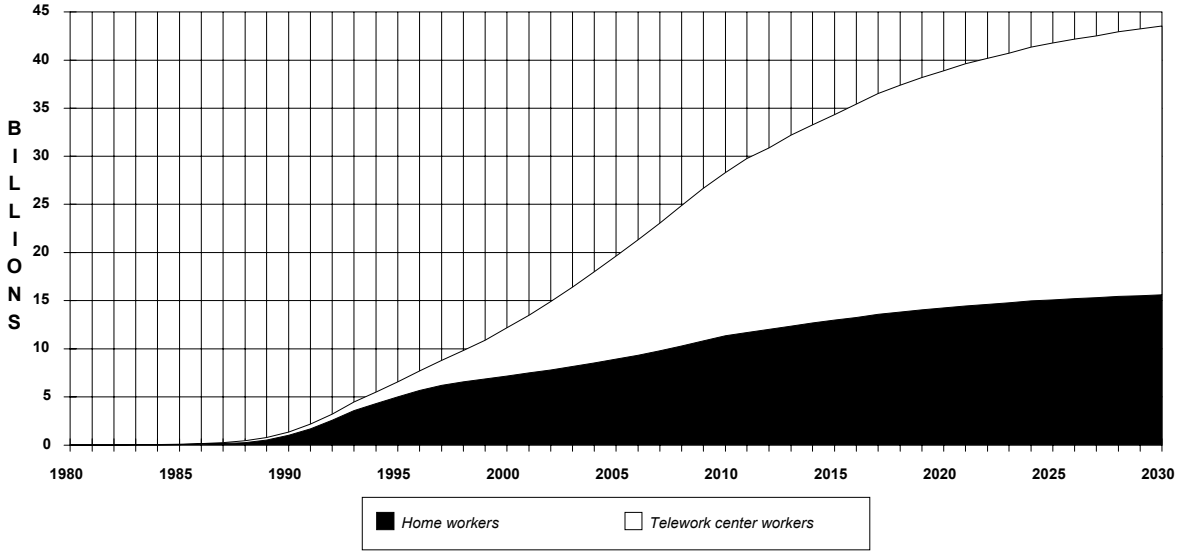
Figure 11: Telecommuting impacts on the Civic Center AVR



Note that, in this general model, we have assumed that the distribution of job types and commuting behaviors is the same at all City facilities. Of course, this is not the case; each facility has its own particular mix of jobs and commuting behaviors. The relationships of Figure 10 are to be used for estimation purposes only. For example, the achieved AVR at the Van Nuys Civic Center in 1992 was 1.107. Its AVR target is 1.5. The ratio of 1.5 to 1.107 is 1.355. From Figure 10 we see that a multiplication factor of 1.355 is off the scale. Actually, it would require an average of about 3.3 days per week telecommuting to meet the goal if no other changes occurred — and if the population distribution at the Van Nuys Civic Center matched that of City employees in general. This is more than double the requirement at the Los Angeles Civic Center and more

than double our, admittedly conservative, estimate of what can be expected from City employees in the next three or four years. If the model is applicable, it is clear that telecommuting alone cannot solve all the air quality improvement requirements; some combination of telecommuting, additional ridesharing and compressed work weeks seems to be required.

Figure 12: Annual Mileage Reductions from Telecommuting: High Growth Scenario



In any case, if the City were to have its 15,934 telecommuters working from home an average of 1.4 days per week, then the annual pollution reduction would be on the order of:

- 6,150,000 pounds of carbon monoxide;
- 380,000 pounds of nitrogen oxides;
- 1,150,000 pounds of unburned hydrocarbons; and
- 26,000 pounds of particulates.

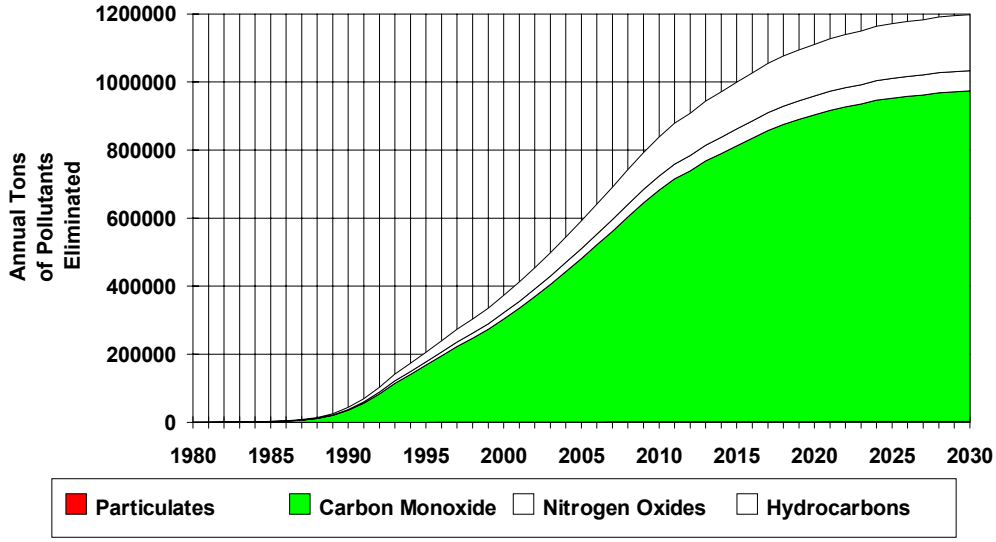
Area-Wide

Figure 12 shows the annual levels of reduced car mileage for the Los Angeles CMSA under the high growth scenario.

Since at least half of this mileage reduction involves automobile cold starts — the most polluting phase of car use — telecommuting promises to be a significant reducer of air pollution in coming years. Figure 13 shows the results for the high growth scenario. Since the pollution reduction data were calculated using a constant ratio of pollutants per vehicle-mile, the results are somewhat understated for the 1990s and, perhaps, overstated for the years past 2000. The early understatement is because the data used were for highway travel in the mid-1980s and did not include an increase in pollution for the startup and idling periods. An overstatement could result from a steady improvement, over the mid-1980s levels, in the quantity of pollutants emitted by cars.

For comparison, air pollution data from the South Coast Air Quality Management District show the annual pollution contribution from cars in 1991 to be 1,580,000 tons of carbon monoxide; 221,000 tons of hydrocarbons; 243,000 tons of nitrogen oxides; and 20,000 tons of particulates. If the high growth telecommuting scenario continues, we could expect a reduction by the year 2000 of 19%; 23%; 8%; and 4%, respectively, from present levels.

Figure 13: Air Pollution Reductions from Telecommuting: High Growth Scenario



Clearly, these air pollution reduction values provide a persuasive argument for further development of telecommuting. In addition to the air pollution factors, there are the energy conservation consequences of telecommuting. Our forecast model calculates the net effect of telecommuting on energy conservation. The net effect is derived from the reduction in automobile fuel use by telecommuters, combined with the possibly increased use of computers and the clearly increased use of telecommunications.

Economic Competitiveness

The key effects of pollution reduction, although the primary incentive for the City of Los Angeles Telecommuting Project, may be eclipsed by the economic impacts of telecommuting. The telecommuter effectiveness increase values we have obtained from the project can be considered typical of those in large organizations. In fact, we have tried to be conservative in every case. Therefore, these results may be generalized to the region as a whole without fear of overestimation, in our opinion.

Employee Effectiveness Changes

We estimated the likely change in work effectiveness that telecommuting would produce for each of the City telecommuting-appropriate job classifications.[26] As in the case of the estimates for the *amount* of telecommuting for a particular classification, the *effectiveness change* estimates are made on a combination of experience gained in the City of Los Angeles Telecommuting Project and from similar projects elsewhere.

The changes are expressed both as an average expected effectiveness improvement and as a total dollar impact for each evaluated classification, using 1992 salaries as the basis. The overall average estimated effectiveness change is 10.7%. **If all of these telecommuters were to perform exactly according to the estimates, the net result would be an annual effectiveness impact of $75,794,175** (constant 1992 dollars) or more than $93 million by 1998, assuming average salary escalation of 4.3%.

Whether, and in what form, these impacts would be realized is beyond the scope of this project since it involves a number of key management issues. Foremost among them is the ability of an organizational unit to assimilate the improvements. That is, does an individual's effectiveness increase translate directly into a comparable increase in the effectiveness of the organization in which the individual works — is the effectiveness change used properly? If so, there are two classical first-order options for the organization:

1. Increase the level of services provided by the unit without increasing the number of personnel in the unit. A variant of this is the diversion of expansion funding to technology improvements (such as computers, networks, telecommunications and/or peripheral equipment) rather than to salaries for more employees.

2. Decrease the number of personnel in the unit without changing the level of services. The current euphemism for this is downsizing.

Each of these options must be examined very carefully as part of the management response to the impacts of telecommuting. However, for many of the units we observed during the project, the most logical option is the first; at least some of these units are currently severely

[26]For details, see the *Department Impact Modeling Report*.

overloaded and telecommuting is allowing them to function at the desired level with their existing staffing.

However the effectiveness impacts are applied, the economic arguments for telecommuting seem quite powerful.

Net City Economic Benefits

Employee effectiveness increases are not the only impacts of telecommuting. There are additional savings in office and parking space, reduced turnover rates and decreased use of sick leave. We have evaluated these total impacts in a series of three alternative scenarios:

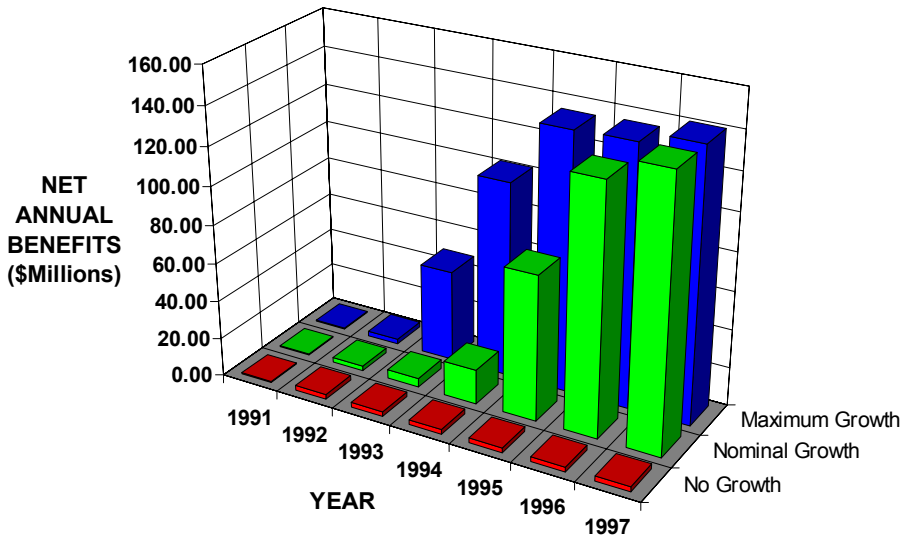
- In the first scenario, the use of telecommuting by the City remains at its current level.
- The second scenario shows a steady growth, beginning in 1993, to the maximum expected number of 15,934 City telecommuters.
- The third scenario shows a more rapid growth rate to the maximum.

The analysis includes estimates of the costs of training and technology improvements required to produce the growth. The net benefits to the City are shown in Figure 14.

Area-Wide

The City of Los Angeles Telecommuting Project and all other well-conceived and organized telecommuting activities show a consistent common economic result: the effectiveness of telecommuters is higher than that of non-telecommuters. Our measures indicate an improvement on the order of 9.3% for the entire group of prospective City telecommuters. Our experience with other organizations in California, both public and private, lead us to expect some

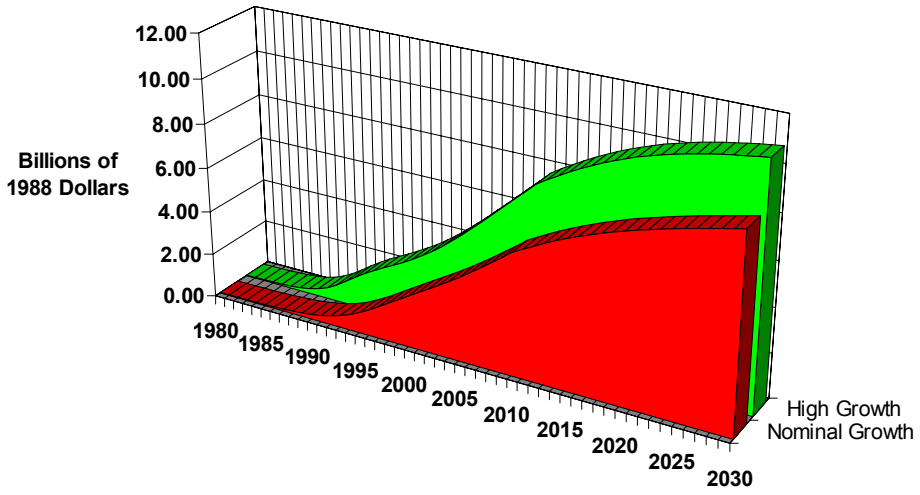
Figure 14: Net Telecommuting Benefits to the City



organizations' averages to be as much as double the City of Los Angeles values. Nevertheless, if we take the conservative approach and use the City's effectiveness changes as typical of the region, then the direct of effect of telecommuting in the area could be as shown in Figure 15.

The direct economic impact of the effectiveness changes in the year 2000 ranges from at least 2.3 billion to as much as 3.5 billion dollars annually, depending on the scenario the future most resembles. These figures are in constant, 1988 dollars and are based on the area's 1988 per capita salary income. Since information workers — or at least those who are likely to be telecommuters — are more likely to have higher than average salaries, the information in Figure 15 are likely to be doubly understated.

Figure 15: Area-Wide Effectiveness Change Impact of Telecommuting



In addition to the direct effect of telecommuting, the indirect impacts must also be considered. At the microeconomics level, if organizational effectiveness improves, so does the organization's profitability. The organization is better able to compete, both by reducing the costs of its existing goods and/or services and by offering new goods and/or services. Both of these goals are achieved by reducing the person-hours required to produce a unit of output (in these cases, units of information). If the organization is in an expanding market, the newly released person-hours can be used to increase or improve product.

At the macroeconomics level, widespread improvements in competitiveness of individual organizations act to increase economic growth in the region in general. Thus, the overall impact is likely to be some multiple of the direct impacts

shown in the figure. We estimate that the actual impacts could be as high as five times the values shown in Figure 15. That is, in the year 2000, telecommuting could be associated with a 10 billion dollar improvement in the region's economy, compared to what it might be with no telecommuting.

Finally, it is important to consider another, potentially major, "side effect" of telecommuting: its ability to bring work to workers who cannot easily go to a traditional workplace. The 1992 riots demonstrated the consequences of a long standing economic dysfunction in Los Angeles: no jobs for a large component of the population. Among the plethora of rationalizations about the fundamental causes of the riots there is one constant: many people feel that they are trapped in a dead end existence. They feel that they have no access to, or hope of, means to improve their condition. Frustration, rage and eventual destruction are the natural consequences of that situation. What to do?

Telecommuting provides one approach to resolution of that problem. First, work can be sent to any residents who are mobility handicapped, either because of physical impairments or the lack of adequate transportation. Second, work can be combined with training (or vice versa), so that worker skills, from basic reading ability to more complex information skills, can be upgraded while the trainees are working. The information tools to accomplish this are here today and are growing in capability daily.

One strategy to develop this capability is through the development of neighborhood business centers that combine "regular" small business operations with telework/training centers.[27] This would promote a system of positive cash flow into the community from the inception of the center(s). Variants of this model have shown themselves to be successful both elsewhere in California and in Europe. As a first step, the Los Angeles County Transportation Commission has plans to initiate one or more centers in South Central Los Angeles in conjunction with its Blue Line stations. Each center would be linked to others via the fiber optics transmission system that is a part of the light rail network.

It is difficult to put a figure on the value of such centers. One success criterion would be that they are at least self supporting and turn out employees who are qualified to work in skilled jobs. If that is the case, then there is a clear economic benefit. If the local economy improves as a direct

[27]The author, in concert with CHARO, attempted to initiate such a center in East Los Angeles in the mid-1980s, but an impasse with a large corporation, regarding facilities sharing, stifled the project.

result of such activities, then the overall benefit can be substantial.

Over 800,000 Americans information workers are disabled every year. Although we were not able to get exact figures, presumably about 42,000 of those newly disabled information workers live in the five counties area. Some fraction of those workers are perfectly able to do useful work, provided the work can come to them at least some of the time. Each worker who returns to the work force instead of receiving benefit income makes a double contribution to the economy. If telecommuting could produce a 10% reduction in the number of newly disabled individuals who were otherwise able to work, then the additional annual impact could be on the order of 200 million dollars.

Energy Use

Like the traffic, pollution and economic impact aspects, the experience of the City's Telecommuting Project in energy conservation can be generalized to both the rest of the City employees and to the region as a whole.

City Employees

Our forecast of the overall energy conservation impacts is based on an analysis of the commuting patterns of all City employees. This estimate is derived from data supplied from the Department of Transportation as a result of their 1990 survey of City employees. Although commute distances were not included in the survey, we were able to estimate them for about 18,000 of the 30,500 employees in the survey[28] on the basis of the ZIP codes for each employee's home and office. The average estimated one-way commute distance for these employees was19.8 miles, slightly less than that of the telecommuters in the project.

We also assumed that future telecommuters would have the same pattern of compressed schedules as were revealed in a survey conducted by the City Administrative Office in 1991. This produces an average effective work week of 4.84 days. The telecommuting rate was assumed to be an average of 1.4 days per week; sufficient to meet the Civic Center AVR requirements.

The calculations produced an average annual energy saving of 4198 kilowatt-hours per telecommuter, for a total annual saving, assuming all 15,934 telecommuters are active, of 59.9 million kilowatt-hours, about 1,600,000 gallons of gasoline.

Area-Wide

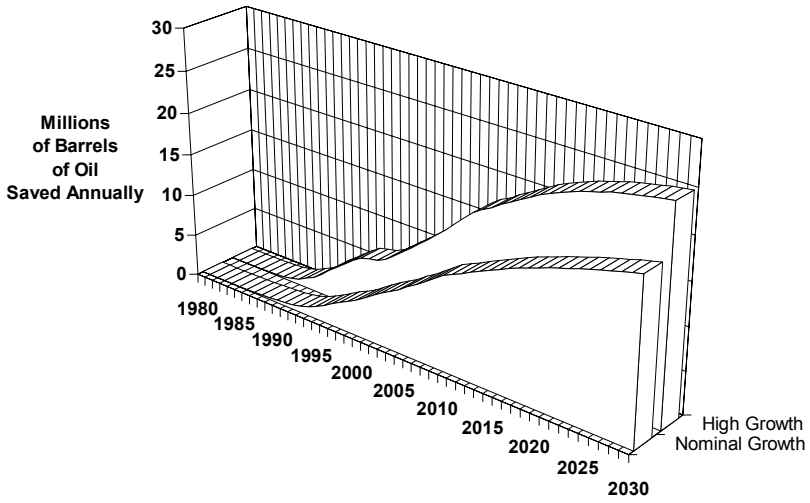
Our forecast model calculates the net effect of telecommuting on energy conservation. The net effect is derived from the reduction in automobile fuel use by

[28]The reamaining employee entries in the database either had missing or faulty entries for one or more of the ZIP codess.

telecommuters, partially offset by the possibly increased use of computers and the clearly increased use of telecommunications.

Two factors are not included in the model. First, notwithstanding the contrary experience of the City project, we expect that telecommuters will tend to use slightly more home heating and cooling energy while they are

Figure 16: Estimated Area-Wide Energy Conservation Impacts of Telecommuting.



telecommuting. At present, there are no data to show an offset of this energy use by a comparable reduction in the heating and cooling of the "downtown" offices of the telecommuters — largely because there are not yet enough telecommuters for the effects to be noticeable. The model assume a wash between these two energy uses in the long run.

Second, the model does not include our finding that about 20% of telecommuter households have a reduction in car use over and above the telecommuting-specific reduction.[29] Given these caveats, we feel that the projections shown in Figure 16 provide a conservative estimate of telecommuting's energy impacts.

Neighborhoods and Regional Structure

One of the perceptions about most large cities is that their citizens suffer/enjoy a large degree of isolation. This is particularly true of so-called bedroom communities, where a large fraction of the resident population travels to somewhere else for nine or more hours every weekday. By

[29]See our report: *Telecommuting Travel Impact Analysis: Los Angeles Telecommuting Pilot Project* for details.

some quirk of Murphy's Law it often appears that people who live on the west side of Los Angeles (or insert the name of any other city in the region) drive to work on the east side . . . and vice versa and so on.

One of the aspects of moving the work to the workers instead of moving the workers to work is that the workers are not doing the locale swap as often; they are spending more time in the areas in which they reside. Our research and that of others indicates that telecommuters, when they do travel to other than their principal offices, are more likely to make trips to nearby locations than are non-telecommuters. That is, the telecommuters are becoming more locally or community oriented. This can have a number of interesting impacts. We have only preliminary data on these effects, since they are somewhat dependent on the number of telecommuters and many of the effects can take several years to develop.

First, if more people are around the neighborhood on ordinary week days, what is the effect on the crime rate? One possibility is that programs such as Neighborhood Watch may be more successful; there are more neighbors to watch. If telecommuters, who are more likely than average to use electronic mail, start to set up neighborhood electronic alert networks, Neighborhood Watch takes on a new dimension. Yet, if telecommuters are busy concentrating on their work all the time, the effect may be negligible. Our experience is that telecommuters become more neighborhood aware even if they do not become more active in neighborhood activities.

Second, if telecommuters spend more time in the local area, they are more likely to do business with local businesses — at the expense of the businesses near their downtown offices. However, they are less likely to go out to lunch, so the lunch time restaurant business may show little change locally and a decrease at the downtown location. On the other hand, they may be more likely to go to a local restaurant for dinner — with the family.

The net result of this may be that neighborhoods with moderate to large numbers of telecommuters will become more cohesive: neighborhoods after the small, cohesive community style. This cohesion could further increase community emphasis on and participation in education and other activities usually identified with such well-functioning communities.

At the same time, the telecommuters are likely to maintain contacts with co-workers and friends who may be scattered all over the region, or all over the world, for that matter. Thus, they will have the advantages of essentially global job and interest/avocation diversity, while maintaining roots in a local community. While it is difficult to see clear

indications of this at this time, there are clues to the trends. The clues are appearing in such statistics as the growing difficulties employers are having in getting their employees to move to other locales[30], and the growing popularity of such computer-based information services as Prodigy™ and CompuServe™.

The desired effect of telecommuting is to help redress the jobs-housing imbalance. That is, to allow existing businesses and employees to be located where they are now without incurring the travel that currently occurs. There is a potential undesirable side effect of telecommuting: the telecommunications equivalent of the "freeway effect." That is, the mere existence of the ability to move to almost anywhere, while still being able to hold a properly paying job, may cause people to flock to new areas with lower housing costs — urban sprawl. To quote from an earlier publication:[31]

> The process as new highways are completed, for example, runs roughly as follows in regions of economic attractiveness:
>
> 1. The improved transportation infrastructure is a major inducement for businesses and households to move to areas that are both served by the infrastructure and have lower land prices. The goal in individual household move decisions is to achieve an attractive, affordable, generally low population density residence location.
>
> 2. The expanded movement to the newly developing area acts to increase land prices and congestion, increasing population density (and decreasing step 1 attractiveness) as population growth continues in the area.
>
> 3. The increasing congestion and improving tax base spur demand for further expansion of the transportation infrastructure either by increasing capacity, often at the expense of removal of local residences, or by extending the infrastructure to more rural areas, or both. Go to step 1.
>
> Continuing repetition of this cycle ultimately results in the wide scale suburbanization of the area and elimination of formerly rural areas. Often these areas were originally forested, agricultural or wildlife habitat land. Los Angeles is often cited as the archetypal example of this process.

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[30] As reported in such publications as *Business Week* and *The Wall Street Journal*. The employees do not want to break up their children's school work and friendships or, in the millions of multiple earner families, jeopardize their spouse's jobs.

[31] Jack M. Nilles. Telecommuting and urban sprawl: mitigator or inciter? *Transportation* **18**: 411-432, 1991

In the telecommuting case, the existence of a telecommunications infrastructure, which could be wireless, could result in the demand for an expanded transportation infrastructure and increasing conversion of rural land to housing and its related physical infrastructure. We have seen no evidence of this, but the possibilities must be considered in any comprehensive regional plan.

Part 3: Recommendations

The author makes the following recommendations to the City for addressing the issues raised in this report.

Immediate Action

The first three recommendations apply for all circumstances.

- **Increase the level of awareness of upper departmental management** concerning the impacts of telecommuting. This can begin with distribution of report summaries and/or high level briefings to all department General Managers. This was our recommendation after both rounds of focus group meetings and it continues to be because it is so critical to the success of telecommuting.
- **Maintain at least the current level of telecommuting and, at a minimum, begin expanding telecommuting** in those departments that already have active telecommuters.
- **Develop uniform telecommuting guidelines**. The project began with the development of a tentative set of guidelines that were provided to all departments as part of the training program. While they proved to be quite serviceable during the project, the guidelines often were interpreted differently by different departments. A revised set of guidelines would address the issues raised during the project. Appendix 1 provides a suggested set of rules.

Internal Implementation Priorities

The subsequent recommendations are made under the assumption that telecommuting will continue in the departments currently participating in the project.

Management

- **Integrate Transportation Demand Management Strategies**. Telecommuting has proven itself to be an

effective rideshare strategy. Promotion and expansion of telecommuting should be a formal part of an integrated strategy for managing the use of transportation by City employees.

- **Create Specific Incentives and Disincentives**. Although the project has been successful, it is abundantly clear that there is still significant resistance to telecommuting — not to mention downright hostility — on the part of many City managers. In addition to the expanded awareness program listed earlier, a system of incentives (recognition, factors in promotion/salary decisions, etc.) and disincentives (such as minimum telecommuting quotas) should be devised to overcome that resistance.
- **Expand Telecommuting**. The results of the project clearly indicate that the use of telecommuting should be expanded. Our analysis suggests that at least 15,934 City employees — one-third of the City's permanent staff — could successfully telecommute.
- **Increase and Expand Training**. It is also clear that training in the management methods of successful telecommuting is important to telecommuting's success. Both initial, pre-telecommuting training and follow-up reinforcement are called for. All of the City's telecommuters and telemanagers should receive training. Further, the training should include:
  1) managers who are not currently (but may become) direct supervisors of telecommuters; and
  2) colleagues of telecommuters.
- **Develop TeleService Program**. The City has already developed regional City Halls in Van Nuys and West Los Angeles. Telecommuting could be used to further distribute City services all over the City. This may be of particular importance in areas affected by the recent riots. Mini- or micro-City Halls could be developed, staffed by telecommuters living locally, to provide most City services to local residents.

Technology

- **Form a City-wide action committee, possibly as a subcommittee of the Telecommuting Task Force**, to define and resolve the issues of technology performance and reliability standards; technology needs and applicability for various types of telecommuting work; and ownership and financing possibilities.
- **Improve Access to Information Technology**. There is no question that access to personal computers is a major factor in improving effectiveness of City information workers, whether or not they are telecommuters. A number of telecommuting-trained

City employees were prevented from participating in the project because they didn't have personal computers at home or were unable to get access to the City's mainframe computer. Our focus group sessions and personal interviews indicated many cases where City employees have invested their own funds in computer equipment that is superior in performance to that in their principal office. It appears that the City is incurring major opportunity costs because of the freeze on computer equipment. It is extremely important that this issue be resolved soon.

- **Resolve the uncertainties about mainframe access** for those prospective, trained telecommuters who have not yet begun to telecommute[32]. This was our recommendation after each round of focus group meetings and continues to be because it still an outstanding issue.
- **Develop a uniform, City-wide policy**, possibly in conjunction with vendors, on duplication of applications software used by telecommuters at home.
- Although voice mail is now available (500 "mailboxes"), most telecommuters are not aware of it. **Broaden the awareness of, and access to, voice mail**, particularly for telecommuters.
- **Increase audio/telephone (and, where appropriate, video) teleconferencing capabilities and awareness** in each department as a means of increasing "attendance" at meetings without increasing travel for meetings.

Provide Area-wide Leadership.

There are many ways in which the City can show leadership in Southern California. The following are examples.

- **Publicize the results of the City of Los Angeles Telecommuting Project** to other cities and to area businesses.
- **Revise zoning ordinances** to encourage telecommuting (while discouraging potential urban sprawl made possible by telecommuting).
- **Cooperate with other Cities and public agencies to share facilities** for telecommuters so that public sector employees all over the region can begin telecommuting from offices near their homes.

[32]Only about half of the individuals trained by JALA were allowed to telecommute.

Part 4: A Brief Action Plan

Telecommuting Implementation Group

The planning phase and the first stages of implementation of the Telecommuting Pilot Project were initiated by the Telecommuting Task Force (TTF). The TTF comprised senior managers from several City departments. The purpose of the TTF was to provide general policy guidance to the project, but it was not closely linked to the details of the implementation. Nor was the TTF an advocate of telecommuting, other than to support its testing. It was deliberately neutral.

Assuming our recommendation for expansion of telecommuting is adopted, we further recommend that the first step in the expansion process is the appointment by the Mayor of a proactive Telecommuting Implementation Group (TIG) whose primary task is to ***motivate*** **and coordinate** the expansion process. This is a quite different mission from that of the TTF. The State of California formed a Telecommuting Advisory Group with a mission similar to that suggested here. The effectiveness of that group is demonstrated by the fact that the Governor decreed that telecommuting is a key work option for State employees and that the number of State telecommuters has more than quintupled since the Pilot Project was completed in mid-1990.

Members of the TIG should be senior managers from every department of the City that has, or is likely to have, active telecommuters. The TIG should also include representatives from all of the affected unions. The Chairperson of the group should be someone who is directly concerned, because of the nature of his/her job, with traffic reduction or with productivity improvement. We suggest

that the City Rideshare Program Administrator accept this responsibility.

The first task of the TIG is to develop a basic telecommuting policy, giving minimum standards and implementation guidelines for the entire City. The duty of each member of the TIG, beyond contributing to the overall standards and guidelines, is to coordinate any expansion of those for her/his own department. The policy should include personnel selection and training criteria and methods; satellite office requirements and implementation procedures; work rules; technology needs; and evaluation requirements and procedures, as a minimum.

Because motivation of managers is fundamental to the success of telecommuting, it is vital that the members of the TIG be movers and shakers, rather than passive coordinators. Their fundamental role, once standards and guidelines are developed, may be to change attitudes within their own departments, where existing attitudes are impeding acceptance of telecommuting. This requires that they be selected on the basis of their leadership and influence with their colleagues.

Further, it is important that the members of the TIG have a minimum tenure of two to three years and that they are suitably rewarded or recognized for their efforts. That is, they should not view their responsibilities to the TIG as just another unwelcome burden.

Telecommuting Expansion Project

In a sense, the Telecommuting Expansion Project is a larger scale version of the Pilot Project. The process is quite similar. First, the Mayor and Council should address the issues of the necessary infrastructure: telecommunications and computers. As we have found from the Pilot Project, a fairly substantial amount of telecommuting can occur with little or modest impact on the budget. However, a fairly small increase in availability of personal computer hardware and software; and an expansion in mainframe access can have substantial additional effects. These issues should be clearly identified, if not resolved, before the next step.

Second, a new series of briefings and/or informal meetings with department General Managers and senior managers should be made, either as a group or on an individual basis. Those briefings should focus on the key policy issues and, where there are Pilot Project data, on the specific experiences in their own departments. No department should be left out of this process. Each General Manager should be asked to develop a telecommuting implementation plan and schedule. The plan should include technology needs.

Third, a series of briefings to mid-level managers and supervisors should be held, on a department by department basis. The purpose of the briefings is to acquaint them with the results of the Telecommuting Pilot Project. Wherever possible, telecommuters and telemanagers from their own departments should attend the briefings and voice their own views on the benefits and risks of telecommuting. The desired outcome of these briefings is that the managers will develop implementation plans for their own groups.

During the first stages of the implementation, some managers — and some departments may continue to reject telecommuting as an option for them. Our strategy has always been, and continues to be, to insist that participation be voluntary at all levels of management. However, in the case of departments that have refused telecommuting and have not achieved the necessary AVR levels by other means, the General Manager should be required to show clearly how the department can achieve its AVR goals without using telecommuting.

Fourth, all potential telecommuters should be given briefings on telecommuting, including clear descriptions of the work options and responsibilities of telecommuters, and should be given an opportunity to volunteer to become telecommuters.

Fifth, it is our opinion that the volunteers and their supervisors should go through some formal selection process that serves as a means for identifying possible problems with telecommuting. If nothing else, the process tends to focus attention on a key ingredient of telecommuting: trust and quality communication between supervisor and employee. During the Telecommuting Pilot Project a set of formal background questionnaires[33] was used for this purpose.

Sixth, the selected telecommuters and telemanagers should be given formal training in telecommuting management techniques. Ideally, the extent of training required by members of a particular work group depends on the level of independence already achieved within the group. In some cases, very little additional training is required. In other cases, several hours of training may be in order. Our experience during the pilot project was that two hours of training for the telecommuters and two hours for the telemanagers was the minimum acceptable for most of the

[33]The questionnaires were administered to both the prospective telecommuters and their supervisors. This background evaluation was limited to the Pilot Project but will be available to the City for further implementation at a nominal cost per telecommuter.

groups. Some groups needed more detailed training, as we determined from subsequent focus group sessions.

Steps three through six need not be completed for all of the telecommuters at once. A better strategy for large departments may be to implement telecommuting on a division by division basis, or even in smaller increments, as dictated by operational considerations. The overall schedule may be dictated by the requirements of the SCAQMD.

TeleService Pilot Project

Although the focus of this project was on reducing the level of commuting by City employees, another major opportunity was suggested repeatedly during the course of the project: Why not use telecommuting as a means of more effective local delivery of City services?

The rationale is as follows. The City has an extensive array of service-providing facilities distributed throughout its area. But many of these are single function facilities, such as fire and police stations, parks buildings, and the like. Although there are multi-function facilities in locations other than downtown Los Angeles, such as the Van Nuys, West Los Angeles and San Pedro City Halls, they are few and far between. Further, there are no such facilities to serve areas of particularly high need, such as South-central or East Los Angeles.

Because not all services are available throughout the City, citizens of Los Angeles spend significant amounts of time and effort traveling from their homes and businesses to City facilities in order to receive any one of the variety of services provided by the City. Often, they are required to visit several different locations before receiving all of the services they need. Presumably, some citizens give up the search in frustration before getting the services. There are no quantitative data available as to the magnitude, extent and success of this taxpayer travel activity.

Given the severe constraints on the City's budget, it is not likely that a series of conventional local City Halls will be built any time soon. However, it seems entirely feasible to do "reverse telecommuting:" to use existing City facilities that are turned into multi-purpose operations for disseminating a variety of information and completing routine City-citizen transactions. Applicants would be able to go to a local City facility and be in contact with the required experts regardless of the actual location of the experts.

This need not result in major inroads on facilities that are already overcrowded. For example, a variant of the information kiosks that are being tested by the State of California might provide significant increases in localization of services. Increased telecommuting by the

usual occupants of existing facilities might free up enough space so that the conversion of some of it to multiple uses would be essentially invisible.

The technology required to accomplish this is already in existence. No new inventions are required. Two key questions are: what level (read cost) of technology is required to deliver what services?; and how important are the benefits derived from the localized delivery? As an example, the Department of Telecommunications is investigating the requirements for a broad-band network interconnecting City facilities. The existence of such a network would be a major asset for implementing a broad TeleService program.

As is the case with telecommuting, the benefits derived from a TeleService program may significantly exceed operating costs. However, until a more thorough analysis is made of the opportunities, issues, potential benefits and costs, it is not possible to gauge the total impact. Therefore, we propose that a pilot TeleService project be planned and developed to explore the opportunity.

Interagency Facilities Sharing Project

Sponsored by the Institute for Local Self Government,[34] a project is currently under way to develop and demonstrate office space sharing arrangements among local governments. The central concept of the project is that local governments can develop satellite office telecommuting arrangements without necessarily leasing new office space elsewhere. A City of Los Angeles employee living in, say, Rialto could telecommute part time from the Rialto Civic Center rather than commuting to downtown Los Angeles — and vice versa.

The primary barrier to demonstration of satellite center telecommuting during the City project was the rule that the City would lease facilities only for a minimum duration of several years. While this is a quite reasonable approach for negotiating the most favorable leasing terms, it was not possible to lease space for only a few months (the duration of the project) in areas close to City employee residences.

Early in the project we identified more than seven areas where satellite offices could effectively serve City employees. None of them included an existing City facility. Most were outside the City limits. Only near the end of the data-taking stage of the project were we able to reach an agreement with the Ontario Telebusiness Work Center to house one telecommuter outside the City limits.

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[34]The ILSG is a non-profit, non-partisan reserach and education organization affiliated with the League of California Cities. Its mission is to promote and strengthen local self government.

To test the impact of a network of available telework centers, we used our computer program for evaluating the AVR impacts of various travel demand management strategies. Our analysis of the residence and work locations of a sample of 580 prospective City telecommuters indicates that only 4 now work at the City (or other public agency) facility nearest their homes. The other 576 would save more vehicle miles by either telecommuting at home or from a different faciltiy than their principal office. For the whole group of 580 employees, including some current home-based telecommuters and some rideshare members, the annual additional vehicle miles saved by telecommuting from a satellite office one day per week would be 900,000 miles (17,600 trips).

Participation in the ILSG project or a similar arrangement could materially expand the City's telecommuting without increasing expenditures for office space.

Appendix 1: Telecommuting Guidelines

The Issues

The general issues of telecommuting are common to most organizations: who controls whom/what; who is liable for what; who pays for what; and who, if anyone, is at a disadvantage as a result of telecommuting? The dominant fear expressed by managers during the preliminary phases of the project was that telecommuting would be forced upon them upon conclusion of the project and that they would have no control over who telecommutes or over how often and under what circumstances telecommuting would occur. An opposite management view was also heard, although it didn't surface until later in the project: "this is just a fad and will go away — we don't have to pay attention to it."

The views expressed by various employee representation groups, both within the City and elsewhere around the world, tend toward: "This is a new way for management to exploit the employees." Here too, another voice is heard: "How can we make it a mandatory option for all employees?"

During the development of the project plan and periodically throughout the project, the usual liability questions arose, typified by: "Who's liable if a telecommuter breaks her leg at home while ostensibly working at two in the morning?" And: "What happens if the equipment used by the telecommuter breaks?" Data security issues also arose frequently, particularly with respect to the possibilities for unauthorized access to the City's mainframe computers.

Finally, the telecommuters' main concerns were the (in their view) possibly frivolous attempts by "management" to

arbitrarily limit — or force — their telecommuting. This apprehension was supported by the failure of several departments to allow many of their trained telecommuters to telecommute, and by others to put strict limits on telecommuting days or schedules. We uncovered no occasions, once the active phase of the project began, where telecommuters felt they were forced to telecommute against their wishes.

Approaches

All of these issues arise from a fundamental adversary attitude, possibly supported by past experience, on the part of all of these groups of people. Lurking in this background is the leaden rule: *Do unto others as you think they will do unto you — only do it to them first*.

The dilemma arises from the fact that successful telecommuting requires an attitude of trust and cooperation among the participants. The question is, can a set of rules be developed that acts to encourage growth of the necessary trust, while avoiding the trap of relying on blind faith?

We should emphasize that these concerns were by no means universal. There was abundant evidence during the project that many telecommuters and their supervisors had well developed and proven feelings of mutual trust. Nevertheless, in those cases where such trust is nonexistent or uneasy, it is important to establish some fundamental rules that will act to help improve the situation.

Consequently, the following recommendations are designed to stipulate the roles and responsibilities of telecommuters and telemanagers is such a way as to promote increasing feelings of trust without being unduly restrictive upon the prerogatives of either telemanagers or telecommuters.

A Core Set of Work Rules

The following rules are proposed as a general guide for City Departments in establishing clear relationships between telecommuters and Department management. Some of these rules should be inviolate, while others may be subject to negotiation. Consequently, we have separated them into two groups.

Absolute Rules

- **Telecommuting is a management option, not an employee entitlement**. Successful telecommuting requires that both the nature of the work to be performed and the working relationships between the telecommuter, the telecommuter's colleagues and her/his supervisor be consistent with the principles of location independence for the period of telecommuting.

- **Telecommuting must always be voluntary** for both telecommuter and his/her supervisor(s). Either the telecommuter or his/her supervisor may elect to discontinue the telecommuting if: a) the telecommuter is not comfortable with telecommuting; or b) the telecommuter is not performing to mutually pre-agreed upon work standards. Any discontinuation of telecommuting must occur upon adequate prior notice.
- **Telecommuters and their direct supervisors must be given training** in the management aspects of telecommuting prior to beginning telecommuting if they do not already operate in a location independent mode.
- **Performance evaluation of telecommuters should be based on prior mutual agreement**, between the telecommuter and his/her direct supervisor, as to specific work goals, objectives and schedules. Although specific objectives and schedules may be based upon estimated times to complete tasks, performance evaluation should not be based on time-to-complete.
- **Telecommuters are regular employees**, not subcontractors.
- **There is no distinction in rates of pay and benefits** between telecommuters and non-telecommuters.
- **Telecommuters should be given the same opportunities as non-telecommuters for promotion and career development,** including access to additional training.
- **Telecommuters should have regular opportunities to meet** their telecommuting and non-telecommuting colleagues in their organizations in order to minimize any feelings of isolation or exclusion.
- **Telecommuters should have access** to electronic mail, voice mail and/or whatever other means are normally used in an organization for keeping them linked with their colleagues.
- **Telecommuters and telemanagers should establish a regular schedule** or other method for maintaining suitable levels of communication with each other.
- **There should be no arbitrary limitation on telecommuting schedules and frequencies**. The specific schedule and frequency of telecommuting for

an individual telecommuter should be dictated solely by the needs of the work unit and the availability of sufficient quantities of "telecommutable" work, not by any unfounded expressions of distrust of the telecommuter such as prohibiting telecommuting days adjacent to "off" days.

- **Telecommuters should have the same rights and access to representation** as their colleagues.

Negotiable Rules

- **Telecommuters should not be required to perform in excess of their in-office levels** as a condition of beginning/continuing telecommuting. An alternative, less protective version: **Telecommuters should not be required to perform in excess of their in-office levels** as a condition of beginning/continuing telecommuting **to the extent that they feel stressed from the extra load**. Telecommuters naturally tend to perform more effectively and feel less stress during their telecommuting days but the fundamental success criterion for the project was to reduce automobile use while maintaining normal levels of performance.
- **All operating costs of telecommuting**, such as business related telephone charges, office supplies and special software or necessary software upgrades, shall be paid for directly or reimbursed to the telecommuter by the City.
- **All necessary equipment and equipment maintenance costs should be covered by the City** in all cases where the telecommuter needs the equipment for telecommuting but does not own, is not able to, or desires not to use her/his own equipment. Several prospective telecommuters were eliminated from participation in the project because they did not have suitable computer equipment at home. Our surveys indicate that the benefits from performance increases to be expected from telecommuters far outweigh the costs of additional computer equipment.
- **Telecommuters may use their personal computer equipment and/or software for telecommuting**, provided that it is compatible with City computers. Many of the City's telecommuters have personal computer installations that are superior to that available in their principal offices. However, in these case the employee, not the City, should be responsible for the maintenance of the

equipment and/or software. The employee should also be responsible for insuring that any of her/his software used for City related work is virus-free and compatible with City software.

- **The City retains the right to, and telecommuters have the right to insist upon, inspection** of home offices and computer equipment/software for safety, adequacy and security.
- **The schedule worked by a telecommuter need not be that same as that of the principal office**, provided that the schedule is given prior approval by the telecommuter's supervisor. For example, given prior approval, the telecommuter may begin and finish work earlier (or later, or some combination other) than the normal office schedule.
- **Telecommuters must be reasonably accessible, via telecommunications, to the principal office during normal work hours**, or during some portion of normal hours, given prior approval by the telecommuter's supervisor. In the latter case, the hours of accessibility and work need not be entirely identical. "Reasonably accessible" means that the telecommuter should respond to a call from the office within some time limit mutually agreed upon by the telecommuter and his/her supervisor

Most of these rules were covered in the manuals issued to the telecommuters and telemanagers as part of the training process. They have been amended and augmented as a result of the experience gained during the project.

Legal Approaches

As with the general management and labor relations issues addressed above, the legal aspects of telecommuting are not materially different from those of the traditional workplace. These issues focus primarily on responsibility and liability. The following proposed rules[35] address those issues.

- **A telecommuter is covered by Workers Compensation Insurance regardless of the location of her/his workplace and work hours,** provided that the work location and schedule was given prior approval by the telecommuter's supervisor.
- **Accidents at a telecommuter's home to persons who are not employees of the City of Los**

[35]Note that JALA International, Inc. is not a law firm. The recommendations given here deal with the substance of the issues and may or may not be in appropriate legal format.

Angeles or, if they are employees, are not engaged in City work activities, **are the responsibility of the telecommuter**.

- **Telecommuters are responsible for protecting City information in their possession, or accessible through the use of equipment in their possession,** regardless of their work location. Any sensitive information in a telecommuter's possession must be given at least the same or equivalent physical protection as would be used or available in the telecommuter's principal office.
- **Telecommuters are not to use City provided equipment or software to perform work for any other employer**.
- **Telecommuting shall not be required as a condition of employment**.
- **The City is not responsible for that portion of home utilities costs or space rental that is attributable to a telecommuter's telecommuting activities**. During the training sessions we stressed that it was extremely unlikely that City employees could deduct the costs of home offices in their federal income tax forms unless telecommuting was required as a condition of employment. A recent Supreme Court decision has strengthened that rule. There are current moves in Congress to change the tax laws so that telecommuters can receive some tax benefits. However, unless and until that occurs, home telecommuters can not deduct those expenses.

Appendix 2: Evaluation Methodology

Two types of evaluation, summative and normative, were used to assess the efficacy of telecommuting. The summative (or 'what has been happening?') evaluation was made via a series of questionnaires administered to the telecommuters, and, in some cases, their families; their supervisors; and members of the control group. A cost-benefit model was derived from the summative evaluation data and from other departmental statistics. The normative evaluation (or 'where should we be going?') evaluation was achieved via individual interviews and a series of focus group meetings.

The control group was composed of City employees who otherwise would have been qualified to be telecommuters but who elected not to telecommute during the course of the project. That is, the control group members were selected to be as similar to the telecommuters as possible, given the variety of personalities and job types in the project.

Summative Evaluations

The summative evaluations comprised two different types of evaluation: overall impact assessments, including a cost-benefit model; and a travel demand analysis. The impact assessments were made via three series of detailed questionnaires[36] that covered general demography; the adequacy of the City's information infrastructure; personnel roles and information activities; technology use;

[36]These questionnaires have been used by JALA in a variety of telecommuting projects, in both the public and private sectors, since the mid-1980s.

commuting patterns; telecommuting details; implementation issues; and overall performance impacts. These lengthy questionnaires, often requiring two hours to complete, were administered to the telecommuters and control group members at the beginning, mid-point and conclusion of the data-taking phase of the project. Supervisors of telecommuters and control group members were also given short evaluation questionnaires, focusing on performance issues. These were administered at the same times as the telecommuter/control questionnaires.

Although the general evaluation questionnaires provided overall information on the trip reduction impacts of telecommuting, it was important to get some information on a persistent question about telecommuting impacts: does telecommuting simply act to move the distribution of trips around, with no overall effect on travel? That is, while telecommuters may not use their cars on telecommuting days, they may use them more than usual on non-telecommuting days, including weekends. Therefore, the telecommuters and members of the control group — as well as their driving age family members — were asked to complete logs for each trip made, for whatever purpose, over a period of one week in March, 1992.

The data derived from all of these formal questionnaire series were used to complete a cost-benefit model that quantifies the known dollar impacts of telecommuting and provides a means of forecasting future impacts under various telecommuting scenarios. A related model was developed that provides a comparative analysis of telecommuting with other means of trip reduction, such as carpools and vanpools.

Productivity vs. Effectiveness Measurement Issues

One of the key economic impact statements about telecommuting is its effect on productivity. There are some very important distinctions to be considered here since major economic commitments may be made on the basis of productivity estimates. The following describes my considerations in developing the various evaluation questionnaires.

Strength of Inference

The results of the surveys, occurring as they did in the real world instead of a laboratory, are complicated by the time-varying composition of the group of telecommuters. Transfers, departures, switches to and from telecommuter/control status (some individuals did this more than once) all tend to obfuscate the results. Consequently, where important factors in the evaluation are discussed, we have included confidence estimates of the reliability of the conclusions. These are generally in the form of an estimate of Type I error: the likelihood that two sample populations (such as telecommuters and controls) are really identical even though the statistic says they

aren't. This is expressed in the form of a probability, p, that the two populations are the same. The lower this probability is, the more likely it is that the populations are indeed different. Ordinarily we don't state that two groups are different in the characteristic in question unless the p-value is 0.1 or less, preferably less than 0.05. That is, the odds are 9 to 1 or 19 to 1 or more [(1-p)/p], respectively against the two groups being the same.

Productivity

Productivity is a loaded term. In particular, manufacturing productivity is usually taken as the model. One has mental images of whiz-bangs being turned out like clockwork. Productivity in this situation is measured as the ratio of the price received for the whiz-bangs produced, divided by the cost of production. When one turns to information work the first problem is: what's the product? In the case of clerk typists the identifiable product may be typo-free letters and memos going into the mail. In the case of a detective or a policy analyst, as examples of the types of telecommuters in the project, the measure of productivity is significantly less well defined. In any case, productivity is a measure of doing things right.

Effectiveness

Effectiveness is the term we prefer to use. Our approach is that productivity is the wrong term to use in any case. This is specifically because of the tendency to count things (letters, typed, decisions made, briefs or specifications written, etc.) as the means of measure. This distracts one from the real purpose of information work: to generate or convey information and to affect decisions. This is a broader concept and, unfortunately, one that is even harder to measure. But the breadth is, we feel, in the right direction. Effectiveness is a measure of doing the right things - and doing them right. As such, it includes productivity as a component, but someone who is very efficient/productive at doing the wrong things is decidedly not effective.

Measuring changes rather than absolutes

It is not possible to measure absolute levels of information work effectiveness, if for no other reason than that there is no consensus on what it is. However, most individual information workers, and their supervisors, have a feel for what has changed over some relatively short period, such as a few months to a year or two.[37] In this way we do not

[37]Even periods of one or two years' duration can be difficult to measure since one's memory of what one did as long as a few days ago can often be faulty.

have to be concerned with what the elements are of the effectiveness evaluation; we do not sink into the pit of endless qualifications of measures for each type of job. We simply ask what has changed, and proportionately how much, in whatever terms the subject is used to thinking of his/her own (or his/her own subordinate's) effectiveness.

Intergroup comparisons

In addition to focusing on changes rather than absolutes, we compare estimates of effectiveness. We compare the self estimates of the telecommuters with the self-estimates of the members of the control group. We compare both of these with the estimates made by the telecommuters'/controls' supervisors of their effectiveness changes. We compare the final self-estimates with the pre-telecommuting self-estimates.

Related measures

Finally, we also examine what has stayed the same. What hasn't changed? The work environment, the roles played by the individuals in their work, the work activities in which they engage, the technological tools they use, the factors that make up effectiveness measures are all part of our evaluation questionnaires. That is, we try to detect any changes in the work environment that might explain changes otherwise attributable to telecommuting. If these work-environmental factors are unchanged and/or common to both the telecommuter and control groups then any effectiveness differences between the groups are more likely to be attributable to telecommuting. Note that there were no significant differences detected in these factors in the pre-telecommuting, the first annual and the final evaluations. In the interests of reducing the length of the questionnaires (and reducing the strain on the respondents), the information infrastructure and work roles questions were dropped from the first annual questionnaire.

Normative Evaluations

Although the summative evaluation techniques provide quantitative snapshots of the impacts of telecommuting, it is also important to be able to improve the process in mid-course. To that end, two series of focus group sessions were held, at about the one-third and two-thirds points in the project. These were augmented by informal meetings and telephone conversations with telecommuters throughout the project, often in response to queries about procedural issues.

The focus group meetings were relatively informal but were structured to elicit comments and suggestions about problems with technology, operating procedures, working

relationships, personal and family impacts of telecommuting. The meetings also served as a means of reinforcing some of the management approaches covered in the initial training sessions. During the first series of meetings the telecommuters and their supervisors met separately, in case there was any reticence about discussing management problems with supervisors (or telecommuters) in attendance. In the second series of meetings, the telecommuters and supervisors met together. There was no substantive difference in the outcomes between the two sets.

Appendix 3: Quotes from Supervisors

The following is a set of comments from the supervisors who completed evaluation forms in the final round of surveys. *[Italicized comments in brackets, for the following items, are those of the author.]*

Good News

- Even with an increased caseload, and the increased complexity of cases, [the telecommuter] has maintained his level of effectiveness. I believe this has been possible because of the quality time telecommuting affords him.
- Telecommuting has allowed [the telecommuter] to keep pace with an increased workload, more complex cases, and specific projects.
- We accomplished things with telecommuting that we haven't been able to do for four or five years. Telecommuting gaves us the time [and the freedom from interruptions] that let these tasks be finished with outstanding results.
- This employee has a significant impairment (physical) to her performance. The telecommute day has helped compensate so that she is more productive, even though her overall performance is below her prior capability. (She has a degenerative disease that is also impairing her mental processing.) Telecommuting is a job saver for her and us.

- I'm very supportive of telecommuting. Originally my support was theoretical. Today it is based upon actual practice. The "quiet" or undisturbed time available to telecommuters allows for very productive work on certain tasks/assignments.
- Our work is difficult to quantify in terms of how long a particular part of it should take, and as everyone is at a different task at different times, it just is not clear if someone is getting more, less or no change in the work done. The only thing I can tell is that telecommuters are happy about telecommuting.
- Telecommuting has helped [the telecommuter] as well as other employees I am familiar with in increasing productivity in that they can work on a project with no distractions such as phone calls and people dropping by to talk.
- Telecommuting has forced [the telecommuter] to be a more organized worker. He has had to plan his work here and at home. He stated that the flexibility in work environment and work schedule has helped relieve the boredom that comes with doing repetitive tasks.
- This individual has been on medical leave of absence. We attempted to use telecommuting to alleviate the degree of worksite pressures. While she telecommuted, her production record improved.
- We are suffering a 50% staffing shortage at this time and are convinced that telecommuting has helped us to maintain an acceptable level of case processing.
- I think the telecommuting program should be continued since the productivity, volume of work, increased for the engineers I supervised.
- Due to required meetings, field work, employee unable to complete telecommute goal of once every two weeks. Excellent use of time the few times she did telecommute. Employee is very productive at the office and in the field and at home telecommuting.
- For certain tasks/functions/projects and employees telecommuting is, in my opinion, vastly more effective than traditional methods. I would like to see it gain acceptance.
- I am also convinced that **many** employees under my supervision could be more productive if they

"telecommuted" (and did not have to contend with phone and other interruptions).

- Telecommuting works very well with this motivated employee. When large complex projects need to be completed in a short period of time, she works from home without interruption. She makes optimum use of the phone for communication and for providing and receiving information. She uses her own computer equipment.
- [The telecommuter] lives near [a City facility]; on several occasions, he was able to do field work "next door" without having to travel downtown and back. For him, [the facility] became a ready-made "satellite center."
- Employee lives 29 miles from work. Effective use of employee's time. Special responsibilities of the job lends itself to telecommuting.
- There is no doubt in my mind that all of our professional and most of our clerical staff could significantly benefit by telecommuting once or twice per pay period. Too many distractions in the office (much public comment telephone work).
- [The telecommuter's] job performance is higher than the average engineer and that continued with telecommuting. He has outstanding PC skills which makes his telecommuting more effective and he has flexible approach to when telecommuting is done. He is well organized and plans ahead which also adds to his being very effective in a telecommuting program.
- I have found that telecommuting works well when an employee is assigned a project that requires extensive reading and analysis.

Mixed News

- [The telecommuter] initially focused on reports and manuals. Later she had access to a main frame connection and devoted time to testing and trouble shooting new information systems. I had to limit the main frame access when I was pressured to keep the phone bill under $70.00 per month. For an effective program, the Dept. needs to solve the Telecommunications Cost Problem by placing low cost or toll free nodes near the telecommuting employees.
- There has been a slight increase in my workload duties that [the telecommuter] would have

handled had he been present, but at the same time this was offset by the greater productivity.

- I believe that telecommuting is a very good program. But the effectiveness of the program is very much dependant upon "the employee" who participated in the program. Most of the participants are performing well but some would be kind of abusing the system (program*). [Hence, the need for pre-telecommuting screening.]*
- The work was tailored to be effectively done at home. Because main frame accessibility was not available to [the telecommuter] , her work focused on reports, manuals and studies. She was able to accomplish almost two days work in one telecommuting day at home. This was a Win-Win for the Dept.

Not So Good News

- Employee lives one mile from work. More effective on job site as position already requires off site field work. *[This and the following quote are from the same supervisor.]*
- Employee lives two miles from work. Responsibilities of position more effectively carried out at work site since job has extensive field work outside of the office. *[Meeting requirements, in a period of great transition, made more telecommuting difficult for these two. Teleconferencing systems might have lessened the problem.]*
- The city has chosen to operate its pilot program on the basis of telecommuters taking one day off per week. I'd like to see a more irregular schedule. *[Note: See the comment on the next quote.]*
- We have removed all our telecommuters from weekly, fixed telecommuting days and have made the option available to any staff member, on a periodic basis, provided that there is justification. We found the practice of having fixed telecommuting days to be negative in that staff began to assume the day as an employment right rather than a privilege. *[Note: Considerable time was spent during the training sessions and in subsequent focus group sessions about the relative advantages and disadvantages of fixed/variable telecommuting schedules, stressing the likely need for flexibility. One can lead a horse to water . . . .]*

- Due to personal problems and work related changes in duties and assignments the telecommuting option did not work out for [the telecommuter]. We both continue to be positive in attitude towards it and if situations change would re-implement. *[Satellite office telecommuting might work out better for this telecommuter.]*
- On the plus side [the telecommuter] is very productive on his TC day. On the down side [the telecommuter's] work (we feel) must be reviewed. *[Note: A major part of the training deals with the work definition and review process. It is interesting to note that the requirement to review output apparently is considered by this supervisor to be a novelty, not applicable to in-office workers.]*

Bad News

- Due to the assignments and upgrading of our work environment [the telecommuter] has not telecommuted in the past several months. There has been a significant decrease in productivity on two of her existing assignments. ***Also, because our [senior] manager is unwilling to commit his team to the program, it is no longer one of his top priorities to promote this program. He finds it easier not to support even if the participants are already enrolled in the program.*** *[Emphasis added.]*
- [The telecommuter] elected to stop telecommuting because of too many interruptions at home. *[Note: We find this happens with less than 5% of home-based telecommuters.]*
- This program required more structure, training and monitoring to be effective. Passing out this questionnaire 5 mos. after we terminated the pilot project is ludicrous. *[Comment by a supervisor who was trained but neither supervised a telecommuter nor attended subsequent focus group sessions. Only two of the active departments, accounting for 9 telecommuters, formally terminated their telecommuting as of July 1992.]*

MTI Report 01-12

MTI

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International Institute for
Surface Transportation Policy Studies
Created by Congress in 1991

A New Planning Template for Transit-Oriented Development

Mineta Transportation Institute
San José State University
San Jose, CA 95192-0219

MTI Report 01-12

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Dick Nelson
John Niles
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September 2001

a publication of the
Mineta Transportation Institute
College of Business
San José State University
San Jose, CA 95192-0219

Created by Congress in 1991

Technical Report Documentation Page

1. Report No. FHWA/CA/RM-2000/06	2. Government Accession No.	3. Recipients Catalog No.	
4. Title and Subtitle A New Planning Template for Transit-Oriented Development		5. Report Date September 2001	
		6. Performing Organization Code	
7. Authors Dick Nelson, John Niles, Aharon Hibshoosh		8. Performing Organization Report No. 01-12	
9. Performing Organization Name and Address Norman Y. Mineta International Institute for Surface Transportation Policy Studies College of Business, San José State University San Jose, CA 95192-0219		10. Work Unit No.	
		11. Contract or Grant No. 65W136	
12. Sponsoring Agency Name and Address U.S. Department of Transportation Research and Special Programs Administration 400 7th Street, SW Washington, D.C. 20590-0001 California Department of Transportation Office of Research MS42 P.O. Box 942873 Sacramento, CA 94273-0001		13. Type of Report and Period Covered Final Report	
		14. Sponsoring Agency Code	

15. Supplementary Notes
This research project was financially sponsored by the U.S. Department of Transportation's Research and Special Programs Administration (U.S. DOT RSPA) and by the California Department of Transportation (Caltrans)

16. Abstract: The Mineta Transportation Institute (MTI) at San José State University assigned a project team to design a planning template for transit-oriented development (TOD) that incorporates an understanding of nonwork travel, that is, trips for shopping, eating out, and engaging in recreational and cultural activities. Nonwork trips are growing in signifigance and now account for four of every five trips. At the same time, TOD has become a popular planning response to the impacts of metropolitan growth. Some planners believe that TOD will induce more pedestrian and transit trips and will reduce the average length and frequency of household auto travel. This effect is assumed to result from improved accessibility to employment and nonwork venues located in compact, mixed-use centers. Planning professionals in many MPOs also suggest that if multiple centers are linked by high quality transit, such as light or heavy rail, access is enabled to the broad range of nonwork activities.

The project arrived at these essential findings: (1) Venues for nonwork activities are very numerous and geographically dispersed. (2) The spatial environment for nonwork activities is the result of growing prosperity, technical innovation, and a dynamic, competitive marketplace. (3) The consumer marketplace will provide many more places to go than mass transit can cost-effectively serve. (4) Current metropolitan planning methods and modeling tools focus on the work trip and do not adequately account for the complexity of nonwork trips and their linkage to work trips.

These findings support the need for a new regional planning process to complement current methods. One recommended approach is that metropolitan communities establish a Nonwork Travel Improvement Planning Process using a multidisciplinary expert advisory group interacting with a core, Internet-enabled, professional transportation planning staff. An iterative interaction across varied but relevant skill sets could be achieved through a Backcasting Delphi process. The focus of the interaction would be on understanding the ramifications of consumer and retail industry behavior for TOD and other new transportation strategies, and then assessing the available strategies for cost-effectiveness in reducing the impacts of growth and automobility in a complex and uncertain metropolitan market.

17. Key Words nonwork travel, regional urban planning, TOD, transit-oriented development	18. Distribution Statement No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161		
19. Security Classif. (of this report) Unclassified	20. Security Classifi (of this page) Unclassified	21. No. of Pages 128	22. Price $15.00

Form DOT F 1700.7 (8-72)

Library of Congress No. 2001095678

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ACKNOWLEDGEMENTS

The Mineta Transportation Institute Project Team for this study consisted of Principal Investigator Dick Nelson and John Niles. Research Associate Professor Aharon Hibshoosh provided valuable input on all working papers and an earlier draft of this report, and his contribution is especially appreciated. Student Assistant Rhys Rowland also contributed to this project by providing important assistance with the maps.

This document has been significantly improved because of constructive feedback received on earlier drafts from Jerry Schneider, Gary Lawrence, Scott Rutherford, Kenneth Dueker, Douglas Porter, Douglas Lee, Ed Mierzejewski, Richard Morrill, Susan Handy, Ed Risse and Richard Wilson.

The Project Team thanks the staff of the Puget Sound Regional Council for critical data files that were used to prepare maps and tables.

The report authors integrated data from many sources and made numerous critical interpretations, and any opinions expressed are solely those of the authors.

The U.S. Department of Transportation's Research and Special Programs Administration and Caltrans funded this project through the Mineta Transportation Institute. Thank you to the Mineta Transportation Institute staff, especially Research Director Trixie Johnson for her guidance, and to former Communications Manager Jeanne Dittman, Research and Publications Assistant Sonya Cardenas, Graphic Designer Ben Corrales, Student Editorial Assistant Robyn Whitlock and Editorial Associate Susan Sylvia for their editing and publishing assistance.

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EXECUTIVE SUMMARY

PROJECT OVERVIEW

The purpose of this project is to improve the planning methodology for Transit-Oriented Development (TOD) by bringing into sharp focus the dynamics of the retail marketplace and nonwork travel demand. TOD involves increasing the density of housing, offices, stores, and services around mass transit stations in an urban region, and making pedestrian access very easy, in order to encourage more use of transit and a reduction in automobile driving. TOD is intended to influence both travel to work (commuting and business travel), as well as all of the other reasons for local travel (so-called nonwork trips, including shopping and leisure travel). Specifically, the project has sought to:

- Analyze nonwork travel demand as influenced by retail market dynamics on a national and regional level.
- Review the state-of-the-art in regional transportation planning by Metropolitan Planning Organizations (MPOs) with respect to nonwork travel.
- Create a planning template for regional transportation and land use planners who are pursuing TOD that encompasses nonwork travel.

The central Puget Sound region of Washington State (four counties making up the Seattle-Tacoma-Bremerton-Everett metropolitan area) was used as a case study for the development of the template. The nonwork travel environment of the region was mapped and analyzed, and the findings generalized to other large metro regions. Of particular interest were the myriad “retail” activities from which consumers choose their shopping and recreational destinations. As a group, these activities generate more than half of all person trips: shopping for goods and services, eating out, entertainment, recreation, culture, and other leisure pursuits.

A basic planning template was designed that generates three new kinds of data: specification of the major nonwork venues that generate travel demand and that should therefore be mapped and spatially analyzed, listing of the forces shaping urban form that need to be monitored and understood for travel generation and land-use implications, and the identification of the factors that will determine the regional (not just station-area) success of TOD in stimulating a shift from driving to mass transit patronage.

The framework for measuring the success of TOD that we use throughout this project is comparing public costs to public benefits. According to this cost-benefit framework, a necessary part of the regional planning process is comparing the estimated future benefits from TOD to the benefits from alternative investments. The most critical regional public benefits come from the expected market share shift from automobile to public transit: increased transit ridership, reduced average travel times and vehicle congestion, and measurable environmental gains such as improvement in air quality. In order for a TOD plan to be judged as successful in our framework, the plan's level of expected future benefits must be commensurate with the level of capital investments made to implement TOD. Those investments include new transit facilities and the financial incentives and other public costs incurred to shape private real estate development toward the more compact and mixed land use forms required to make TOD successful.

NONWORK TRAVEL: IMPLICATIONS FOR TRANSIT-ORIENTED DEVELOPMENT

Travel to nonwork activities has grown steadily over the last three decades in the United States. It now accounts for about three-fourths of all household vehicle trips and four of every five person trips. Nonwork is the major travel purpose even in weekday peak periods, both morning and afternoon. As people strive to make efficient use of valuable time, nonwork trips are increasingly linked into trip chains or tours involving several stops. This is true for travel to and from work as well as for travel to purely nonwork activities. More than half of all trips from work to home involve a stop to shop, pick up a family member, or conduct personal business.

The observed growth of nonwork travel is directly related to the relentless progression of changes that have occurred in the retail and consumer services marketplace. Technological innovation, combined with increasing wealth, has produced a greater variety of business opportunities and consumer choices.

Nonwork travel, because of its magnitude, has important implications for transportation and land use policy, particularly transit-oriented development. TOD is a policy response to the impacts of metropolitan growth and its effects, including traffic congestion and travel-related environmental impacts, and to the concern that growth patterns threaten the livability of American communities.

As TOD has been implemented, it has come to mean compact, mixed-use centers made up of residential units, offices, and stores, supported by and, in turn, supporting new rail transit investments. Pedestrian movement is emphasized, and parking is limited. The number of metro areas, large and

small, that have embraced this approach to managing growth has increased over the last two decades to the point that it can be said that rail-TOD is one of the most important urban planning paradigms in the United States. Federal policies, especially the land-use criteria that must be met to qualify for "new starts" fixed-guideway transit funding, encourage TOD.

These efforts are motivated by the belief that TOD will induce more pedestrian and transit trips and will reduce both the average length and frequency of household auto travel. This is assumed to result from improved accessibility to work locations and to better proximity to nonwork venues. Further, it is suggested that if multiple centers are linked by high quality transit, access is enabled to a broad range of nonwork activities across a metropolitan region.

SUMMARY OF FINDINGS

The research arrived at a number of key findings that support the initial project premise of a need for a new regional planning process to complement current methods.

- Although support for transit-oriented development is based, in large part, on the assumption that when venues for nonwork activities are located at TOD station areas more people will use transit, there has not been a careful analysis of the actual spatial environment for nonwork activity and the travel patterns it engenders.
- The consumer marketplace for goods, services, eating out, and leisure activities in a metropolitan region is exceedingly large, varied and geographically dispersed. For example, a map prepared by the authors (Figure 3-4) indicates the locations of approximately 1900 major nonwork destinations in the Puget Sound region, overlaid on the 21 urban centers around which TOD will be emphasized.
- The number and location of, and the spatial relationships for, the myriad nonwork venues is the result of growing prosperity, technological innovation, and a highly adaptive entrepreneurial market that seeks to satisfy consumer needs and wants.
- Nonwork activities, which now account for approximately two-thirds of all personal travel, will continue to grow in variety as wealth and prosperity spread, and as the nation becomes more ethnically diverse.
- Since the consumer marketplace for goods and services will inevitably provide many more places to go than mass transit can effectively serve, the success of TOD as measured by less automobility cannot be taken for

granted.

- Even the choice of mode for the work trip is determined in large measure by nonwork activities, as people make stops during the commute to shop, drop off and pick up family members, and conduct personal business.
- For the purpose of gauging the success of TOD, it is important to distinguish between local (station-area) benefits and costs, and corridor or regional benefits and costs.
- Academic research to date suggests that neotraditional forms of development in a station area, such as grid street patterns and compact, mixed-use centers, alone will not have a significant impact on personal travel patterns.
- A benefit-cost ratio for the TOD paradigm that is superior to other investments that increase transit market share may not be an *a priori* possibility in every metropolitan region. Regions differ greatly from each other in their existing land use pattern, travel pattern, transit corridor availability, topography, political culture, and governmental structure. One size does not fit all.
- Metro regions may discover greater net public benefits by exploring a wider range of paradigms that encompass other strategies for dealing with the large growth in automobility associated with nonwork activities.
- The current metropolitan planning process is focused on the work trip and produces a limited set of strategies that do not bracket the range of possible cost-effective alternatives that are needed to address the variety and volume of nonwork travel.
- If a broader search for cost-effective alternatives is to be carried out, a new complementary planning process is required, one that involves a much wider and deeper knowledge base and range of expertise than is typically included in the current process.
- Unlike the current process, the new planning process must be able to account for the inherent complexity of human behavior and associated land use and travel patterns, and it must address the large uncertainty attached to the prediction of future patterns and the impact of government actions on these patterns.

RECOMMENDATIONS

In response to these findings, we recommend:

- Development and testing, in a few metro areas, of an explicit augmentation

to the metropolitan planning process that responds to complexity and uncertainty, and that deals with nonwork travel in the context of transit-oriented development.

- In response to the realities of and reasons for consumer behavior and retail industry practices as seen now and as predicted for the future, the new process should strive to specify ways that TOD can be strengthened so that consumers more often use mass transit and walking to shop and recreate. This specification would describe how and to what extent the market economy can be influenced to support TOD land use patterns.
- If, on the other hand, the recommended augmentation to the process reveals that transit investments and government policies cannot realign the market to yield a larger transit market share in the urban travel market, then the planning process should direct attention to the specification of paradigms other than TOD.

A Backcasting Delphi process, previously used to predict the efficacy of transportation and land use strategies outside the US, can be a useful supplement to the current method. It is expected that each metro region that uses the process will elaborate on the basic template to meet their specific circumstances and needs. The process would have the following key characteristics and elements:

- Defining the problem in terms of desirable behavior change to be achieved as measured by actual improvements in transportation system performance and environmental externalities, as opposed to simply providing options for behavior change.
- Focusing on choice of mode for travel to nonwork activity.
- Creating a knowledge-based understanding of nonwork activity and travel trends in the region, including new trends that are difficult to quantify but that may affect future travel and land use patterns.
- Designing the process to be carried out either by the MPO as an augmentation to existing procedures, or else by a civic organization acting in parallel to complement the existing MPO process.
- Recruiting and using multidisciplinary professionals in a structured, interactive process in which they share ideas and learn from each other and educate the regional leadership and populace.
- Employing an iterative process (Backcasting Delphi) of designing feasible transportation investments and strategies with costs and risks that are justified by the likely transportation performance to be achieved.

Although the focus of the research leading to the above recommendations was on nonwork travel, we suggest that the supplementary planning process examine the growing geographic dispersion of employment sites, the diverse requirements of journeys to work and work-related travel, and the increasing linkage of work and nonwork trips in complex trip chains. In other words, all trip types in a metropolitan area should be covered in the planning process we have sketched in this report. The planning template would be useful whether or not the metro region has embarked, or plans to embark, on TOD.

The U.S. DOT should support the refinement and testing of the new planning tool through its grant process, just as it now supports conventional regional planning.

Several actions should be taken to provide empirical data and other information in support of TOD planning, whether or not it is undertaken with the recommended planning process**.**

- Federal and local government consumer surveys should be structured to shed more light on the reasons people choose to live in a TOD. This would help in understanding whether TOD attracts people other than current transit users.
- Similarly, surveys should identify the locations for nonwork stops on the commute trip to assist in understanding the malleability of these locations, i.e., can they be induced to relocate to station areas?
- Studies should be undertaken of how well older neighborhood commercial areas and central business districts have adapted to the changes that have occurred in the larger retail marketplace.
- Research should be conducted to identify and catalog existing and emerging retail goods and services business strategies that have demonstrated synergy with the public policy requirements (for example, floor space and parking limitations) of locating facilities within transit-oriented developments.
- Other nonwork, nonretail activities may involve personal choices that result in trips outside the household's immediate neighborhood even though there are closer opportunities. The travel patterns associated with these activities, such as visits to the family doctor, and trips to school and church, should be investigated.

PROJECT REPORTS

During the course of the project, the authors produced five documents that are referenced in this final report. These documents, summarized below, are available for access and review at http://www.globaltelematics.com/mineta/

Report One, The Growing Importance of Nonwork Travel: The first report summarizes national trends for nonwork activities and travel patterns. Growth of nonwork travel is related to the changes that have occurred in the retail and consumer services marketplace, particularly in shopping for goods and services, eating out, and engaging in leisure activities. The travel impacts of these activities estimated by aggregating four of the trip purposes in the Nationwide Personal Transportation Survey (NPTS): shopping, eating out, recreation, and other kinds of personal business. In the NPTS of 1995, these four categories encompass 54 percent of person trips. Report One also assesses the state of the art in the modeling of future nonwork travel behavior.

Report Two, Preliminary Template Design: In the second report, the TOD paradigm and the impetus for its widespread adoption is described. The report reviews the limited experience of TOD's effect on travel and land use patterns, and it summarizes the growing critique of TOD's benefits compared to its costs as measured by changes in regional transportation systems performance and development patterns.

A new Nonwork Travel Improvement Planning Process (NWTIPP) is proposed that would provide additional guidance to metropolitan decision makers beyond the traditional transportation planning protocol that focuses on journey-to-work and four-step demand modeling. The NWTIPP centers on aggregating diverse expert opinion, and is intended to cope realistically with considerable complexity in the present and with much uncertainty about the future.

Report Three, Prototype Nonwork Database: The third report presents an example database of maps, tables, and commentary that would serve as a key input to the Nonwork Travel Improvement Planning Process sketched in the previous report. The central feature of this database (covering for purposes of illustration, the Seattle metropolitan region in western Washington State) is a series of maps that illustrate key elements of the retail and consumer services environment that generate nonwork travel. Other parts of the database include information on residential and employment conditions, transportation system performance, land use planning status, current planning tools now used in the region, and a summary of exogenous forces potentially shaping activities, land use, and travel.

Report Four, Revised Template Design: This document revises the template in Report Three based on a more thorough review of the literature for the Backcasting Delphi procedure and recent research on transit-oriented development, and the completion of the prototype nonwork database assembled in Report Three.

Report Five, Final Template Design: The fifth report sets out the final template design that was arrived at after submitting the revised design to a peer review of transportation and land use planners.

CHAPTER ONE

TRANSIT-ORIENTED DEVELOPMENT: A POPULAR PLANNING PARADIGM

INTRODUCTION

Low-density, separated-use development has become the predominant land use form across much of urban America in the post-World War II period. This form's connection to the large growth in personal and commercial travel in the same time span is well recognized, if not fully understood. Concerns over the impact of land use and personal transportation on the human and natural environment have been voiced in rising and falling crescendos over the last fifty years. Recently, interest has risen anew in response to the continuing growth and spread of urban development, ever higher rates of personal travel, and to the linkage between increasing travel and the greenhouse gases responsible for the suspected warming of the earth's atmosphere.

Public concern over growing congestion is the most tangible manifestation of problems linked to current urban form. In reaction, the federal government, states, local jurisdictions, metropolitan planning organizations, and transit agencies have adopted policies and strategies directed at reshaping development into more compact, mixed-use patterns. These efforts have been encouraged by numerous non-governmental organizations and individuals who view our current land use patterns as both environmentally and socially damaging.

One policy that has gained wide acceptance is transit-oriented development. TOD has, over the last decade, become a leading urban planning paradigm in the United States. Proponents of TOD envision dense, mixed-use activity centers connected by high quality transit systems. Metropolitan planning organizations, local governments, and public transit agencies have launched major efforts to direct growth to existing centers, infill sites, and new suburban communities, and in some cases to constrain growth from leap frogging and spilling into adjacent jurisdictions. These efforts are motivated by the belief that new urban forms, which in some ways replicate older forms, will produce significant transportation benefits. Planners assume that TOD will induce more pedestrian and transit trips, and reduce both the average length and frequency of household auto travel.

THE CONCEPT

Figure 1-1 depicts TOD's hypothetical spatial environment. Calthorpe (1993) provides a detailed delineation of the TOD concept. He defines a TOD as a center with a mix of high-density residential, retail, office, public, and open space uses. Retail shops and services are in a commercial core within an easy walk of homes (600 meters or about ten minutes). A transit station is at the center of the core. Uses in the core are "vertically integrated"—apartments and offices rise above ground-floor stores.

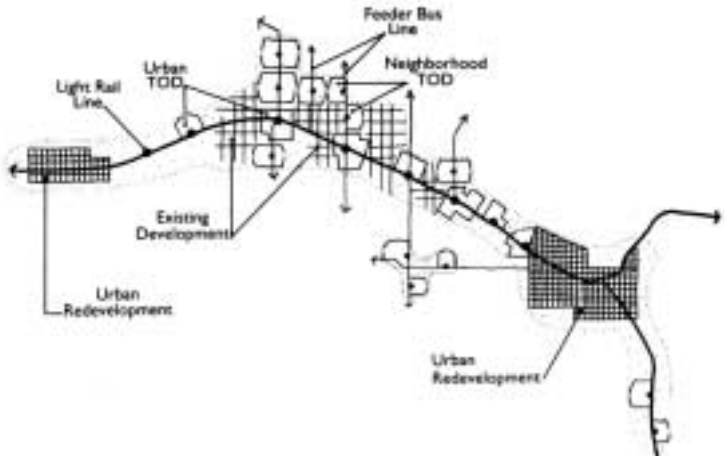

Figure 1-1. Schematic of the Transit-Oriented Development (TOD) Planning Concept (Calthorpe 1993)

Secondary areas for lower intensity uses surround the core to a distance of 1,600 meters. These areas might be locations for single-family housing in a range of sizes, small parks, schools, and light industry. Housing design emphasizes "neo-traditional" features: front porches, shallow setbacks from the street, and alley access to off-street parking. Streets largely conform to a grid pattern and provide direct walking and biking access to the core.

Calthorpe explains that the number and mix of commercial establishments in each TOD would vary depending on the size, location, and overall function of each center, whether servicing nearby residents or an entire community.

Linkage of Centers

Proponents of TOD acknowledge that in order for significant numbers of people to be persuaded to switch from driving their cars to riding transit, centers must be linked by a high quality regional transit system. The centers and the transit linkages between them must be sufficiently numerous and dense to form a "transit metropolis" (Bernick & Cervero 1996). This kind of

metropolis would cause significant numbers of people to switch from using automobiles to riding transit because both their homes and their work locations would be well-served by transit stations. Aside from support of commuting to work, the regional transit linkages of a transit metropolis would also enable access to a range of goods, services, and recreation unavailable in a community center.

Types of Centers

Calthorpe distinguishes two types of TODs—urban and neighborhood—depending on their articulation with the transit system and the intensity of their development.

- Urban TODs are located at stations on a trunk line of the regional system, which could be light rail, heavy rail, or express bus. Their locations are determined by station spacing and are typically 0.8 to 1.6 kilometers apart. Urban TODs have high commercial intensities, employment clusters, and moderate to high residential densities. If urban TODs are located in established neighborhoods, Calthorpe recommends that they be developed at the mix of uses and densities allowed or required under current planning rules.
- Neighborhood TODs are located on a local or feeder bus line within three miles (no more than ten minutes) of a trunk line transit station. They are developed at moderate residential densities and provide for retail, service, entertainment, recreation, and civic uses. Neighborhood TODs can be closely spaced to form a “corridor” of activity nodes.

Proximity of Competing Retail

Since a TOD depends, in part, on retail uses to attract pedestrians and transit riders, nearby auto-oriented retail centers can compete with and diminish its utility. For this reason, Calthorpe (1993, p.82) proposes that new competing retail uses should be strictly limited within one mile of the core commercial area through zoning amendments within the TOD market area.

A RISING NATIONAL PARADIGM

So numerous are the metropolitan planning organizations across the United States that have embraced transit-oriented development (TOD), that it would not be inaccurate to describe it as the key national transportation-land use planning paradigm. Its genesis goes back at least to the rail systems built just after WW II. Porter (1997, 1998) recently reviewed the status of station-area development for North American urban rail systems that were placed in operation beginning in the mid 1950s. His categorization of these systems and older systems by generation is shown in Table 1-1.

Efforts are underway to extend and upgrade several of the current systems, and many other regional and local transit agencies have initiated or are contemplating major investments in new transit capacity, particularly light rail systems. These agencies expect that dense and mixed-use development around stations will follow and cause significant shifts away from automobile usage for both work and nonwork trips.

Table 1-1. Generations of Urban Rail Transit Systems

Generation	City or Region (Year Operations Initiated)
Simultaneous city/transit development, continuous since the mid 1800s, including modern extensions:	Boston Chicago Cleveland New York Philadelphia
Mid 1950s to mid 1970s major regionwide systems:	Toronto (1954) San Francisco (1973) Washington, D.C. (1976)
The Third Wave, late 1970s through 1980s:	Atlanta (1979) San Diego (1981) Miami (1984) Buffalo (1985) Pittsburgh (1985) Portland (1986) Vancouver (1986) Baltimore Metro (1987)
New systems the 1990s:	Los Angeles (1990) Sacramento (1990) San Jose (1991) Baltimore LRT (1992) Detroit (1993) St. Louis (1993) Denver (1994) Dallas (1996)

Source: Porter 1997, 1998

FEDERAL AND PRIVATE SECTOR ENCOURAGEMENT OF TRANSIT-SUPPORTIVE LAND USE

Federal transit support for construction of these new systems is conditioned on a showing of supportive land use patterns. And several separate federal initiatives have been mounted to encourage the integration of transportation with land development. Federal interest in the linkage between land use and transportation goes back to the late 1970s when new subway systems in the San Francisco Bay area and metropolitan Washington, DC failed to gain the ridership expected because not enough housing and commercial development was close to the train stations (TCRP 1995). Authority for the most recent efforts was granted in the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and revised in the Transportation Equity Act for the 21st Century (TEA-21) of 1998. TEA-21 requires that the metropolitan planning process provide for consideration of projects and strategies that will, among other things, "protect and enhance the environment, promote energy conservation, and improve the quality of life."

Regulations implementing the Act (23CFR450.316) require several factors to be considered and reflected in metropolitan transportation plans including: "the likely effect of transportation policy decisions on land use and development and the consistency of transportation plans and programs with the provisions of all applicable short- and long-term land use and development plans." The regulations specify that this analysis should include "projections of metropolitan planning area economic, demographic, environmental protection, growth management, and land use activities consistent with metropolitan and local/central city development goals, and projections of potential transportation demands based on the interrelated level of activity in these areas."

Thus, TEA-21 appears to explicitly require a future estimate of the level of activities encompassing both work and nonwork and their impact on transportation patterns.

Federal New Starts and Funding Criteria

"New starts" transit projects are funded by the Federal Transit Administration under authority granted by Congress in TEA-21 and the federal transportation budget. Recommendation for full funding is now based, in part, on a number of land use criteria that are strongly supportive of TOD goals (Table 1-2). Projects receive higher ratings and are more likely to be funded when there are transit-supportive land use conditions and government policies, including regional growth management policies to control dispersed development.

Current New Starts Funding Status

The U.S. General Accounting Office, in a report to Congress that scrutinized the "new starts" transit projects, identified 14 projects under construction, and 42 other projects already either in final design or preliminary engineering stages (GAO 1999b). The GAO estimated that the $8.2 billion that Congress authorized in 1998 for new transit projects will fall $7.6 billion short of the federal money needed to construct these projects. In addition, the GAO said the FTA expects that over $40 billion more in federal dollars will be requested to help fund another 100 projects currently in the early planning stage.

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Table 1-2. FTA Land Use Criteria for New Starts

Category	Rating Based On:
Corridor Economic Conditions	Demand for locating in corridor
Existing Zoning	Density and mixed-use allowable
Existing Station Area Development	Existing land use is transit-supportive
Station Area Planning	Is being conducted and is supportive of TOD
Regional Growth Management	Effective region wide policies implemented
Urban Design Guidelines	TOD-supportive; implemented for station areas
Promotion and Outreach	Agencies actively conducting for TOD
Parking Policies	Strength of restrictive policies
Zoning Changes	TOD-supportive, implemented or developed
Market Studies	Comprehensive analysis of TOD market potential
Joint Development Planning	Strength of public-private program

Source: U.S. DOT 1998

Other Federal Support for TOD

Several federal agencies, including Department of Transportation, Department of Housing and Urban Development, and Environmental Protection Agency have initiated efforts to encourage more compact and efficient patterns. These new initiatives include grant programs the Federal administration announced in January 1999 and re-emphasized in the FY2001 budget submission in January 2000. The programs try to protect sensitive lands and leverage new, more intensive forms of development (Table 1-3). They supplement efforts begun under ISTEA and continued under TEA-21 to rate and fund new mass transit starts based on a set of land-use criteria.

Table 1-3. New Federal Transportation-Land Use Initiatives

Agency	Program
Environmental Protection Agency	Better America Bonds—$10.75 billion in bonding authority over five years to finance projects that preserve green space, create or restore urban parks, protect water quality, and clean up brownfields.
Department of Transportation	Transportation and Community and System Preservation Pilot—$52 million in FY 2001 encouraging states and localities to coordinate land use plans and transportation.
Department of Housing and Urban Development	Regional Connections Initiative—$25 million in FY 2001 for matching grants to design and pursue smarter growth strategies across local government jurisdictional lines.

Source: Clinton-Gore 2000

Fannie Mae Mortgage Initiative

In August of 1999, Fannie Mae announced a $100 million “location efficient” home mortgage initiative (Fannie Mae 1999). The program will attempt to increase home ownership in densely populated communities accessible to efficient public transit. It recognizes the lower household expenditures that result if household members use transit rather than a personal vehicle. More of a household's income is thus available to pay housing costs, and the owner can

qualify for a mortgage loan at a lower level of income. Trials of the program are underway as of mid 2000 in five cities.

ACTUAL EXPERIENCE AND GROWING CRITIQUE

In spite of unprecedented efforts to rebuild metropolitan areas around transit-oriented development, the actual future benefits of TOD on a metropolitan scale remain uncertain, as we will show in the research review below. The most important reason for the uncertainty is the difficulty of predicting the market's response to policies dependent upon major transit system changes and land use shifts.

As described in the previous section, TOD often involves major new transit capacity investments, usually hundreds of millions of dollars or more in light rail and commuter rail systems. In order to stimulate new land use patterns and density, these public investments are typically made before supportive land uses — employment, housing, and commercial services— are in place.

Unfortunately, at the state of the planning art at the end of the 20th century, transit investments are made without the assistance of empirical data or predictive models that can test the veracity of the assumption that benefits commensurate with costs will be achieved. In particular, the effect of TOD on nonwork activities, from which a majority of all personal travel is derived, has not yet been thoroughly addressed by research. The analysis of nonwork travel for shopping, eating out, and recreation is complex because of the interplay of numerous variables that determine developer, store owner, and consumer reaction to transit investments, land use policies, and other government actions. New data and insights regarding the consumer marketplace are needed to realistically evaluate the likely success of TOD and the expensive investments in new transit capacity that it requires.

Furthermore, taxpayer-funded investments whose payoff depends on private-sector organizational and consumer embrace of TOD are invariably made without a research-based recognition of the many elements that already determine the current patterns of retail structure and consumer behavior (Nelson & Niles 1999). An understanding of retail structure and derived travel as it exists today is obviously essential for the determination of TOD success tomorrow. Retail, when broadly defined as activities involving shopping, eating out, or engaging in recreation and other leisure pursuits, constitutes a major portion of all personal and household trips. In addition, retail logistics patterns account for much of the growing intraurban commercial truck travel that contributes to traffic congestion.

Thus, information that reveals the interplay of real estate and retail industry investments and consumer preferences is important for the purpose of validating two separate, widely-held planning assumptions: 1) that TOD, and its required transit expenditures, will actually result in dense, mixed-use centers; and 2) that these centers will, if created, appreciably change the overwhelming preference for automobile-based mobility.

After further framing of the important research questions, this section reviews the existing research that does bear on these issues.

Framework for Measuring TOD's Success

In our research framework, the central question for planners and decision makers is the magnitude of TOD's effect on travel behavior on a regional scale in established metropolitan areas. From an economic perspective, regional success of TOD will depend on the benefits it produces—both public or societal and personal—relative to its costs (Table 1-4). The public may experience benefits in the form of congestion reduction and air quality improvements. To the extent that TOD reduces excessive infrastructure costs associated with dispersed development, these would be accounted as secondary public benefits. The principal personal benefits may be travel time and expense saved, in addition to reduced congestion time. Personal benefits also include the possibility that some households can reduce the number of cars they own and operate. Other benefits, of a social nature and more difficult to monetize, are associated with the enhanced quality of living that some social analysts believe TOD produces (TRCP 1997).

Table 1-4. Simplified TOD Regional Cost-Benefit Accounting

Costs	Benefits
Transit system construction	Congestion reduction (time delay and excess fuel)
Transit system operations	Air quality improvement (health costs reduction)
Mitigation of traffic congestion caused by compact development	Reduced infrastructure
TOD planning, developer incentives	Personal travel time, vehicle operation savings
	Personal vehicle ownership reduction

Source: Nelson & Niles 1999b

The antecedent transit capital and operating costs are the primary public costs of TOD. The cost of producing housing in proximity to stations may also be higher. Other direct costs may arise, as well. For example, to the extent that increased density does not result in reduced travel, congestion mitigation measures may be required. There may also be costs associated with TOD planning and any public incentives that may be needed.

Achieving a level of benefits that exceed costs under the accounting in Table 1-4 depends on the response of developers, consumers, and taxpayers to the concept and to the public strategies that encourage it. We note in passing here that this response depends on even more elements than the complex of retail industry and consumer behavior issues, which this report identifies. The specific characteristics of the selected transit technology, the compatibility of TOD with personal housing, employment and commuting preferences, and the economics of location selection by organizations that do not serve the general public are also pertinent. Niles and Nelson (1999a) have identified 16 planning elements that will determine success at the regional or transit corridor level (Table 1-5). The table also highlights that fewer factors will control success at a single station-area, which puts the already well recognized challenges of station-area planning in perspective (PSRC 2000).

Table 1-5. Factors Determining the Success of TOD

Factor	Station Area Success	Regional Success
Number and siting of TODs (station areas)		X
Transit quality		X
Transit technology		X
Street pattern	X	X
Station area parking	X	X
Employment and housing density	X	X
Commercial mix	X	X
Retail siting criteria		X
Regional market structure		X

Table 1-5. Factors Determining the Success of TOD (Continued)

Factor	Station Area Success	Regional Success
Consumer activity patterns		X
Travel behavior/trip chaining		X
Zoning flexibility/land assembly	X	X
Resident reactions	X	X
Housing type preference/life style & life stage		X
Self-selection in residential choice	X	X
Government policies		X

Source: Niles & Nelson 1999b

Empirical Studies of TOD's Impacts

Since multi-center TOD on the regional level is now only a vision in the minds of planners, the impact of TOD on regional travel demand, patterns and mode choice cannot yet be directly measured from experience. Consequently, researchers have resorted to comparing older neighborhoods that approximate TOD and conventional suburban neighborhoods that do not. Other studies attempt to isolate the influence of specific design features and land use density and diversity. Also, metropolitan planning organizations and others have carried out limited modeling of TOD under a layer of arbitrary assumptions about future mode splits.

Empirical studies suggest that compact and mixed-use development may produce localized transportation benefits (See Table 1-6). However, these investigations fall short of giving planners and decision makers confidence that the promised macro-scale transportation benefits of TOD can be achieved (Nelson & Niles 1999a).

Table 1-6. Empirical Studies of the Travel and Land Use Impacts of Transit-Oriented Development and Related Design Elements

Location	Authors
Neighborhood/Community Form Comparisons	
Austin (Texas)	Handy 1996
Palm Beach County (Florida)	Ewing et al. 1994
Puget Sound region (Seattle)	Moudon et al. 1997
San Francisco Bay area	Handy 1992 & 1993
San Francisco Bay area	Friedman et al. 1994
San Francisco Bay area	Cervero & Radisch 1996
Seattle area	Rutherford et al. 1996
Density, Design, and Mixed Use Factors	
Los Angeles metro area	Boarnet & Sarmiento 1998
Puget Sound region (Seattle)	Frank & Pivo 1994
San Diego County	Crane & Crepeau 1998
San Francisco Bay area	Cervero & Kockelman 1997
Regional Congestion Management	
San Francisco Bay area	Luscher 1995
Post TOD Studies	
Portland metro area	Dueker & Bianco 1999
Los Angeles Blue Line	Moore 1993

Source: Nelson & Niles 1999a

In particular, the studies available do not sustain the belief that the necessary restructuring of the urban landscape and retail marketplace can actually be accomplished. And even if major restructuring can be realized, they provide little evidence that the large transit investments supporting the restructuring are

likely to produce transportation system performance benefits that the traveling public seeks.

Crane (1999) summarizes his review of empirical studies of the effect of land use variables on transportation as follows: “The results reported in any given study (may not be) incorrect, (rather) they appear to lack sufficient credibility to be the basis for policy. The risks of assuming they are reliable include unintended consequences, such as worsening traffic problems.”

There have been books and articles written that offer the opposite point of view (Calthorpe 1993, Cervero 1998), but none of them provide empirical evidence that refutes the conclusion we offer here.

Portland, Oregon, has been a laboratory for TOD and a focal point for research. Its Eastside Metropolitan MAX light rail transit line, the first in a planned metro-wide radial network focusing on downtown Portland, opened in 1986. Portland has gone to considerable lengths to encourage transit-oriented development that supports MAX.

Dueker and Bianco (1999) analyzed data to measure the impacts of the first ten years of operation of MAX on development patterns, choice of residential location, freeway traffic, and transit ridership. They found that light rail alone was not sufficient to change development patterns appreciably, and that the length of the peak period became longer for freeway traffic in the same corridor over the same decade. Growth in MAX riders occurred mainly in the non-peak and weekend periods. The researchers also observed substantial self-selection in housing location choice, meaning that some of the new housing near MAX light rail stations was mainly filled with residents who were already heavy transit users, rather than by formerly auto dependent households looking for a new, more transit-oriented style of mobility.

Implications of Empirical Research

Having an awareness of this empirical research, Dunphy (1995) suggests that if TOD is to make a meaningful difference in development patterns, there must be significant change on a regional scale. This change must be accomplished within the economic and political context of a particular region whose urban form has developed over a long period, the result of local zoning policies and myriad private investment decisions. Zoning, once established, is difficult to change, especially if the intent is to increase density. And because real estate is inherently a long-lived investment, a large majority of structures will still be standing at the end of the normal planning period.

Assuming that higher density centers linked by a quality transit service can be created, the scale of the transit investment required is an important

consideration. Downs (1994) provides one estimate by calculating the number of TODs needed to accommodate the average population growth during the 1980's of metropolitan areas with a 1990 population of one million or more. He concludes that TODs could handle the growth if their numbers were large, but that this would require a regional transit system that would likely not be financially feasible.

Long-term public support for such major investments requires that the potential benefits of TOD be clearly identified. Although station-area benefits are important, the public will put more weight on regional benefits, since typical household travel patterns extend beyond an individual's home neighborhood. Furthermore, most people will measure success by reduced congestion on major corridors and improved regional air quality, not by the more subjective goals of the proponents of New Urbanism and opponents of automobile-dependent development, goals such as less social segregation, a better quality of life, and a heightened sense of community.

TOD is more than a planning exercise; it involves major public investments. Sound public process dictates that officials estimate TOD's benefits before making major policy decisions. Beyond building new regional transportation systems, governments will need to buy public services and infrastructure that support compact development—streets, sidewalks, and parks. To the extent that mode shift does not follow from the changes in land use, there will be additional public expense associated with the management of increased vehicle traffic within compact areas.

These investments will likely compete with other demands on the public purse. And, if intended benefits are not forthcoming, they will translate to lost opportunity costs for government and to wasteful expenditures of political capital required to achieve significant urban restructuring.

As Bookout (1992) suggests, the challenge is to know the market that planning seeks to restructure, i.e., gain more information on the "ever-changing needs, preferences, and aspirations of people who make up communities." Howe and Rabiega (1992) posed a similar question after finding that the attitudes of members of the Oregon planning profession were negative toward strip malls and positive about "urban village" forms of commercial structure: "What do consumer choices and travel patterns reveal about their relationship to the most elemental parts of the commercial urbanscape—the stores?" Calthorpe, a leading proponent of TOD, acknowledges this challenge: "Clearly much more research and analysis is needed to clarify and quantify the potential results of new land use patterns on our travel behavior. It is critical... to effectively directing federal and state transportation dollars..." (Calthorpe 1993).

Robert Cervero, who has done extensive studies of the land use and transportation connection, has commented that “transit investments that are out of kilter with how our cities and regions grow do nobody any good. Running trains and buses that fail to draw people out of drive-alone cars does little to relieve traffic congestion, conserve fuel, or reduce pollution. The best prescription for filling trains and buses, and winning over motorists to transit, is to find a harmonious fit between transit systems and the cities and suburbs they serve” (Cervero 1998).

CHAPTER TWO

IMPORTANCE OF NONWORK ACTIVITIES AND TRAVEL IN REGIONAL PLANNING

INTRODUCTION

Travel for the purpose of engaging in nonwork activities has grown steadily in significance over the last three decades of the twentieth century. As we will show in this chapter, nonwork travel now accounts for about three-fourths of all household vehicle trips and four of five person trips. Nonwork is the major travel purpose even in weekday peak periods, both a.m. and p.m. Increasingly, nonwork trips are linked to work trips as well as to other nonwork trips in tours involving several stops. And nonwork activities may also be indirectly responsible for the increasing volume of commercial vehicle trips.

Yet, in spite of its overwhelming dominance in trip volumes, nonwork travel has received little attention in personal travel research and transportation planning, compared to the work trip. There have been only a few cursory analyses of nonwork travel, and these have neglected the probable impact of the large changes in the consumer marketplace that occurred in the 1980s and 1990s.

The focus on the work trip may be the result of its presumed regularity and predictability and its association with peak demand and congestion. Nonwork, in contrast, covers a broad variety of purposes, destinations, and starting times. Patterns of nonwork activities for one traveler change from day-to-day, and this has led some analysts to consider it to be discretionary travel. Nonwork travel is inherently more complicated and therefore more difficult to address analytically—to measure and to model predictably—than is work travel.

In real-world applications of transportation data, planners and project engineers often estimate the impact of nonwork trips through standardized trip generation rates for different land uses, covering the spectrum from fast food restaurants to major shopping malls. However, the effect of multiple generators on aggregate travel demand does not appear to have been fully explored.

A complete picture of personal travel in the United States requires an understanding of nonwork as well as work trips, the specific purposes and spatial locations of nonwork trip generators, and the often complex travel patterns that involve nonwork activities linked in a trip chain or tour. This understanding is of more than academic interest. Nonwork travel, because of

its magnitude, has important implications for current transportation and land use policy, particularly transit-oriented development (TOD).

In this chapter we summarize national trends for nonwork activities and travel patterns. We review the conclusions of previous studies that speculated on the causation of growth of certain categories of nonwork trips, and we offer some additional reasons for nonwork travel growth that seem more explanatory of the observed phenomena. In particular, we relate the growth of nonwork travel to the dynamic changes that have occurred in the retail and consumer services marketplace, particularly to shopping for goods and services, eating out, and other leisure activities.

NONWORK TRAVEL DEMAND

The Nationwide Personal Transportation Survey provides data on nonwork travel aggregated at the national level (U.S. DOT 1995). Table 2-1 indicates the distribution of the 379 billion person trips by all modes in the United States in 1995, by specific trip purpose. Shopping generates more individual point-to-point trips than going to work. The three next largest purposes are also nonwork categories: “other family and personal business”, “other social and recreational,” and “eating out.” The “other family and personal business” category includes the purchase of services such dry cleaning, auto repair, personal care, banking, and legal services. “Other social and recreational” includes entertainment, recreation, and cultural events. These four nonwork categories accounted for about 54 percent of all person trips in 1995.

Our focus is on these trip purposes because they involve locations that comprise what we define as the retail marketplace: namely stores and other businesses offering consumer goods and services, restaurants and drinking establishments, and venues for a wide range of recreation, social, and cultural activities. These activities tend to have numerous locations as a result of multiple enterprises competing to find the best sites for attracting the consumer’s dollar and attention. In other words, a traveler has more than one possible choice of destination for each activity. The “other” category includes some nonwork activities that are more likely to be constrained to locations that are fixed by circumstances, such as visiting friends, seeing a doctor or dentist, and trips to school and church, although we recognize that even doctors, schools, and places of worship in some sense compete for customers, and that people switch their allegiance from time to time.

Table 2-1. Trip Purpose as Percentage of All Person Trips, 1995

Trip Purpose	Percentage	Destination Flexibility
Work and Work Related	18	Somewhat inflexible
Shopping	21	Flexible
Other Family and Personal Business	15	Somewhat flexible
Out to Eat	8	Flexible
Other Social/Recreation	10	Flexible
Other	28	Somewhat inflexible

Source for columns 1-2: U.S. DOT 1995
Source for column 3: Integrated Transport Research

Growth of Nonwork Travel

Nonwork travel can now be tracked across five applications of the NPTS as shown in Table 2-2. (The data are divided into two periods to reflect changes in the survey methodology that were made in the 1995 NPTS.) Although nonwork person trips have remained essentially constant as a share of all trips, nonwork vehicle trips have increased in relative significance. The largest vehicle trip frequency growth over the 26-year period has been for purposes of shopping and other family and personal business. VMT and vehicle trip length also increased until 1995, when some decreases were noted. Work trips grew between 1990 and 1995 as employment expanded in a strong economy.

Table 2-2. Percentage Change in Vehicle Travel and Trip Length by Trip Purpose, Per Person, 1969-90 and 1990-95

Trip Purpose	Average Annual Vehicle Trips		Average Annual VMT		Average Vehicle Trip Length	
	1960-90	1990-95	1969-90	1990-95	1969-90	1990-95
All Purposes	27	12	27	15	1	2

Table 2-2. Percentage Change in Vehicle Travel and Trip Length by Trip Purpose, Per Person, 1969-90 and 1990-95 (Continued)

Trip Purpose	Average Annual Vehicle Trips		Average Annual VMT		Average Vehicle Trip Length	
	1960-90	1990-95	1969-90	1990-95	1969-90	1990-95
To or from work	1	22	20	33	17	8
Shopping	76	16	108	28	16	16
Other family and personal business	137	8	169	1	14	-5
Social & Recreation	15	7	-1	11	-10	-5
Other*	27	36	-32	68	1	23

* Includes trips to school, church, doctor/dentist, and to drop off and pick up.
Source: U.S. DOT 1995

The average length of trips show interesting differences; work, shopping, and other family and personal business trips all increased in length to about the same degree in the 1969-90 period. In contrast, social and recreational trip lengths decreased.

Mode Choice for Nonwork Travel

Table 2-3 indicates the mode used for trips to work and selected nonwork purposes. The private vehicle, in its various forms, dominates as expected, across all trip purposes, but especially for nonwork trips. Walking is the second mode of choice compared to transit for a small, but still significant, portion of trips. This is especially true for “eating out” and “other social and recreational” activities, which probably reflects the convenience of walking from home to a nearby neighborhood commercial center.

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Table 2-3. Percentage of Daily Person Trips by Mode and Selected Trip Purpose, 1995*

Trip Purpose	Private Vehicle	Public Transit**	Walk	Other***
To work	85.8	3.2	4.3	6.7
Shopping	87.6	1.0	4.9	6.5
Other family or personal business	86.0	1.4	4.6	8.0
Out to eat	86.4	0.5	5.8	7.3
Other social/ recreational	79.1	1.8	7.5	11.6
ALL	84.5	2.0	5.3	8.2

*Does not include 3 percent of all trips for which a mode was not ascertained.
**Includes taxicab.
***Includes school bus and bicycle.
Source: U.S. DOT 1995

Timing and Linkage of Nonwork Trips

Nonwork trips are a major portion of all trips at all times of the day as seen in Figure 2-1. More than 80 percent of trips that start in the 4-7 p.m. peak period are for nonwork purposes. Many of these trips are individual links in chained trips or tours as indicated in Table 2-4. More than 60 percent of women and 46 percent of men make at least one stop on work-to-home tours. The location of stops in these tours is important because it tends to reflect the spatial distribution of nonwork activities. However, NPTS data is not geocoded for destination location so it does not give us the spatial pattern of tours.

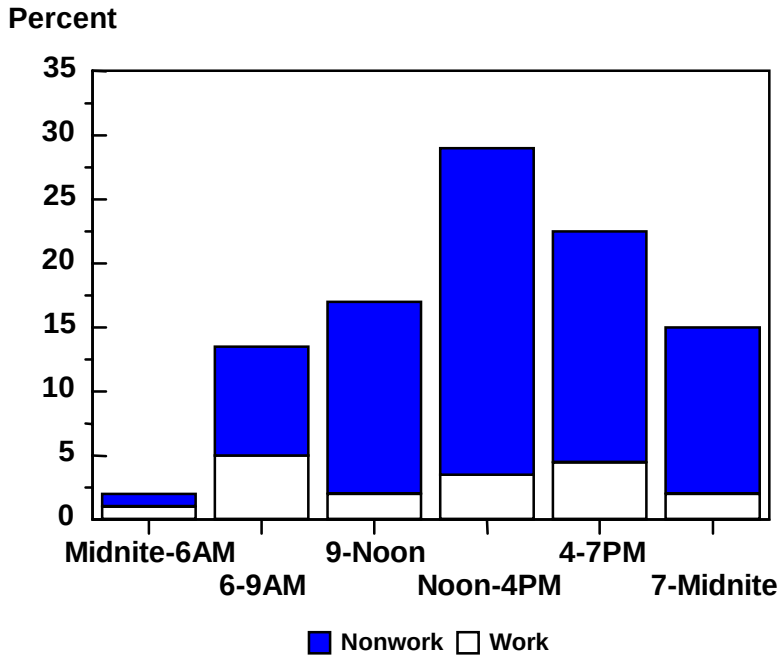

Figure 2-1. Percent of Work and Nonwork Trips by Time of Day

Source: U.S. DOT 1995

Table 2-4. Percentage of Men and Women Who Stop on Work-to-Home Tour

Number of Stops	Men	Women
One or more	46.4	61.2
Two or more	17.7	28.3

Source: McGuckin & Murakami 1998

As chaining of nonwork with work trips has become more prevalent, the distribution of nonwork trips across the seven days of a week has changed. For example in 1995, 77 percent of all shopping trips occurred on weekdays. On average, shopping trips had a higher frequency on weekdays than on weekend days (U.S. DOT 1995).

Vehicle Occupancy in Nonwork Travel

As Table 2-5 shows, vehicle occupancy has decreased for all major trip purposes since it was first recorded in 1977. Yet occupancy for nonwork trips remains considerably greater than for work trips, reflecting the social nature of shopping, family business, and leisure activities. Of course, it is understood that two or more people going to the same destination makes driving more attractive than transit when a private vehicle is available.

Table 2-5. Trends in Average Vehicle Occupancy for Selected Trip Purposes

Trip Purpose	1977	1983	1990	1995	Change (1977-95)
To or from work	1.30	1.29	1.14	1.14	-15.4%
Shopping	2.10	1.79	1.71	1.74	-19.1%
Other family or personal business	2.00	1.81	1.84	1.78	-10.0%
Social and recreational	2.40	2.12	2.08	2.04	-16.7%
All purposes	1.90	1.751	1.64	1.59	-15.8%

Source: U.S. DOT 1995

DISCUSSION

The large growth in personal travel in the last three decades has largely resulted from increased frequencies of nonwork trips, especially trips for shopping and other family and personal business activities. Retail activities account for more than half of all person trips, and most are made to locations where the traveler has more than one choice of destination. Many retail trips are linked in complex tours that involve multiple stops for a variety of purposes. Several family members may be traveling together. These tours require the flexibility that the private vehicle provides, and consequently transit and pedestrian modes are chosen for only a small proportion of all person trips.

CHAPTER THREE

RETAIL ENVIRONMENT AND NONWORK TRAVEL TRENDS

INTRODUCTION

Although the NPTS and regional surveys have documented the large and continuing increases in several categories of nonwork trips since the late 1960's, there have been surprisingly few investigations into root causes. Researchers have suggested various reasons for the growth of nonwork travel: changing lifestyles, a greater proportion of women in the work force, and the decentralization of housing and jobs that has reduced commute time, allowing time saved to be used for nonwork pursuits.

In this chapter we suggest why these explanations provide an incomplete causal understanding of nonwork travel growth. As we have indicated, activities generating nonwork trips have also changed remarkably in the past few decades. An important additional explanation of nonwork travel growth is the rise of considerably more opportunities and choices than ever before to shop, purchase services, and engage in recreation and other leisure pursuits.

We summarize in this chapter the transformation that has occurred in the national retail environment in the new postindustrial, information-based economy. Societal, behavioral, and market forces have combined to create new patterns of retail structure and nonwork activities. Our focus, illustrated by national data, is on the major changes that have transpired in the last three decades in the consumer goods and services marketplace. These changes are ongoing and have important transportation policy implications.

National data are supplemented by the example regional database assembled in this study for the Puget Sound region (see Task 3 report, available at http://www.globaltelematics.com/mineta/). A search of the literature turned up only one other study of the current retail structure of a U.S. metropolitan region. An examination of metropolitan Atlanta found that retail activity in existing neo-traditional communities tended to be limited in scope—coffee bars, restaurants, and dry cleaners—and that general household shopping requires numerous auto trips outside the neighborhood (Fujii & Hartshorn 1995).

NEW STORE FORMATS

The retail landscape has been reshaped by the introduction of numerous new "discount" formats, some at the expense of traditional formats such as

department stores and smaller, often neighborhood, stores. The new formats range from mass merchandisers like Wal-Mart to a wide variety of specialty retailers. The pace of their introduction has been extraordinary (Table 3-1), typically yielding a tenfold or more growth in the number of stores over the last two decades. Because of the many variations and the constantly changing environment, it is difficult to classify all of the store concepts and formats. But nine distinct categories stand out, each increasingly dominated by a small number of national chains (Table 3-2).

Table 3-1. Selected Examples of the Rapid Growth of Mass Retailers

Chain	Category	Units		
		1979	**1989**	**1999**
Wal-Mart	Discount Department Store	229	1,378	2,433
Home Depot	Home Center	3	118	761
Toys “R” US	Toy Superstore	84	522	700
Costco	Wholesale Club	--	43	217
Circuit City	Home Electronics Superstore	--	125	585
Staples	Office Supplies Superstore	--	50	745
Walgreen’s	Combination Drugstore	926	1,416	2,800

Sources: Discount Merchandiser 1999
Chain Store Age: State of the Industry Report 1979, 1989, and 1999

Table 3-2. The New "Discount" Mass Retail Formats

Format	Approx. Units Nationwide - 1998	Size Range or Average (sq. ft.)
Mass merchandiser (discount department store)	9,000	10,000-100,000
Supercenter	1,000	120,000-200,000
Club warehouse	800	100,000
Specialty or "superstore"	91,500	20,000-100,000
Home center	1,000	150,000
Outlet store	10,000	10,000
Combination supermarket	3,900	59,000
Combination drugstore	3,600	13,500
Convenience Store	93,200	800-5,000

Sources: Discount Merchandiser 1999
National Association of Convenience Stores 1998
American Express, 1999

All of these new retail formats are described in some detail in a progress report (see the Task 1 Report, available on the Web for downloading at http://www.globaltelematics.com/mineta/). We focus here on only two: "superstores" and "combination" grocery stores. These stores exemplify the changes in trade areas and trip patterns as stores seek to find competitive advantage in specialization and economy of scale.

Superstores

Superstores, also known as "category killers," are chain stores that control a particular specialty market (Table 3-3). These stores attract customers by offering a large variety of goods within a particular specialty such as books, sporting goods, or office supplies. Superstores typically draw their customers from large trade area equivalent in size to one that is commanded by a regional mall. In fact, many superstores tend to cluster near malls creating major retail concentrations. However, they are not just a suburban phenomenon; superstores are distributed widely across the urban landscape, both inside and

outside central cities. Because of its recent and rapid growth, the superstore phenomenon has not been well documented.

Table 3-3. Superstores in the Puget Sound Region

Category	Number of Stores
Arts & Crafts	6
Books	14
Car electronics	7
Computers	25
Drugs & misc. goods	31
Electronic games	9
Home electronics	25
Home furnishings	10
Music recordings	12
Office supplies	29
Pets & supplies	27
Sporting goods	32
Thrift (second hand)	4
Video tapes	41

Source: Integrated Transport Research

Super or Combination Grocery Stores

Grocery stores are growing in size and decreasing in number, even as the population grows. The number of stores peaked in about 1978 and over the last two decades has been steadily decreasing (Figure 3-1). Between 1990 and 1995, all types of grocery stores decreased 7 percent. Conventional supermarkets decreased 20 percent while the number of grocery "superstores," which typically have a delicatessen, bakery, and nonfood goods and services, increased 17 percent. Some grocery stores have added gasoline pumps. As a result, trips to the supermarket are growing in distance and probably in time expended.

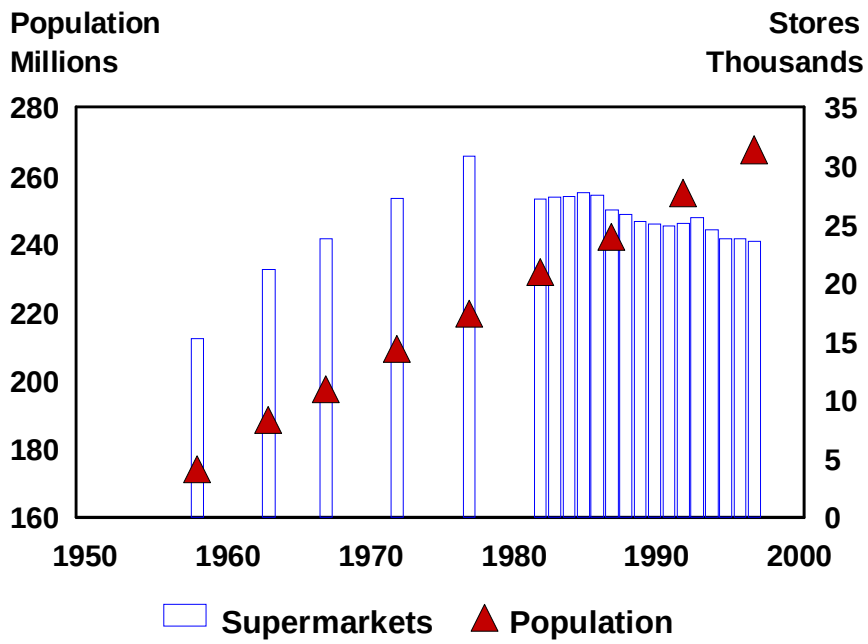

Figure 3-1. Relative Growth of Grocery "Supermarkets" and Population, 1958-1997

Source: U.S. Department of Agriculture, Economic Research Service 1998

NEW CONSUMER SERVICES

The importance of the service industry in the new economy is often measured by its increasing share of the job market. But another measure is the growing diversity of commercial services. Many specialty businesses have been created just for the maintenance and repair of houses, cars, and other personal equipment, and to serve other household and small business needs. Several services in these categories are listed in Table 3-4. A number of these reflect the society's growing wealth and decreasing available time. More people place a higher value on their time and will pay for services, even for routine home maintenance tasks that may have been previously performed by a household member. Time freed up can then be used for higher-valued purposes, whether work or leisure.

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Table 3-4. New Consumer Services

Services We Travel To
ATMs
Specialized auto servicing and repair
Copy centers
Day care
Health clinics
Personal beauty care
Services That Come To Us
Package delivery
Home systems repair
Landscaping
Housecleaning
Used goods charity pickup
Municipal recycling pickup
Home security
Delivery of online and mail-order merchandise

Source: Integrated Transport Research

GROWTH OF OUT-OF-HOME DINING

Dining out continues to be a strong feature of American leisure habits. Although people are not eating and drinking more, they appear to be enjoying a much greater variety. While per capita food expenditures remained essentially constant, food consumed away from home grew from 34 percent of food expenditures in 1970 to 45 percent in 1997 (U.S. Department of Agriculture 1998). The number and variety of eating and drinking establishments grew even faster. In the period 1963 to 1992, the total of these venues rose 66 percent, compared to a 35 percent increase in population. Annual sales growth

between 1999 and 2000 is estimated at five percent by the National Restaurant Association (National Restaurant Association, 2000).

As viewed from the consumers perspective, several reasons have been suggested for the increase in spending on food away from home: 1) the increase in two-earner households that leaves less time for food preparation, and which also increases household income and makes more discretionary income available; 2) the rise in single person households; and 3) the greater variety of restaurant options available (Robicheaux & Harmon 1997).

Fast Food Dominance

Table 3-5 indicates the current major restaurant industry segments and market shares of the leading 100 companies in 1998. These companies accounted for about $125 billion in sales and 164,000 units (Nation's Restaurant News 1999). This was about half of all away from home food expenditures and two-thirds of all units. Fast food—sandwiches, chicken, pizza, snacks—is the predominant choice over sit down eating, and it represents more than half of all units.

Table 3-5. Restaurant Market Share by Major Market Segments for Top 100 Chains

Concept	Market Share
Sandwich	42
Dinner House	10
Pizza	9
Family	7
Chicken	6
Snack	2
Grill-Buffet	2
Fish	1
Other (Contract/sports concessions, Hotel, Buffet, Coffee, Convenience Store, In-Store, and Theme Park)	21

Source: Nation's Restaurant News 1999

Popularity of Cuisines

Although national counts that would reveal the restaurant industry's fine structure are lacking, the changes in the restaurant industry involve much more than the growth of fast-food establishments. For example, foreign and specialty cuisines have shown astonishing popularity, and consequently the food dollar is being spent at many more locations than previously. Table 3-6 indicates the growth of foreign and specialty cuisine restaurants in the Seattle metro area. An industry survey of leading chefs strongly pointed to ethnic cuisines and foreign flavors as the dominant trend (National Restaurant Association 1999). The impetus, in part, may be due to the large immigrant stream from many nations in the last decade. Another factor may be the growing number of Americans who travel abroad and are exposed to foods of different regions and cultures.

Table 3-6. Growth of Cuisine Restaurants in Seattle Metropolitan Area, 1980 -1998

Restaurant Cuisine	Number of Establishments 1980	1998
American	14	30
Barbeque	5	23
Chinese	27	81
Indian	1	27
Italian	13	101
Japanese	10	77
Mexican	19	67
Pizza	13	26
Seafood	13	36
Thai	1	67
Vietnamese	1	24
Other (46 cuisines)	73	188
TOTALS	190	747

Source: U.S. West Yellow pages

GROWTH OF LEISURE ACTIVITY

Recreation is still another example of the major transformation that has occurred in nonwork activities. The share of household expenditures on entertainment and recreation, increased 40 percent between 1950 and 1995, from 4.0 percent to 5.6 percent (U.S. Department of Labor). Real dollars spent by all households on entertainment jumped 8 percent between 1987 and 1997. Since a large portion of recreation is consumed outside the home, the travel effects have been equally large.

More revealing are economic studies that show per capita participation rates for recreation have increased as incomes and leisure time have increased, and as invention and technology have stimulated a rich diversity in the types of recreational opportunities, whether for participants or spectators (Costa 1997). People are able to buy much more recreation value for every dollar they spend. From an increasingly wide variety of choices, people enjoy the opportunity to select the forms of recreation that best serve their interests, abilities, age, and lifestyle.

According to Schwenk, the trends in leisure time and entertainment expenditures can be attributed to demographic patterns, the movement toward healthier lifestyles, and new technology (Schwenk 1992). In 1989, baby boomers between age 35 and 44 spent more than those in other age groups on recreation and entertainment. As these people age, they can be expected to have more discretionary income to spend on leisure activities compared to previous generations.

The great diversity of leisure opportunities makes analysis of participation rates specific activities and the spatial patterns of venues very difficult. Given the ever-changing nature of leisure, trends are even more difficult to follow. Most activity surveys are either lacking in scope or accuracy of measurement technique to allow much more than the identification of broad trends. One national survey has tracked attendance at live artistic performances and participation in other leisure activities since 1982 (National Endowment for the Arts 1998). Growth in participation rates is evident in most major categories (Table 3-7).

Table 3-7. Participation in Arts Events and Other Leisure Activities

Activity	Percent Attending or Participating Once in Last 12 Months			
	1982	**1985**	**1992**	**1997**
Classical Music	13	13	13	16
Musical Play	18	17	17	25
Non-musical Play	12	12	14	16
Active Sports	39	41	39	45
Exercise	51	57	60	76
Amusement Park	49	45	50	57

Source: National Endowment for the Arts 1998

SPATIAL ORGANIZATION OF RETAIL STRUCTURE

In addition to the growing variety of retail activities, the spatial structure of the retail environment has undergone major reorganization in the past few decades. We can only review here the highlights of these changes on a national level that we described more fully in the Task One report. We also provide examples of the spatial distribution of retail locations selected from a series of maps produced for the Puget Sound region nonwork database that was documented in the Task Three report.

Growth in Numbers and Types of Shopping Centers

The planned shopping center is largely a post WW-II invention. Figure 3-2 shows the growth in number of shopping centers of all categories and sizes since 1986, when reasonably accurate national data was first collected. For shopping centers of all sizes, the 1980s were a period of rapid growth that mirrored the increasing numbers of baby boomers who have high levels of personal expenditures.

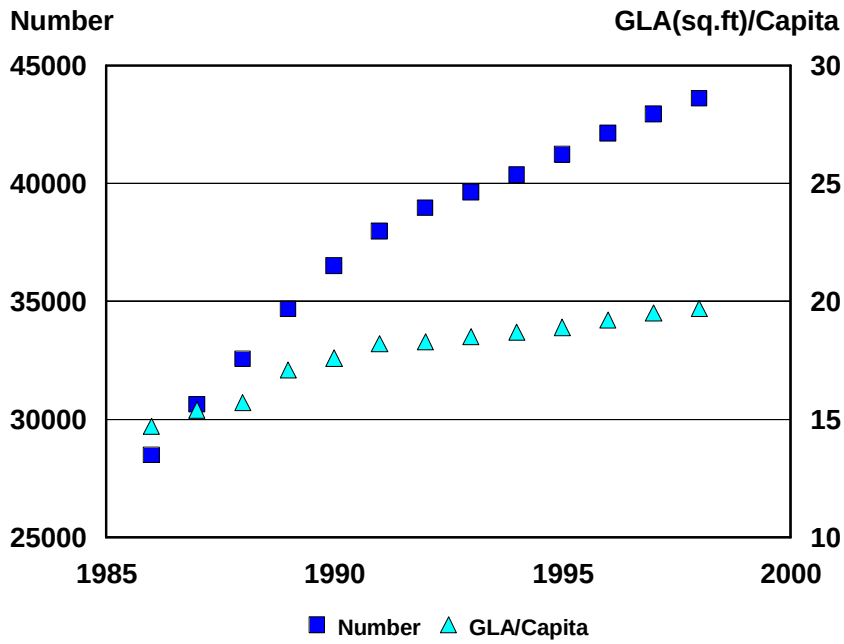

Figure 3-2. Shopping Center Trends

Source: National Research Bureau 1999

Over half of all shopping center area is in facilities that are less than 200,000 square feet. On a per capita basis, the amount of shopping center area has continued to increase. If automobile sales are ignored, planned shopping centers now account for more than half of all retail sales (ICSC 1998). Over the years, new types of centers have emerged, comprising a wide variety of spatial configurations and sizes (Table 3-8).

Table 3-8. Types and Spatial Characteristics of Shopping Centers

Shopping Center Type	Typical Configuration	Floor Area (Sqare Feet)	Primary Trade Area Radius (Miles)
Super regional	Mall, usually enclosed	>800,000	5-25
Regional	Mall	400,000-800,000	5-15

Table 3-8. Types and Spatial Characteristics of Shopping Centers (Continued)

Shopping Center Type	Typical Configuration	Floor Area (Sqare Feet)	Primary Trade Area Radius (Miles)
Community	Strip	100,000-350,000	3-6
Neighborhood	Strip	30,000-150,000	3
Power	Freestanding Cluster	250,000-600,000	5-10
Specialty	Mall	80,000-250,000	5-15
Theme	Mall, sometimes in historic building	80,000-250,000	N/A
Outlet	Mall, strip, "village" cluster	50,000-400,000	25-75

Source: International Council of Shopping Centers 1998

OTHER SPATIAL PATTERN CHANGES

Retail Activity Increasingly Polycentric and Dispersed

That metropolitan America is rapidly developing a polycentric structure is a fact that has been widely documented. Perhaps an extreme example is the Atlanta region, which has more than 70 retail cores, including downtowns and regional malls, with over 1000 retail employees each (Fujii & Hartshorn 1995).

Clustering at Regional Centers Creates Major Retail Concentrations

Both regional and superregional centers are often surrounded by other smaller centers that together comprise very large retail concentrations. National, and even regional, data on the number and size of these commercial clusters is lacking. One regional mall in the Puget Sound area has as many stores and retail space outside as inside (Task Three report). These stores are in strip malls and power centers within one mile of the regional mall.

Freestanding is Still a Major Choice

Many national chains prefer freestanding sites for enhanced visibility and customer access. In 1997, more than half of retail construction starts in the U.S. were freestanding (Levine 1998).

Decay, Renewal and Adaptation of Older Neighborhood Centers and Arterial Strips

The major changes in store format and size, and the increasing number and variety of shopping centers has obviously had an impact on older community and neighborhood centers and strips, as well as the downtowns of older cities in a metropolitan region. However, other than a few studies of individual inner city strips and centers in Los Angeles and some anecdotal information about the condition of strips elsewhere (Loukaitou-Sideris 1997; Jacobs 1997), there appears not to have been a systematic study of the change that these centers have experienced. Although commercial activity in some of these centers has declined, others have adapted and prospered by becoming specialty centers serving a large trade area. One older neighborhood commercial strip in Seattle (Wallingford) is now a center for eating out and entertainment that attracts customers from across the city and nearby suburbs.

Markets Differentiated by Age and Lifestyle

Many stores, especially those selling apparel and other soft goods, target market segments having narrow age and lifestyle ranges. Some stores now cater exclusively to the early teenage market. Thus, household shopping excursions can be expected to involve stops at several different locations, or in the extreme, several separate trips.

Maldistribution of Essential Services

In some instances, the market does not provide convenient access to necessary goods and services for those with low levels of mobility (U.S. HUD 1999). One example that has been studied is the lack of inner-city supermarkets, and as a consequence, higher food prices and/or transportation costs for residents of these areas. A study of 21 metro areas found significantly fewer grocery stores per capita in the lowest-income areas compared to region wide averages. These same areas also had the lowest rates of vehicle ownership (Cotterill & Franklin 1995). Those inner-city families who are able to gain the income and wealth to purchase a vehicle or to move to a better neighborhood probably enter into a more automobile-dependent lifestyle of the type that TOD planners are working against.

Examples of Retail's Spatial Environment

The Task 3 report described the Puget Sound region's retail environment in a series of maps that indicate locations for major nonwork activity venues relative to the proposed TOD structure. Just two of those maps are reproduced here to provide examples of the variety and dispersion of these venues. Figure 3-3 shows the locations of the 300 "superstores" listed in Table 3-3. Many of these stores are clustered in proximity to the major malls and have equally large trade areas. Figure 3-4 shows the locations of all of the major nonwork

trip generators that were geocoded and mapped in the process of creating the Puget Sound nonwork database. These range from discount department stores to nightclubs, and total approximately 1,900 separate venues.

DEVELOPER, RETAILER, AND CONSUMER DECISION DYNAMICS

Several market indicators help explain the observed spatial structure of the retail marketplace, including the size of individual stores, their siting at particular locations, and their spatial relationships to other establishments. They also explain why the retail structure appears to be successful, i.e., why consumers patronize the stores, how it attracts their discretionary spending, and how their response in turn helps shape the retail environment. This synergistic relationship between the interests of developers/retailers and consumers is an essential determinant of nonwork transportation patterns.

New Retailing Strategies

Retailers today, more than ever before, are running their businesses based on a financial planning approach rather than a merchandising approach. A strong economy throughout the 1990s and resulting available investment capital has meant growth in the size of retail firms and resulting monopolistic and oligopolistic behavior. For example, in 1992, the top five supermarket chains had 19 percent of the national market; in 1999 that share grew to 33 percent (Bergmann 1999). Merger activity is high. Hence, the increased importance of larger, national chains in the marketplace.

Investments by larger firms in information and other technologies have caused advancements in manufacturing and logistics to the point that cost of goods and the physical distribution to the store are a shrinking share of the cost of consumption. The main problem faced by firms serving consumers is that of marketing against competition. For retailers, store location is paramount, and planning multiple store sites in a regional market has become much more sophisticated.

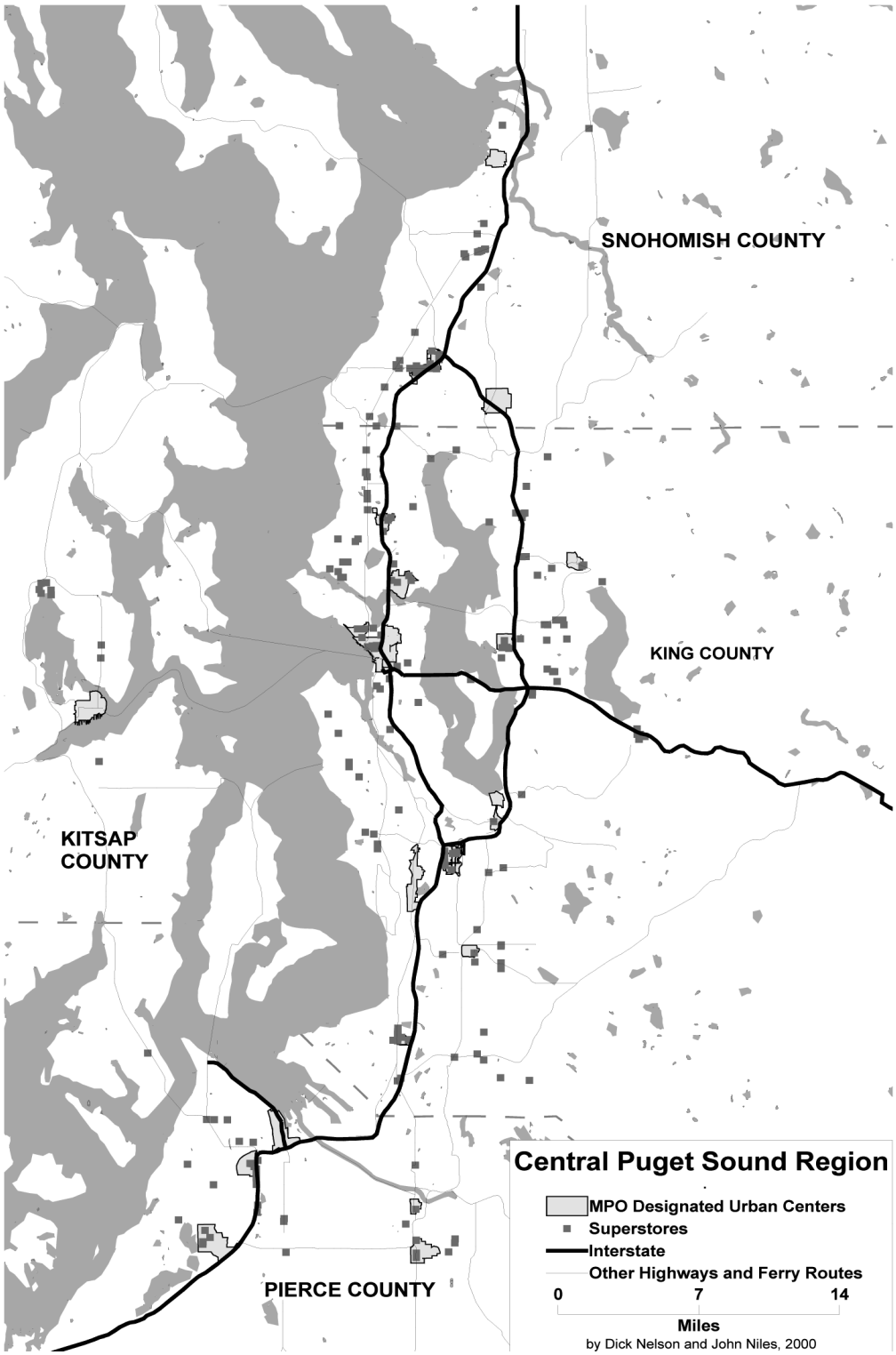

Figure 3-3. Locations of "Superstores" Relative to the Proposed TOD Structure of the Puget Sound Region

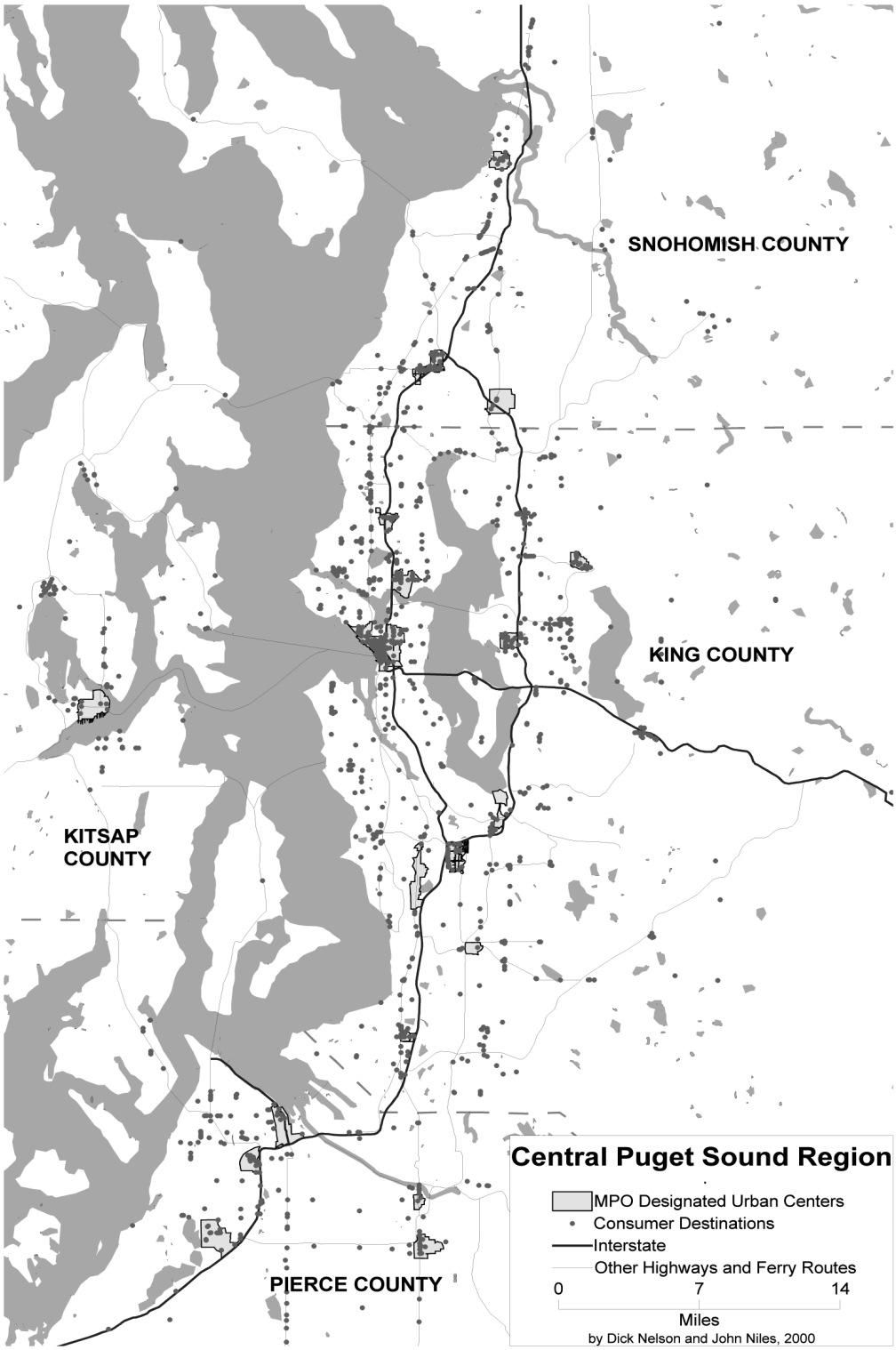

Figure 3-4. Locations of Major Nonwork Trip Generators Relative to the TOD Structure of the Puget Sound Region

Power in the market has shifted to the consumer and in turn to retailers who are closer to the consumers and are aware of their needs. One need is time saving. Thus as society becomes more affluent, the time constraint is replacing the income constraint in the allocation of goods. Increasingly, people buy goods and services that save time that is then allocated to other activities.

The trend toward increasing polarity in retailing continues. On one hand, superstores emphasizing large-scale diversified operations and logistical efficiency take a larger share of the market. On the other hand, firms that emphasize deep but narrow product lines and more responsive consumer services grow in importance. As the share of the market of both types increases, the share of firms in the space between these two poles shrinks.

Social institutions, such as the family, the work place, and the school, are in charge of shaping consumption and are directing and constraining both the times and nature of activities. Social institutions similarly influence the choices that consumers make among major product categories associated with activities.

Store Location Strategies

Table 3-9 lists the chief factors that are involved in the land developer's and retailer's choice of size of retail unit, and the general location and specific site selected for the unit (Nelson & Niles 1999). We briefly describe each of these factors.

Table 3-9. Key Retail Location Decision Factors

Scale and scope economies
Agglomeration economies
Regional accessibility
Visibility, local access and parking
Environmental impacts
Zoning and public resistance
Local government revenue needs

Source: Nelson & Niles 1999

Scale and Scope Economies

Economies of scale and scope are the most visible manifestations of the new retail economy and structure. Many categories of retail firms are building

bigger stores that attract customers from a larger geographic market area. Even stores that have been traditionally a part of neighborhood retail centers, and that remain so today—groceries, barbershops, pharmacies, and bookstores—have scaled up. Some retail formats have reached a market size that requires a store area, including parking, that would be a difficult fit in a core commercial center such as a downtown. These include "big box" retailers—discount department stores, warehouse club stores, home improvement centers, and other "category killers"—that generate large numbers of trips for many hours of both week days and weekends. Most customers arrive by car which enables them to conveniently haul purchased items that are heavy, bulky, or numerous.

Even the convenience store, which has replaced the "mom and pop" neighborhood grocery as the nearest place to purchase food, bottled drinks, and tobacco, has achieved a market scale that creates a difficult fit except in locations at the edge of a residential neighborhood. Most convenience stores are on busy arterials, and their customers are drawn from a large trade area.

Agglomeration Economies

Clustering has long been a feature of the retail marketplace. Competition leads simultaneously to competing stores positioning themselves geographically into clusters and to similarity among products (Hotelling 1929). Retail firms also tend to locate in close proximity to other firms that offer complementary goods (Jones & Simmons 1990). The clustering of competitors facilitates comparison shopping; the clustering of different kinds of stores facilitates one-stop shopping. In both cases, clustering benefits both the retailers and their customers. Total travel distance and cost are reduced, and positive externalities are created, i.e., a total market that is greater than the sum of the individual markets when the same stores are not clustered. Agglomerations also offer retailers the benefit of reduced overhead. Parking is shared, as are other costs such as security and even advertising.

Clustering occurs at several levels: in central business districts, regional malls, outlet malls, "power centers," and smaller malls and retail strips along arterials. Clusters involve services as well as retail stores, e.g., post offices, libraries, banks and ATM machines in shopping centers and malls. The mix of stores is usually subject to careful selection to maximize cumulative attraction and impulsive purchasing.

Fast food outlets cluster with department stores in regional malls to take advantage of high pedestrian flows generated by their neighbors. Restaurants also cluster. Pilsbury concluded, after an extensive study of the Atlanta-area restaurant industry, that clustering was the most important factor determining restaurant location (Pilsbury 1987). According to Pilsbury, this "competitive

linkage" strategy has produced an almost total clustering of restaurants in most communities in Atlanta.

As the retail marketplace continues to reinvent itself, clustering becomes even more heterogeneous. A recent development is the "stacked entertainment zone," that may include restaurants, food courts, cinemas, ice rinks, video game arcades, art galleries, and spas. These highly diverse activity assemblages have replaced the department store as the destination anchor in some shopping centers.

Regional Accessibility

The growing size of market areas is obviously related to the greatly increased regional accessibility that personal vehicles and modern urban roadway systems provide. Some retail centers—e.g., ethnic and lifestyle shopping districts, factory outlet malls, major recreation venues—may be dependent on a market that extends across an entire metropolitan area. Even regional shopping malls generate a considerable amount of "cross shopping," i.e., shoppers live close to one mall but also frequently shop at other regional malls.

Large stores and their lower prices are also very much facilitated by modern information technology, another form of accessibility. This includes bar-code price scanners to keep checkout lines moving, point of sale terminals wired to inventory management systems and credit/debit card networks, and global logistics management systems connecting stores to warehouses and factories worldwide.

Visibility, Local Access, and Parking

All stores seek visibility to attract customers and to provide convenient access to the site. Since the car is the dominant mode for shopping trips, many retail chains prefer stand-alone sites on major roads and at key intersections. Such sites serve to project the image of the company and to support its advertising, and they provide convenient site access, entrance and egress, and parking that is free from competition from other activities. Compared to a shopping mall location, freestanding stores control their own business hours and can be open to customers around the clock. Stand-alone sites also allow retailers to grow at faster rates than through traditional shopping center development.

Environmental Effects

Quite apart from the vehicle traffic consequences caused by large size, certain stores are difficult to locate adjacent to residential areas because the activity generates noise, high volumes of refuse, or just looks bad. These include modern grocery stores, auto repair services, funeral homes, and operations like craft stores and brew-pubs that have manufacturing or processing operations on the premises.

Zoning and Resident Resistance

In already developed areas, current zoning is a central political issue for realization of restructured neighborhood centers. Residents resist rezones that allow more mixed-use development. Efforts to introduce commercial businesses into existing residential areas, even when not requiring zoning changes, often meet opposition. Expansion of commercial activities is more probable in commercial zones that have underutilized capacity. It will tend to take the form of the existing commercial center, which is most often an arterial strip.

Local Government Competition

Local governments generally see commercial development as a net tax revenue generator compared to even dense residential development, and are inclined to being receptive to the siting of major retail stores and complexes. Some local governments provide incentives to attract developers who are looking for a site and who can choose among locations within a large trade area.

Consumer Behavioral Factors

Several key behavioral traits of consumers that hold implications for TOD planning are listed in Table 3-10.

Table 3-10. Key Consumer Behavior Factors

Bargain hunting
Comparison shopping
Preference for variety
Destination flexibility
Schedule flexibility

Source: Integrated Transport Research

Bargain Hunting

Competition attracts price-conscious consumers who travel outside their neighborhood, trading higher travel and time costs for lower-cost merchandise. This is particularly the case when consumers purchasing prepackaged, standardized, well-known brands are responding to regional promotion. Newspapers typically carry inserts containing coupons, rebates and advertising

inserts describing low-priced goods available only in big-box stores, superstores, and off-price retailers located throughout a metropolitan region.

Comparison Shopping

Both stores and goods are classified as either convenience or specialty. Convenience stores and goods account for most purchases, and consumers choose locations for convenience shopping that minimize travel. Even for specialty shopping, consumers generally prefer locations that are as close as possible.

However, some specialty stores—such as those selling furniture, major appliances, or automobiles—generate higher levels of longer, "comparison" shopping trips, i.e., customers will bypass other similar stores to shop there. This behavior results from marketplace competition offering customers unique mixtures of price, quality, variety, and service that may be scattered throughout a metro area.

High levels of comparison shopping have been observed on a regional scale. Although large malls in the same metro region may have the same anchoring chain stores, they may differ in their mix of specialty stores. Some may have a more upscale mix compared to the regional average. This tends to produce "cross shopping," with some consumers consistently visiting two or more regional malls.

Preference for Variety

People will pay more in travel costs to find variety or a unique shopping experience. For some, shopping is a recreational activity, and "satisfaction" is a large component. Malls that include food courts, multi-screen cinemas, amusement rides and electronic game parlors, concert stages, traveling festivals, and fashion, automobile, hobby, and crafts shows are playing to this preference. These venues and events are typically designed to draw customers and their family members from a large area well beyond the immediate neighborhoods.

Bargain hunting, comparison shopping, and preference for variety all show up in market research. From 1995 to 1999, the number of weekly shopping trips by females held steady at 3.5, but the number of stores visited doubled, from 1.4 to 2.9 across the same period of time (Prepared Foods Online Newsletter 2000). Consumers who were surveyed viewed shopping as part necessity, adventure, pragmatism, and emotion.

Location Flexibility

Choice in the marketplace allows travelers to adjust to changes in the cost of a trip. For example, to avoid congestion or to combine several travel purposes in

a chained trip, consumers can access the same retail store at another location without increasing the time or direct cost of the trip.

Schedule Flexibility

Consumers exhibit considerable flexibility in the time scheduling of trips to retail activity centers, often made possible by extended store hours. Nonwork trips combine with trips to and from work, and they originate from work sites. Tours involving one or several nonwork activities typically occur after work hours and on weekends.

Dispersion of Other Nonwork Activities

In the past, people might have chosen to patronize local businesses and professional services. Now, many of these nonretail, nonwork household activities, have for many people moved to locations outside their immediate neighborhoods. Examples are choice of church, children's school, and family doctor.

DISCUSSION

Table 3-11 summarizes important current national trends in the size, number, variety and spatial dispersion of stores (Nelson & Niles 1999b). Equally important trends are apparent in the consumer services and recreational sectors.

Table 3-11. Major Trends in Retail Structure

Retail activity increasingly polycentric and dispersed
Planned shopping centers dominate market
Smaller malls cluster around major malls
"Big Box" market share growing
"Super" stores growing in kind and number
Many chains prefer stand alone sites
Drive to and through convenience growing

Source: Nelson & Niles 1999b

From a transportation perspective, the most important aspects of the new store formats is their number, spatial distribution, and spatial organization, i.e., their siting with respect to other stores and to older centers of retail activity. The number of trip generators has expanded greatly, much faster than population. At the same time, retail's spatial structure has changed in ways that both

increase and decrease travel. One trend is to one-stop shopping, either within an individual retail unit that offers a wide range of goods and services, or as a result of the spatial clustering of several separate units. The result in the latter case can be very large retail concentrations such as those found at regional malls. Another trend is the choice of some retail businesses to prefer isolated locations. While some retailers prefer to cluster, even with their competitors, other retailers choose stand-alone sites that provide greater visibility, access, and control over hours of operation, which increasingly are 24/7—24 hours per day and 7 days per week. The market has reacted to the need for more flexible hours of operation that more closely fit increasingly varied household schedules.

Store locations and their spatial organization have not been unduly constrained by land use limitations, and developers and retailers have been generally free to build stores where they are most profitable. Their freedom to locate has been indirectly assisted by residents who, being very protective of existing residential zoning, are not critical of the retail strip and the retail clustering that are the bane of planners. Freedom for retailers to locate about anywhere is also helped by competition among local jurisdictions for tax revenue generated by retail sales.

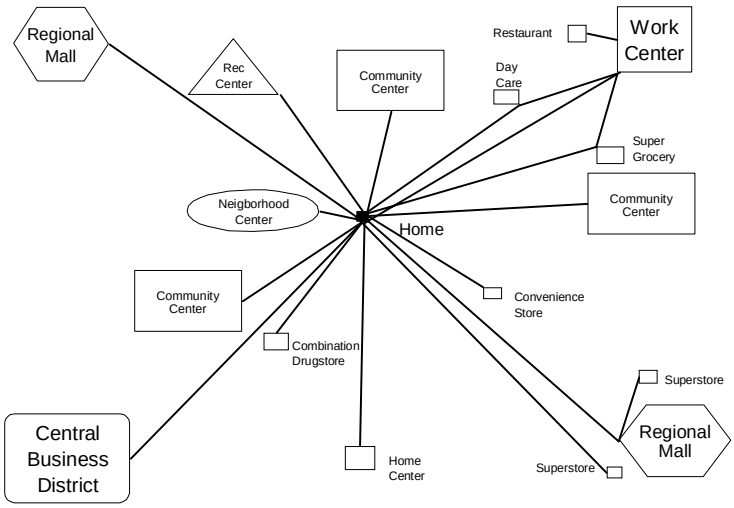

Figure 3-5. Hypothetical Household Nonwork Travel Patterns

Source: Integrated Transport Research

Figure 3-5 attempts to represent schematically the household travel patterns generated by the new retail structure. Obviously, individual household patterns

will differ greatly. And a simple diagram cannot begin to suggest the complexity of actual travel patterns that are integrated over the population and time. Even the frequency of travel from one household to specific locations is not easily captured in one diagram.

But the schematic is instructive in that it does provide a sense of the increased number of retail destinations, their spatial relationships, and how high levels of mobility and accessibility enable trips to multiple centers and stand-alone sites dispersed across a metropolitan region.

Figure 3-5 also suggests how chaining of trips improves the efficiency of travel. Finally, it attempts to portray a basic reality: consumers are willing to spend more of their disposable income on transportation to access the great variety of offerings now available in the marketplace.

An understanding of the new retail environment provides insight into the growth of nonwork travel, which is an essential element of TOD planning. Nonwork activities and travel have grown in a dynamic process involving consumer demand, technological change, and market innovations. Growing disposable income provides the buying power that supports expanding consumer preferences for a variety of goods and services and for the needs of saving time and achieving multiple purposes in trips to make purchases. These consumer needs are fed by the outputs of technological and market innovation, including new products and services, global production and supply chains, various levels and forms of customer service, and development of new retail niches. Innovation and expanding consumer preferences feed on one another, yielding the modern retail structure described in this chapter—many retail venues both large and small, dispersed widely, and responsive to the accessibility provided by automobiles, the overwhelmingly dominant mode of transport. This retail structure in turn leads to increasing nonwork travel demand.

An inherent aspect of a modern capitalistic market system is a two-way link between consumer preferences and business-driven innovation. Feedback serves and expands those preferences. And opportunities generated by growing wealth and technological innovation stimulate the market to offer even more variety and choice.

All of this plays out in the spatial realm of a metropolitan region, whether inside or outside the central city. New trip attractors are continually being added that change personal and aggregate travel patterns, both increasing the number of nonwork trips and vehicle miles traveled. People organize their trips into complex tours that allow efficient access to the increasing numbers of

destinations, while minimizing trip time and distance within their activity budgets.

CHAPTER FOUR

NEEDED: PLANNING METHODOLOGIES THAT ACCOUNT FOR URBAN COMPLEXITY AND UNCERTAINTY

INTRODUCTION

Retail dynamics, consumer behavior, and nonwork trip generation establish the dimensions of the complex, dynamic urban system that is the context for TOD planning. The complexity encompasses the interaction of known, multiple forces and the continuing introduction of new forces as a result of technological innovation, entrepreneurship, and competition. This chapter begins with a brief review of the theoretical understanding of complex systems and uncertainty. It then describes the limitations of current urban planning to encompass complexity and uncertainty, and it indicates the key elements of a new urban transportation and land use planning process that can deal with the complexity and future uncertainty of the dynamic urban system.

As Richmond (1998) points out, planners have to face up to this complexity in their planning: "Recognizing that transportation is inevitably tied into an intricate web of overlaps with all other urban functions and with the rich morass of human life complicates the planning task but makes it more likely to achieve meaningful results." Along the same lines, Innes and Booher (1999) note that in the complex metropolitan development system "simplification results in fundamentally wrong answers, and focus on individual sectors separately will be counterproductive."

CHARACTERISTICS OF COMPLEX SYSTEMS

As Casti (1997) describes, complex systems generate surprises from five distinct mechanisms:

- Paradoxes, leading to inconsistent phenomena;
- Instability, leading to large effects from small changes;
- Incompatibility, leading to behavior that transcends rules;
- Connectivity, leading to behavior that cannot be decomposed into parts; and
- Emergence, leading to self-organizing patterns.

These mechanisms work across the dynamics of daily vehicle traffic, of consumer response to opportunity over a seasonal buying period such as Christmas or summer, of the labor market as firms start up, expand, contract, and shut down, and of industry responses to business opportunity, whether the industry is commercial real estate, entertainment, or retail.

The surprises that come from complexity force planners to grapple with three forms of uncertainty about the future (van der Heijden 1996):

- Risk, where the occurrence has historical precedent, and the probability of reoccurrence can at least be estimated.
- Structural uncertainties, where we can understand how a unique new event can happen, even though there is not enough experience to judge the likelihood.
- Unknowables, where a future event cannot even be imagined. The existence of unknowables calls for enhanced perception and skill in reacting appropriately.

FACTORS CAUSING COMPLEXITY IN URBAN TRANSPORTATION AND LAND USE PLANNING

Table 4-1 summarizes the substantive factors that should be accounted for in long-range transportation and land use planning. This list of sources of risk, uncertainty, and complexity is organized around a list of topics and categories that we created from our own observations and general reading about the forces that bear on how urban areas function. Many of these are complex in themselves, and some are obviously interrelated, which adds additional complexity. Aspects of this complexity are analyzed by Hibshoosh and Nicosia (1987), who describe how the dynamics of family life, employment, and other social institutions work individually and in combination to influence travel behavior.

It is important to note that many of these factors carry both a weight and direction in terms of their impact on metropolitan spatial form and travel patterns (Colby 1933). In other words, they differ in the effect they have on the compactness and integration of land uses. Some are centripetal, tending to produce lower densities and separation of uses, e.g., the need of families for affordable housing tends to move demand and growth to the periphery of an urban region. Others are centrifugal, tending to cause higher land use densities and an amalgamation of uses. This could be the case for some members of an aging population who seek to downsize their residence and find a location convenient to goods and services. The factors are vectors in mathematical terminology, and should be treated as such when used in a planning exercise.

Furthermore, the amount of change across any future time period cannot be very well predicted, and thus is a cause of the risk and uncertainty inherent in transportation planning. The new factors that might arise in Table 4-1 that are totally unexpected illustrate the potential for unknowables.

An understanding of these vectors is enhanced by both national and regional empirical data and other more subjective information. We have presented national data in our Task one report. Regional nonwork-related data for the case study region, the central Puget Sound area, is presented in the Task three report.

COMPLEXITY AND THE CURRENT PLANNING PROCESS

The results of metropolitan planning processes carried out by Metropolitan Planning Organizations (MPOs) are generally not infused with a recognition of the complexity and uncertainty that is underlined by the length of the list in Table 4-1. Metropolitan Transportation Plan (MTP) documents rarely describe and discuss the many risks and areas of uncertainty that result from the action and interaction of the factors listed. In particular, an emphasis on guiding development toward areas of currently existing and emerging areas of geographic concentration, and then connecting the areas with mass transit, does not obviously seem to embrace the need for flexibility to respond to unknowables.

Mierzejewski reaches a similar conclusion about the handling of complexity and uncertainty after a comprehensive survey of current planning and modeling approaches (Mierzejewski 1995, 1996, 1998a), and a close study of the planning efforts of 25 MPOs in Florida (Mierzejewski 1998b). He reviews the inability of travel demand models to accurately predict future travel patterns, and he suggests a need for new regional planning methods that take into account uncertainty and provide for flexibility in transportation investments and strategies.

Table 4-1. Sources of Complexity, Risk, and Uncertainty

Demographics/Socioeconomics
Net population change, including migration
Household size trends
Age profile, life span, and lifestyle
Income levels and distribution
Residential Dynamics

Table 4-1. Sources of Complexity, Risk, and Uncertainty (Continued)

Residential mobility
Preference for residential size, style, and environment
Regional distribution of housing costs
Effects of aging population
Preference for home ownership
Self-selection by transit riders
Household reaction to congestion
Employment/Education Dynamics
Industrial Structure
Spatial distribution of workplaces
Change in workday and week
Part-time and temporary work
Multiple jobholders
Self employment/work at home
Telecommuting/telelearning
Employer reaction to congestion
Work-based travel for work-related and other purposes
Population Distribution
Growth beyond central cities and counties
Intra-regional shifts
Inter-regional shifts
Older central city resurgence
Land Use Dynamics
Land use policies and regulations
Redevelopment and in fill development

Table 4-1. Sources of Complexity, Risk, and Uncertainty (Continued)

Open space preservation
Public reaction to density and mixed-use
Nonwork Activity
Variety and spatial distribution of "retail"
Local government need/competition for tax revenues on location
Trends in going out vs. staying at home
E-commerce
Freight and Goods Movement
Just-in-time delivery to industry
Home delivery of goods
Courier services
Changing load factors in trucks
Costs, Benefits, and Other Fiscal Factors
System capital and operating costs, including those for feeder
System utilization rate--new transit riders
Externalities, including delay time and wasted fuel
Direct private vehicle costs, including demand pricing
Net benefit (cost) of alternatives
Opportunity costs
Available government and private resources
Employer subsidization of alternative modes
Personal and Public Transportation Technology
Alternative fuels
Advanced vehicle propulsion technology
Advanced fixed-guideway systems

Table 4-1. Sources of Complexity, Risk, and Uncertainty (Continued)

Safety improvements
ITS applications
Other Technology Affecting Travel to Work and Nonwork Destinations
Teleconferencing
Electronic service delivery
Ubiquitous Internet
Virtual reality
Environmental Policy
Air quality standards
Greenhouse gases
Pollution from surface water runoff

Source: Integrated Transport Research and Global Telematics

LIMITATIONS OF CURRENT MPO MODELING

The response to complexity seen in the typical MPO planning processes (standardized in Federal laws such as ISTEA and TEA-21) yields a simplified geographic configuration consisting of travel analysis zones (TAZ) made up of three kinds of subzones where people to varying degrees sleep, work, and engage in buying goods and services. The usual four-step model used to describe movement among these zones and subzones is a series of equations calibrated to the latest available data on traffic flows and transit patronage. The model defines how land use is related to the movement of cars and transit vehicles. The basic structure of the model is then applied 20 or more years in the future against the same zones with projected estimates of who and what will be in the zones, based on assumptions for future residential population, employment, and kind of development. The mode by which people will travel in the future, car, train, bus, or walking is also estimated.

The modeling process carried out as described has a number of significant limitations (Nelson & Niles 1999), summarized in Table 4-2.

Table 4-2. Limitations of Four-Step Transportation Modeling Applied to Nonwork Travel

Characterizes nonwork travel as unlinked trips
Aggregates all nonwork purposes into one or two categories
Assumes that functional relationships between input data and nonwork activity are constant from the present to 30 years out in the future
Does not encompass all the presently known forces shaping consumer activities and destinations
Cannot be calibrated in the baseline historical year with nonwork activity data
Makes no allowance for consumer or retail industry response to congestion

Source: Integrated Transport Research

A planning methodology that exposes the considerable complexity in current and future transportation and land use patterns will consequently add to the uncertainty attached to regional models used to predict future patterns and transportation system performance. This should cause MPO planners to reconsider the application of models to long term prediction or, in the very least, should persuade them to introduce uncertainty into their modeling practice in their predictions of both continuous and discrete values.

CURRENT MAJOR PREMISE: GOVERNMENT ACTION SHAPES URBAN FORM

The overarching paradigm and set of policies governing all the assumptions in MPO planning is a government plan for changing transportation and land use in the future—typically, new roads, expanded public transportation systems, and more density near the places to be served by public transportation.

The very common TOD-rail paradigm that is considered a front-edge planning practice in alignment with Smart Growth principles is essentially a high-stakes gamble that in the long-run, government investment, incentives, and rules will cause the density of population, employment, and service offerings to increase around a network of transit stations. This density boost on top of the

availability of transit capacity is assumed in the future to cause a reduction in driving, to be replaced by transit use, walking, and bicycling.

Ironically, while the TOD paradigm responds to the complexity of the marketplace, technology, and entrepreneurial behavior with a seemingly elegant concept, TOD also introduces additional complexity to both urban development and the lives of individuals:

- Mixed-use buildings in a dense configuration are more complex to construct and operate than single uses in a more dispersed configuration (City of Seattle 1999).
- Experience has shown that mixed-use TOD projects introduce complications to the development process. For example, as Boarnet et al (1997, 1998, 1999) have found in California that local governments that are pursuing the TOD-rail paradigm seek to maximize their tax revenue by emphasizing commercial and minimizing housing near transit stops. In most cases they pursue local needs over regional policies.
- For travelers, journeys involving transfers at transit stations between modes or vehicles are often more complex and time-consuming than single-mode auto journeys.
- Visible stores in a traditional mall with parking may be easier for more consumers to find and use more of the time than multilevel retail space packed around a train station.

One track for urban transportation improvement, of course, is to work to overcome these complexities inherent in TOD. But even doing that does not reduce the real risk that TOD—even if very well done—may not be able to change the travel behavior of enough people in a region to make any difference in the environmental quality that people care about. Our conclusion from the findings presented so far is that the time is right for a new, structured examination of the assumptions and results of the MPO's planning work. A new process could take advantage of the existing modeling, design-oriented visioning, and other MPO practices, but then bring an additional focus on the complexity in metropolitan markets and nonwork travel, and the resulting uncertainty about the future. The results of a supplementary process, described below, could then be melded into the results of the MPO planning process for a more robust result in the face of risk, uncertainty, and unknowables. The new planning process could generate a range of possible future scenarios that go beyond TOD, that could serve an alternative or supplementary response to growing complexity and the manifestly uncertain impact of present TOD policies designed to achieve goals.

KEY ELEMENTS OF A NEW NONWORK TRAVEL PLANNING PROCESS

We call the new approach the Nonwork Travel Improvement Planning Process (NWTIPP). These are the definitions of terms we commonly use:

- Premise: The assumptions about how the world operates that stand behind paradigms, scenarios, and policies. A common main premise in MPO transportation planning is that government over several decades can influence land use to change sufficiently to cause modifications in household behavior that show up as a regional shift in travel mode.
- Paradigm: A vision of how society could work if certain premises about individual and organizational behavior hold true and if certain policies are implemented. TOD is a paradigm that follows from the main premise in MPO transportation planning.
- Scenario: Summary description of patterns of events in the future, as influenced by uncontrollable external forces and by public policies and spending. Scenarios are alternate implementation paths for paradigms. An example of a scenario: Developers of retail space changing their focus from customers arriving by automobile to customers arriving by transit.
- Policy or strategy: Broad principles that guide action by government and the private sectors, often in pursuit of a paradigm, as in the case of transportation planning. Investment in rail mass transit to influence future land use is an example of a policy or strategy. In the private sector, "strategy" has a connotation of taking competitive behavior into account, whereas "policy" does not.
- Program or tactic: Specific action that conforms to and implements policy or strategy. The detail of zoning and design requirements around a transit station is an example.

One objective in the design of the NWTIPP is to create a planning template that is capable of identifying strengths and weaknesses in the main premise behind the TOD-rail paradigm. In detail, the main premise is that low-density, single-use urban form can be reshaped by government action—rail (mass) transit investments and land use policies/strategies—to result in compact, mixed-use urban form that in turn supports and justifies the rail investment by producing new transit riders.

Example statements that summarize the TOD-rail paradigm are shown in Table 4-3. They range from general to specific and from national to regional to local. The first is from a meeting of U.S. planning professionals and local

government officials in 1991, the second from a metropolitan planning organization, and the third from a city planning department. In the case of the Puget Sound Regional Council statement, "transit" refers to a mix of light rail, express buses, and local buses. Viewed in light of the previous chapters, these statements together represent good intentions of well-meaning leaders to change the way businesses operate and people live their lives, despite the challenge of market forces that work in different directions.

Table 4-3. The TOD Paradigm: From General to Specific

Congress of New Urbanism: The Ahwahnee Principles **Guidelines for New Urbanism Development — Community Principles**
"Community size should be designed so that housing, jobs, daily needs, and other activities are within walking distance of one another." "As many activities as possible should be located within easy walking distance of transit stops." Source: Local Government Commission 1992
Puget Sound Regional Council – Vision 2020 Plan for Urban Centers
"The VISION 2020 strategy is to reinforce and diversify our existing urban centers ... to build an environment that will attract residents and businesses to the advantages it offers. These advantages include excellent access to frequent and fast transit that connects to other centers and to surrounding neighborhoods, a selection of attractive and well-designed residences, and proximity to a diverse collection of services, shopping, recreation and jobs." Source: Puget Sound Regional Council 1995
City of Seattle Transportation Strategic Plan – October 1998
"Support Development of 'Full Service' Neighborhood Business Districts." "This strategy promotes shopping within neighborhoods by helping Seattle's urban villages to offer a full range of products and services to meet people's day-to-day needs." Source: City of Seattle 1998

We think a good planning process needs to consider alternative premises: for example, that the forces at large in the marketplace are too numerous and strong for government actions to reshape regional form and modes of travel to any meaningful degree. Following from revised premises, the NWTIPP would be able to identify alternative paradigms, scenarios, and policies/strategies.

Premise and Paradigms are a Planning Choice

Table 4-4 illustrates how the recognition of a broad premise—that government action can make a difference—leads to the opportunity to choose among a variety of paradigms and strategies that may reduce automobility and its impacts. Note that we take account of cost in classifying the strategies for a particular paradigm. The pursuit of one strategy may consume so many public dollars that the opportunity to pursue other strategies is lost because of insufficient resources. In short, every strategy carries with it an *opportunity cost*.

Although the paradigms and strategies listed in Table 4-4 appear to encompass a broad range of possibilities, the listings in the table are intended to serve only as examples. And as we continually emphasize, the planning process may choose to begin with a wholly different premise regarding the efficacy of public transit construction to shape land use and the resulting regional market share of transit and walking modes.

Other characteristics we have designed into the NWTIPP:

- **An emphasis on continuous learning by participants in the planning process.**

From analyzing urban development in California as a complex system, Innes and Booher (1999) conclude that more sustainable urban development will come from learning that is generated from the individual interactions of system participants. They note that "sustainability is about process, not about a particular vision, pattern, set of rules, or criterion."

Table 4-4. Policy Paradigm Choices and Strategies in Government Action that Address Growing Urban Automobile Usage

Paradigm	Strategy Examples Classified by Relative Cost			
	Higher Cost	**Moderate Cost**	**Lower Cost**	**Incremental**
Improve or promote transit to increase its market share in the competition with cars	Rail construction	Bus rapid transit; park and ride lots	Increase frequency and quality of existing transit service	Subsidies and incentives for bus pass distribution, carpools, and vanpools

Table 4-4. Policy Paradigm Choices and Strategies in Government Action that Address Growing Urban Automobile Usage (Continued)

Paradigm	Strategy Examples Classified by Relative Cost			
	Higher Cost	**Moderate Cost**	**Lower Cost**	**Incremental**
Change land use to stimulate more walking and transit use and constrain car use	TOD at new transit stations	TOD at existing transit centers	Limit parking spaces at new developments if served by transit	Prohibit zoning that limits apartment development in areas served by transit
Accommodate cars and other vehicles by increasing road capacity	Build new roads	Intelligent Transportation Systems (ITS) applications	Widening, intersection improvement and better signalization	Maintain existing roads to quality standards; build more only in proportion to population growth
Reduce pollution from cars to make their use less damaging	Buy back old, polluting vehicles	Promote the use of zero-emission vehicles	Annual emissions inspections	Spot detection and citation of polluting vehicles
Constrain automobility to reduce use of cars	Congestion pricing on existing highways	Tolls to finance new highways	Traffic calming	Raise taxes and fees on gasoline or cars
Preserve open space and sensitive lands	Extensive government land purchase	Moderate land purchase	Purchase of development rights	Require cluster development and dedicated open space

Note: Shaded two cells together constitute the Rail-TOD paradigm. Paradigms and strategy elements are illustrative. They can be mixed and matched in various combinations. The main point is to illustrate the wide range of choices available.

Source: Integrated Transport Research

Based on the findings described earlier in this report, we conclude that a uniform, nationwide planning model imposed by the Federal Government on complex metropolitan transportation development may not yield sufficient learning to successfully address the complex problems at hand.

- **Explicit focus on nonwork travel.**

As fully described earlier, travel for shopping, eating out, culture, and recreation constitutes the majority of urban trips and these activities are a very important shaper of urban form. Our process also includes the residential and employment site location dynamics—the places where nonwork trips either originate or terminate.

- **Metro-region-wide process.**

Many retailers now think in terms of total metropolitan areas, so we recommend that thinking about nonwork travel improvement be focused on this scale as well, instead of at the corridor level or subarea level like the Major Investment Studies (MIS) carried out under ISTEA and now merged into Environmental Impact Statements (EIS) as a result of TEA-21. For TOD in particular, much of the research and planning focus is now carried on at the station-area level, rather than at the level of comprehending regional impacts.

- **Explicit recognition that not making an additional transportation investment, or doing less than initially contemplated, may be the most desirable alternative.**

There are two reasons for this recognition—(1) people can adapt to reduced transportation services by using alternative locations and behaviors, and (2) there are productive, non-transportation purposes for spending the money that is diverted from transportation-related spending, with some of these purposes serving the same needs that transportation spending would fulfill.

As a general example, it may make more sense to build a new shopping center close by to a residential community that lacks adequate roads to a distant shopping center, rather than expanding the road capacity to the existing shopping center. By putting limits on transportation spending, the planning process remains open to the larger array of issues and options in which transportation planning is embedded.

- **May be carried out by Metropolitan Planning Organizations (MPOs), but more likely to be carried out initially by civic interests not officially sanctioned by the MPO.**

MPOs are generally deeply invested in a limited set of options. The opportunity for designing new alternatives is most likely to come from a new set of actors. If not carried out by an MPO, the end result of the planning process will have influence on official decision making to the degree that the analysis carries the authority of expert knowledge and persuasive reasoning.

- **Will not necessarily follow federal planning guidelines, programs, and other requirements for transportation planning by MPOs.**

Figure 4-1 depicts a general representation of the urban transportation planning process carried out by MPOs, as described by Pas (1995). The NWTIPP we describe below emphasizes just the underlined portions of the overall process, in addition to the focus on nonwork travel. The Planning Team may recommend changes in federal requirements if they appear to block the execution of a superior planning process and set of resulting outcomes. Table 4-5 makes a comparison between the NWTIPP and the typical Metropolitan Transportation Plan carried out by MPOs.

- **Able to work within a more time-constrained planning horizon than the 20 years mandated by the U.S. government for a Metropolitan Transportation Plan, and much more constrained than the 30 to 50 year time frame utilized by some MPOs.**

We have stressed the complexity of the urban milieu that governs human activity and transportation, and entrepreneurial real estate development and consumer service offerings. The rapidly emerging Internet economy adds to the complexity. While planning for capital-intensive transportation infrastructure such as bridges, tunnels, freeways, and rail systems certainly calls for a multi-decade planning horizon, we note that options for transportation improvement need not be limited to capital expenditures of this type. We find the notion of putting all transportation planning into a multi-decade framework troubling, because the result may be an unnecessary

emphasis on capital expenditures, and a variety of lower cost, more short-term options may remain unconsidered.

Table 4-5. Comparison between the Proposed Transportation System Improvement Planning Process, and the Current Metropolitan Transportation Planning Process (MTP)

MTP	NWTIPP
Carried out by MPO under legal mandates	Possibly carried out by MPO, but more likely to be carried out initially by other civic interests
Legal basis for regional transportation investments	Potential influence on investments based on quality of planning results
Based on Federal regulatory requirements	Not constrained by Federal regulations
Seeks to optimize the morning peak period	Can be focused on other problems and issues
20+ year time horizon mandatory	Shorter time horizons possible and preferred
Typically begins with a paradigm such as rail-TOD or new road projects and seeks to justify that paradigm	Seeks to find better paradigms to address problems of public policy importance
Centered on the 4-step urban transportation model	4-step model results are just one input

Source: Integrated Transport Research

URBAN TRANSPORTATION PLANNING PROCESS

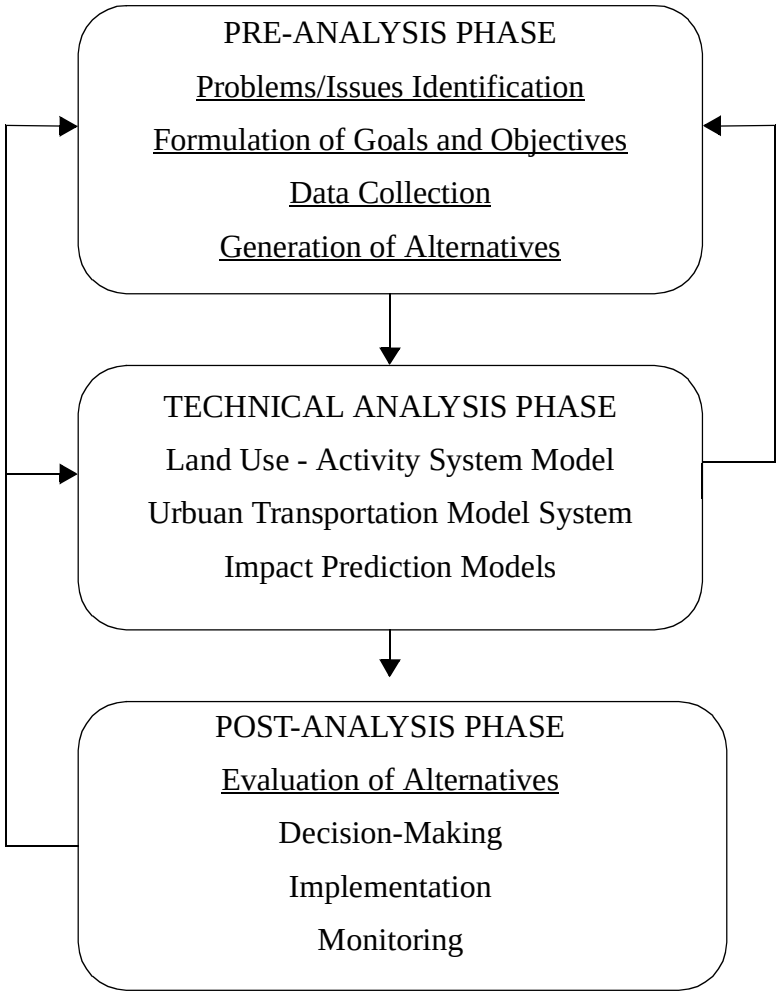

Figure 4-1. Urban Transportation Planning Process Flow Chart

Source: Pas 1995

Planning for more incremental expenditures may provide a more flexible response to an uncertain future, as opposed to demonstrating an heroic but ill-founded attempt to shape the future with steel and concrete built for the ages. With longer time horizons, solutions that are more easily implemented and

more flexible may be ignored in comparison to solutions that appear to be more durable and long-lasting, yet less effective in terms of public benefits (Zwerling 1974).

The reason that a more time-constrained planning horizon may be preferable in the case of the transportation planning overlay we are recommending goes beyond the uncertainty about the future that is inherent in a complex system. The accelerating rate of change of the system adds to the uncertainty. The volume curves for several drivers of our society at the end of the century show accelerating rates of growth—transistors in a microchip, Internet hosts, Internet web sites, volume of online shopping, business-to-business electronic commerce, and e-mail messages.

- **Generates and supports strategies and policies that are flexible and adaptable.**

Given the complexity of urban development and of the market economy that drives development, we expect that premises may need to be modified with the passage of time as a result of new understanding about the way the metropolitan area is functioning, and about the impact of public policies. The ability of a policy to change as premises and paradigms change is a measure of the policy's ability to achieve objectives and solve problems under an array of scenarios that may not be in government's control.

- **Incorporates predictive models that are transparent.**

The four-step, gravity-analog transportation models that are at the heart of MPO transportation planning are notoriously obscure for the non-specialist. We believe it is important to carry out additional processing on the raw outcomes from these models.

Assumptions, simplifications, and their impact on accuracy need to be apparent and outside the complex inner workings of the "black box" computer model.

- **Provides outputs as a range, in addition to discrete "point estimate" values.**

In practice, many MPO planners use their transportation models to issue only single values, rather than ranges. This practice portrays the estimates of transportation performance several decades in the future as more precise that they really are. Providing "predictive intervals" is educational as to the degree of uncertainty about the future.

- **Acknowledges and manages all technical transportation system alternatives — immediately feasible or not.**

Individual members of the public and the media are very interested in the prospect of advanced transportation systems. Businesses around the world have new options on the drawing board. A higher level of public involvement will result if a fairly open process of considering all technical transportation options is maintained. These can be handled fairly through a consideration of their performance and cost parameters. We observe that transportation planning in practice focuses very quickly and conservatively on a rather narrow range of technical alternatives—light rail, commuter rail, and standard buses.

- **Comes to grips with the emergence of the Internet economy, widely deployed microcomputers, ubiquitous personal communications, and other likely technology expansions over the next five years, and the decades beyond.**

The rise of the network economy is already a distinctive feature of the present era. The ubiquitous presence and use of computers and telecommunications is not yet mentioned in very many Metropolitan Transportation Plans, yet already is producing impacts on transportation. The routine use of cellular phones in cars is increasing the value of time alone in a moving automobile, for example. The continuing growth in small package delivery services in urban areas is another example, along with the announcement of billions of dollars in warehouse construction by firms selling goods on the Internet. The growing impacts from online selling on particular categories of retail businesses—bookstores, automobile dealers, and travel agencies—is a third illustration.

- **Accounts for the range of costs and benefits of the various scenarios that will arise from each examined alternative paradigm and its associated policies.**

This accounting also should describe the public costs and potential revenue sources to implement the policies.

CHAPTER FIVE

BACKCASTING DELPHI: A PLANNING TOOL FOR A COMPLEX PRESENT AND AN UNCERTAIN FUTURE

INTRODUCTION

This chapter provides a description of the template for the Nonwork Travel Improvement Planning Process (NWTIPP) that implements the characteristics we described in the previous chapter. We designed the methodology, a modification of the Delphi process, after a search of the planning literature to find an approach with a scope that matches the complex and dynamic scope of the urban transportation planning problem. As described earlier, we see the NWTIPP as an overlay and complement to the existing, well-established, government-mandated Metropolitan Transportation Plan (MTP) processes. The recommended steps listed here could certainly be carried out by existing Metropolitan Planning Organization (MPO) staff if they chose to do so. We would encourage that outcome. More likely, however, a new set of regional players from among the civic leadership of a metropolitan region would need to step forward to implement our recommendations.

THE DELPHI METHOD

An existing, well-tested group process that we recommend be adapted to meet the requirements listed in Chapter 4 is the Delphi expert panel, a technique originally developed at the Rand Corporation in the early 1950s. A Delphi panel is a structured interaction among the members of a group with different kinds of expertise that allows a consensus—or possibly very explicit points of divergence—to be reached on judgments about a complex topic, typically a forecasting problem.

In standard Delphi methodology, all responses to a given set of question on the problem are compiled in a feedback document, with display of the reasons for responses that deviate from an emerging consensus average. The feedback document is sent back to each participant, each of whom is now given the opportunity to change opinion and provide new responses based on what others have said that is persuasive. If a response will lie outside the average found in the previous iteration, the respondent is asked to supply supporting information. The goal is to achieve consensus among the experts as they learn from each other. Consensus is typically achieved after three to five rounds of feedback and response (Irving and Conrath 1988).

Khan, who has reviewed available methodologies for transportation policy and planning decision making, views the Delphi process as capable of dealing with uncertainties in factors that determine future travel demand and the technical performance of transportation systems (Khan 1989). He suggests that through group assessment and the application of decision theory, available information can be better utilized and more flexible plans are produced that can adapt to a range of future requirements.

Backcasting Delphi

Traditionally, Delphi has been used in making forecasts of the future. Backcasting, on the other hand, makes judgments about the steps needed to reach a desired future state of affairs. In the NWTIPP, we are somewhat interested in forecasting and even more interested in backcasting. In the context of the NWTIPP, backcasting means bringing goals, resources available to effect change, the reality of activity and movement, the feasibility of changes, and public policy recommendations all into alignment. A Backcasting Delphi panel works backwards from the problem and desired outcome—reduced traffic congestion, for example—to determine if it is feasible, and then assesses necessary policies and other inputs that will produce the outcome or a set of potentially feasible alternative solutions on which experts have agreed to disagree. When consensus cannot be reached on proposed solutions, alternative solutions are brought forward, or else some aspect of the goal is changed based on new knowledge (Robinson 1990, Dreborg 1996).

Table 5-1 summarizes Delphi and backcasting, the combination of which is a distinct feature of the proposed planning template.

Table 5-1. The Components of Delphi Backcasting

Delphi: Diverse expert opinion collected from a group and iteratively presented as feedback to the group to modify opinions and converge on a consensus.
Backcasting: Working backward from a particular desirable future endpoint to determine the feasibility of that future and what policy measures would be required to reach it.

Source: Integrated Transport Research

Note that “backcasting” is *not* used here in the sense of transportation planners calibrating their traffic forecast models by adjusting parameters to make the

models conform to already available input and output data describing the baseline year and the forecast year.

PREVIOUS APPLICATIONS OF DELPHI METHOD TO TRANSPORTATION AND LAND USE

Backcasting and Delphi have been applied separately and together to transportation futures, principally in Europe and Canada. Hojer (1998) used Backcasting Delphi to study the feasibility and effectiveness of three alternative passenger transportation scenarios: improved road system with user fees, improved public transit through rider information, and a hypothetical dual mode system which combines the flexibility of the private car with the capacity of public transport.

Backcasting Delphi was also employed by Marchau and van der Heijden (1998) to explore the likely benefits of driver support systems. Cooper et al (1974) used the Delphi technique to study the likelihood of future environmentally desirable developments in transportation.

An application of Delphi somewhat similar to its proposed use in supplementing MPO planning for TOD was the study by Cavalli-Sforza and Ortolano (1984). These investigators used the Delphi method to predict the impacts of three alternative transportation programs in Santa Clara County (San Jose) California. Three alternative transportation improvement scenarios were evaluated: highway improvements, highway improvements with HOV lanes, and highway improvements plus a light rail system supported by zoning changes at stations. Each of the alternatives also involved a bus system improvement plan. Forecasts of residential land use and choice of transit mode were made for 1990 and 2000, from 1978 baseline data.

A related point of familiarity is that expert panels are routinely employed by MPOs to predict future land use patterns that are used as inputs in regional travel demand modeling. Although perhaps not a formal Delphi method, local planners are asked to estimate the distribution and of new residential population and employment out 20 to 30 years.

SCOPE OF THE PROPOSED METHOD

In the NWTIPP, we envision engaging a multidisciplinary panel with expertise collectively to understand the many areas of substantive knowledge and experience that bear on the key factors necessarily considered in transportation and land use planning, listed comprehensively in Table 4-1. We call this panel the Expert Advisory Group (EAG).

We recommend that the EAG consist of at least fifteen persons with a range of diverse expertise that bears on an assessment of consumer activities and nonwork travel in the present and the future. Areas of useful expertise for this group are shown in Table 5-2.

Table 5-2. Areas of Expertise for the Expert Advisory Group

Regional economics
Population demographics
Retail business strategy and store location planning
Consumer behavior regarding spatial choice in shopping, residential preference
Leisure and recreation
Behavioral characteristics of key segments: by age range, ethnicity, income group
Public opinion analysis
Electronic commerce: telework and teleshopping
Commercial real estate development, leasing, appraisal
Residential real estate development, marketing, appraisal
Public transit planning
Highway planning
Intelligent Transportation Systems (ITS)
Personal travel behavior
Freight logistics
Rideshare/vanpool promotion and coordination
Local government lawmaking and regulation
Urban land use planning
Architecture
Urban geography

Table 5-2. Areas of Expertise for the Expert Advisory Group (Continued)

Environmental quality
Cost-benefit analysis
Dynamics of citizens' land use objections

Source: Integrated Transport Research

Before the backcasting exercise in NWTIPP, we have specified two forecasting exercises to orient the panelists to the overall transportation planning topic and the process of providing opinions and receiving feedback. We envision that a draft problem statement, set of alternative solutions, and framework for evaluation would be initially provided by a professional planning team at the beginning of the backcasting procedure. The panelists themselves as independent authorities would have the opportunity to modify all inputs in the pursuit of a better way of approaching the problems of urban transportation.

ADVANTAGES OF BACKCASTING DELPHI

Within the context of the NWTIPP overlay on existing MPO processes, and for the purpose of TOD reassessment and new approaches to nonwork travel, Backcasting Delphi provides several advantages over other methods. In the ideal case, it would precede decisions to invest in capital-intensive transit capacity such as light rail. It would allow involvement of a broader range of expertise than is normally the case in transportation and land use planning. For example, retail industry analysts, commercial real estate portfolio managers, and consumer market researchers would have equal status with regional transportation planners. Many more of the significant forces shaping urban form would be considered. The process would allow setting a planning horizon that reflects the uncertainty inherent in these forces. The land use-transportation scenarios evaluated would not be limited to the regional planning vision and to typical "no-build" and "build" transportation alternatives.

Within many of the areas of expertise that bear on understanding urban activities, movement demands, and transportation and land use options, there are divergent opinions among experts. The results of the Delphi process will be dependent on the specific point of view of the individual representative experts selected. This introduces some uncertainty into the outcome of the planning process, which we do not regard as a bad event.

Through the iterative process, both capital-intensive and low-cost incentive and marketing solutions would be considered until a consensus is reached on

one or even several scenarios that are compatible with the forces shaping the urban environment. With appropriate framing, broader social equity questions would be considered, as well as a range of opportunity costs.

The attributes of Backcasting Delphi are summarized in Table 5-3.

Table 5-3. Attributes of Backcasting Delphi

Embraces multiple disciplines of expertise
Considers all forces shaping urban form
Incorporates all environmental and economic dimensions
Allows for iteration to reach policy consensus
Can be executed at any geographic scale, including across multiple jurisdictions
Understandable by a wider audience than is four-step transportation modeling as practiced by MPOs

Source: Integrated Transport Research

THE TEMPLATE: IMPLEMENTING BACKCASTING DELPHI IN A NEW PLANNING PROCESS

The NWTIPP is presented in this research effort as a planning "template," that is, a set of guidelines and elements, that indicate how to augment and modify an MPO-created Metropolitan Transportation Plan (MTP) to reflect more accurately and comprehensively the existence and characteristics of nonwork activities and trips. The heart of the proposed process is interaction between a small core Planning Team and the Expert Advisory Group that will carry out a focused environmental assessment and a public policy backcast using a structured Delphi Backcasting technique of opinion-gathering and feedback. As this planning exercise proceeds, it is quite likely that the participants will modify it to fit the circumstances of the metropolitan region. Thus, the template is described next with a minimum of detail. Somewhat more detail than is presented here is provided in the Task six report from this project, posted at http://www.globaltelematics.com/mineta/.

Table 5-4. Components of the Nonwork Travel Improvement Planning Process (NWTIPP)

Charter that establishes the sponsorship and mission of the NWTIPP.
Expert Advisory Group that brings diverse knowledge to the improvement of transportation planning for urban nonwork travel.
Professional Planning Team to carry out a knowledge acquisition and dissemination process and to facilitate the knowledge generation activities of the Expert Advisory Group.
Knowledge Management Process that initiates, refines, expands, and disseminates a Knowledge Base.
Initial Knowledge Base that includes the findings from this project, plus a region-specific database like the prototype presented in the third report of this project, and that will expand throughout the project.
Delphi process for eliciting structured opinions and justifications from the Expert Advisory Group; backcasting orientation brings goals, policies, and market conditions into alignment.

Source: Integrated Transport Research

COMPONENTS, PHASES, AND TASKS OF THE NWTIPP

The key components of the NWTIPP are listed in Table 5-4. The NWTIPP consists of fourteen steps, organized into the five distinct phases, all listed in Table 5-5.

Table 5-5. Phases and Tasks of the Nonwork Travel Improvement Planning Process

Phase 1: Process Initiation
Task 1-1: NWTIPP Planning Team chartered and organized
Task 1-2: Planning Team assembles Knowledge Base
Task 1-3: Planning Team recruits Expert Advisory Group

Table 5-5. Phases and Tasks of the Nonwork Travel Improvement Planning Process (Continued)

Phase 2: Orientation of Expert Advisory Group
Task 2-1: Expert Advisory Group receives and assimilates initial Knowledge Base in preparation for meeting
Task 2-2: Planning Team and Expert Advisory Group meet face-to-face for team building and exchanging viewpoints
Task 2-3: Planning Team modifies initial Knowledge Base and adjusts remaining processes in response to Expert Advisory Group feedback
Phase 3: Consideration of consumer activities and nonwork travel scenarios
Task 3-1: Planning Team facilitates Expert Advisory Group's web-based Delphi review process on consumer activities and nonwork travel scenarios
Task 3-2: Planning Team modifies the Knowledge Base in response to the Expert Advisory Group's Delphi findings
Phase 4: Development of public policy objectives and action alternatives
Task 4-1: Planning Team compiles draft public policy objectives for nonwork travel
Task 4-2: Planning Team creates draft action alternatives to meet nonwork travel policy objectives
Task 4-3: Planning Team facilitates Expert Advisory Group's web-based Delphi Backcasting process on objectives and action alternatives
Task 4-4: Planning Team modifies objectives and finalizes action alternatives based on Expert Advisory Group's Delphi Backcasting outcome
Phase 5: Process completion: Evaluation and dissemination of results
Task 5-1: Planning Team prepares reporting documents on results of NWTIPP
Task 5-2: Planning Team and Expert Advisory Group evaluate the NWTIPP just completed

Source: Integrated Transport Research

FURTHER DETAIL ON THE TASKS OF THE NWTIPP

The following is a brief preliminary sketch of the work steps of a prototype Nonwork Travel Improvement Planning Process that meets the requirements set out earlier in this report. More detail is provided in the Task 6 report at http://www.globaltelematics.com/mineta.com/.

Phase 1: Process Initiation

Task 1-1: NWTIPP Planning Team Chartered and Organized

The basic requirement for proceeding with an NWTIPP is its chartering and the commitment of resources to compensate and otherwise support the professional Planning Team. The source of resources could be a government agency or legislative body, foundation, corporation, or individual.

We envision that the Planning Team (PT) would consist of at least one full-time project management professional as Team Leader and enough other personnel to equal one and one half additional Full Time Equivalent persons. We recommend that the Planning Team organize around the following full and part-time roles: research coordinator, student intern supervisor, liaison with MPO, public involvement coordinator, web master, and Expert Advisory Group coordinator. At least half of the members of the Planning Team should have transportation planning experience, although it will be useful that some have relevant experience outside of transportation planning.

Task 1-2: Planning Team Assembles Knowledge Base

The Planning Team should carry out its work in a framework of knowledge management (Cortada 1999, Heide 1996). The PT will be continually augmenting a Knowledge Base (KB) that is made available to the Expert Advisory Group and other interested parties. The conclusions of the EAG will be part of the KB also. We recommend presenting this KB as a well indexed, well summarized, cross-linked series of documents on the World Wide Web.

The KB would begin with an updated *review of academic research focused* on land use, transportation, and the TOD paradigm, as was begun by the present project in the review of literature in the appendix.

Other important parts of the Knowledge Base:

- Review of the forces shaping the future of retail.
- Assessment of present and future consumer activities.
- Descriptive data on present land use and land use trends underway.
- List of the exogenous forces likely to be shaping the retail land use and activity in the region over the next five to ten years.

- Information on how and why people travel now.
- The current Metropolitan Transportation Plan by the MPO .
- “Present commitments” land use map of the region in the MPO's planning horizon year.
- Assessment of significant transportation-related actions to be taken by governments, large employers, and significant trip-attraction sites.
- Overview of the available financial resources to pay for government implementation of transportation capital construction and services.
- All of the information described above should be rolled up by the Planning Team into a series of alternative, descriptive draft scenarios on the future of nonwork travel in the region.

Task 1-3: Planning Team Recruits Expert Advisory Group

As a central feature of the NWTIPP, the Planning Team interacts with a specially recruited panel of at least 15 experts we call the Expert Advisory Group (EAG). The EAG will carry out an initial review of the Knowledge Base at the beginning of their work, plus two Delphi exercises that assess and expand upon critical additions to the KB made by the PT. Earlier in Table 5-2 we specified the expertise of the EAG.

Phase 2: Orientation of Expert Advisory Group

Task 2-1: Expert Advisory Group receives and assimilates initial Knowledge Base in preparation for meeting

The EAG will be provided immediately with Internet web access to the structured Knowledge Base, with their attention initially invited toward the mission of the NWTIPP, an overview of the process that is planned to be followed, and a baseline set of findings and conclusions from previous literature on consumer activities and nonwork travel. Over a period of a month or so, each member of the EAG would need to have a working familiarity with the full range of material in the initial KB as sketched in Task 1-2 earlier.

Task 2-2: Planning Team and Expert Advisory Group meet face-to-face for team building and exchanging viewpoints

In general, because we recommend the use of a web-enabled Delphi process, the PT and the EAG do not need to do their work in a face-to-face fashion. However, we do recommend one early face-to-face meeting of the EAG and the Planning Team to gain a common understanding of the NWTIPP to motivate a high level of participation and to build mutual understanding and trust.

This meeting would be an important opportunity for the EAG members to learn about the Delphi process to be used, and to provide feedback on the initial Knowledge Base and on the planned Delphi activities over the coming months of activity. The face-to-face meeting should result in a common understanding by the EAG and Planning Team on problem definition, and the range and scope of the premises, paradigms, and strategies that the NWTIPP will encompass.

Task 2-3: Planning Team modifies initial Knowledge Base and adjusts remaining processes in response to Expert Advisory Group feedback

In response to information received during the face-to-face meeting between the EAG and the PT, the PT would in this step take steps to augment the KB with additional information requested by the EAG. The PT would also make adjustments in the planned Delphi processes to take into account suggestions made by the EAG members about those processes.

Phase 3: Consideration of Consumer Activities and Nonwork Travel Scenarios

Task 3-1: Planning Team facilitates Expert Advisory Group's web-based Delphi review process on consumer activities and nonwork travel scenarios

In this step, the Planning Team facilitates the Expert Advisory Group's Delphi review process on consumer activities and future nonwork travel scenarios. This facilitation requires providing the EAG with structured information on a series of options for these activities and scenarios that the members can validate, refine, qualify, extend, or endorse.

The EAG members would be encouraged to ask for additional information as they see fit from the Planning Team or anyone else. Information requested by one EAG member would be made available to all members. We would expect that the specialists on the EAG would come up with descriptions of many areas of risk and uncertainty that should be incorporated into the Knowledge Base.

Developing conclusions on important trends defining consumer activities over the next five to ten years in the region is the first desired result from the Delphi process to be exercised with the EAG. Under the guidance of the PT, over one to three iterations, the EAG would review, comment on, add to, and vote on a structured list of potential trends provided by the PT.

Simultaneously and in coordination with this review of trends, as a second component of the Delphi exercise, the EAG would review, comment on, add to, and vote on a number of scenarios on future regional nonwork trip-making for consumer activities, as prepared by the PT.

Task 3-2: Planning Team modifies the Knowledge Base in response to the Expert Advisory Group's Delphi findings

After the EAG has reached its conclusions on consumer activities and nonwork travel scenarios, the PT will incorporate the results of the Delphi process into the KB.

Phase 4: Development of Public Policy Objectives and Action Alternatives

Task 4-1: Planning Team compiles draft public policy objectives for nonwork travel

In this step, only after gaining insight into the nature of the urban environment as described in this project, the Planning Team establishes draft public policy objectives for nonwork travel. This means defining the problem or problems that the government is capable of addressing in its transportation and land use policy, and how one would know the extent to which the problems are solved. Reduce the congestion caused by the growth of nonwork travel? Reduce air and water pollution from vehicular travel? Preserve and protect environmental values? Increase the quality of urban life, including opportunities for home ownership with desired amenities? The objectives may go beyond those in the MTP. To the degree possible, the PT should work with regional decision makers to understand and incorporate their views into the draft objectives.

The objective for nonwork travel may be the same as the objective for *all* travel in the region. It may be that the public policy objective for nonwork travel is related to land-use; freezing the number of major decentralized shopping destinations, for example.

The statement of the objectives that the NWTIPP can reasonably address also needs to specify how to measure these problems in a base year and in a defined out year, and how success in the resolution of these problems will be judged in the out year. As stated before, it is also important that financial budget limitations be recognized in the statement of objectives.

Task 4-2: Planning Team creates draft action alternatives to meet nonwork travel policy objectives

In this step, the Planning Team would formulate one or more paradigms and the associated policy packages that would potentially cause the region to achieve the draft objectives defined in the previous step. The output of this step is a draft list from the Planning Team of three to five effective and efficient policy packages intended to impact transportation performance in the out year for submission to the EAG.

Planners carrying out this NWTIPP template may want to include TOD as one of the alternative paradigms, but they should be free to design and choose whatever alternatives fit the circumstances of the region that is the focus.

Task 4-3: Planning Team facilitates Expert Advisory Group's web-based Delphi Backcasting process on objectives and action alternatives
In this critical portion of the NWTIPP, the focus for the Expert Advisory Group would be on judging the effectiveness and cost-effectiveness of different policy packages developed by the PT. By cost-effectiveness, we mean consideration of what transportation performance or what amount of problem resolution is delivered for each dollar of cost. Cost-effectiveness may well have to be estimated, and different policy packages may offer different kinds of performance, so comparing packages may well be subjective.

The recommended policy package may end up being one suggested by the Planning Team, or it may be an alternative policy design. Under the backcasting protocol that is part of this step, the PT must be ready to accommodate an adjustment of the problem definition or at least of the public policy objectives associated with the definition, if the EAG is unable to find a set of policies and associated actions that is likely to solve the defined problem within a cost that is reasonable given available resources.

Task 4-4: Planning Team modifies objectives and finalizes action alternatives based on Expert Advisory Group's Delphi Backcasting outcome
After two to three iterative rounds of Delphi consideration by the EAG that reaches consensus or at least a stable point of non-consensus, the PT would end the EAG process and add what was learned from their deliberations to the KB.

Phase 5: Process Completion

Task 5-1: Planning Team prepares reporting documents on results of NWTIPP
If this template works as designed, a refined, winnowed package of policy initiatives will be the result. This work of the Planning Team and Expert Advisory Group should be packaged for presentation to the media, the MPO, government administrators, elected decision makers, the general public, and the civic leadership of the region.

The Team may also recommend further planning steps. Under the influence of what the EAG reports, the Planning Team may face the prospect of having to repeat and rework earlier steps to account for considerations brought to light by the interaction of the diverse experts. There may be a need for further iterations of the objectives-paradigms-policies development. Alternatively or additionally, recommendations for action by the MPO may result.

Task 5-2: Planning Team and Expert Advisory Group evaluate the NWTIPP just completed

A final step in the NWTIPP is a reflective end-of-project evaluation of how the entire process functioned, with an emphasis on documenting and disseminating recommendations for the improvement of future planning rounds. A fundamental characteristic of the NWTIPP will be the probable need to revisit the process regularly as new knowledge is developed.

ADDITIONAL CONSIDERATIONS

The intent of the described NWTIPP planning template is to produce a supplemental transportation plan in the form of a report, web site, or other document that can educate and influence established planning authorities, decision makers both elected and appointed, the business community, various special interests, other stakeholders, the media, and the public generally.

We have not specified in any detail how the NWTIPP should or could manage its relationships with all of these parties along the way during the elapsed time when the planning process described above is carried out. These ongoing relationships are important, and they will need to be managed by the professional Planning Team and those responsible for oversight of the NWTIPP.

In this description of the NWTIPP we have maintained a sharp focus on a particular area of substance (consumer behavior, retail industry dynamics, and resulting nonwork travel behavior) that is too slightly considered in today's MPO-led transportation planning. We will leave specifying the important tasks of external relations to the pioneering community leaders that first implement the NWTIPP.

CHAPTER SIX

CONCLUSIONS ABOUT PLANNING FOR TOD

GROWING POPULARITY AND CRITIQUE OF TOD

Regional and federal planners and decision makers, in response to traffic congestion and other impacts resulting from growth and change in human activity patterns, have embraced transit-oriented development. However, there is a growing body of empirical research suggesting that TOD, when preceded by large investments in rail system capacity, will in most cases not produce benefits that are commensurate with the costs. Consequently, TOD planners need to be informed of the technology and market factors beyond the control of public policy that cause traffic growth, congestion, and related environmental impacts. In addition, they need to appreciate the difference between TOD's success at the station-area level compared to the regional level, and adopt methods to measure regional success.

With regard to regional success, the large differences in patterns of population and land use change across metropolitan America over the past few decades suggests that a one size fits all approach to land use and transportation planning is not effective. Each urban region has its own unique set of characteristics and forces that are determining settlement and mobility patterns.

IMPORTANCE OF NONWORK TRAVEL

The large growth in personal travel in the last three decades has in large part resulted from increased frequencies of nonwork trips, especially trips for shopping and other family and personal business activities. Retail activities account for more than half of all person trips, and most are made to locations that are flexible in that the traveler has more than one choice of destination for a given activity. Many retail trips are linked in complex tours that may involve multiple stops for a variety of purposes and several family members traveling together. These tours would usually benefit from the flexibility that a private vehicle provides, and consequently transit and pedestrian modes are chosen for a small proportion of all person trips.

THE EVER CHANGING RETAIL MARKETPLACE

The new retail marketplace is characterized by considerably more variety and opportunity than ever before in history. Consumers now have a much larger

array of choices for their household needs, leisure-time pursuits, and other personal activities. For retail structure, this has translated to larger and fewer retail store formats in any one category, at the same time the number of individual categories has greatly increased. Some retailers have taken advantage of consumer demand for more choice and good values by inventing new formats and offering a wide scope of products. Others have carved niches from older store formats while expanding product offerings.

Although past trends suggest future realities, the retail marketplace can be expected to continue to reinvent itself in new ways that are difficult to predict. A good example is online marketing. E-commerce is currently a small fraction of all retail sales, yet it has a large and unknown potential, and an equally large possible impact on personal travel patterns.

PLANNING THAT ADDRESSES COMPLEXITY, RISK, AND UNCERTAINTY

A large number of socioeconomic, technological, and other factors, in addition to those that define the retail environment, are active in a metropolitan region, and they produce a state of continuous dynamic change in urban form and personal travel patterns. Key among these are preferences for the location and size of residence, the location of work centers, and the growth and spatial dispersion of nonwork activities. These forces are strong in comparison to the policy tools that American government jurisdictions have at their command to control and shape urban growth. Taken together, the array of forces implies a future planning environment that must deal with considerable complexity, risk, and uncertainty.

A NEW METRO PLANNING TOOL: BACKCASTING DELPHI

There is a clear need for a new and better urban transportation planning approach that supplements existing four-step modeling and other statutory processes, and that more directly matches the difficulty of the urban transportation problem. A new and better planning tool would take into account the complexity and ongoing dynamic evolution of the metropolitan economy. A new and better tool would employ available descriptive data and information, and not demand that only quantitative results from mathematical approximations be relied upon for estimating the likely impacts of TOD. A new and better tool would bring in new, heretofore unconsidered descriptions and analysis of the way the market economy for consumer goods and services is now being served in metropolitan areas.

One tool that appears to meet these requirements is Backcasting Delphi. With this technique, the urban transportation problem is addressed by using a

diverse panel of experts (Delphi) to consider the feasibility of TOD and alternative paradigms and strategies (Backcasting).

FINAL CONSIDERATIONS

The core of the research project that designed the NWTIPP lies not in the particular details of the phases and tasks of how the process is carried out, but rather in the specification of four ideas for action to improve transportation planning:

- Emphasizing nonwork trips in urban transportation planning.
- Assembling data to describe these trips and the activities and destinations that cause them.
- Assessing the complexity, risk and uncertainty that these data reveal for transportation in the future.
- Adjusting the direction of public policy in response to the revealed data and the assessment of what they mean for the future.

If the specifics in this Planning Template do not resonate within a particular metropolitan community's leadership as a good way to implement the four ideas listed, we recommend trying an alternative implementation that fits the community.

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APPENDIX A:

REVIEW OF SELECTED TOD LITERATURE

A number of researchers have been actively testing various features of the TOD paradigm and the premise that government actions can significantly reshape urban form and travel patterns so that a greater share of urban travel is by mass transit. We very briefly review and cite selected examples of their work. These papers touch on, to various degrees, important TOD issues, including nonwork activity patterns and the land use-transportation linkage. We provide direct quotes (in italics) that appear to summarize key findings and conclusions. While this review does not by any means include all of the research literature on these topics, we believe these authors and papers to represent a consistent and comprehensive perspective of the current state-of-understanding.

Marlon Boarnet

Marlon Boarnet is associate professor, Urban Planning and Economics Departments, University of California at Irvine, and research associate of UC-Irvine's Institute of Transportation Studies. His interest is how local governments actually implement TOD. In a series of papers and a forthcoming book with Randall Crane, Boarnet addresses the financial and other objectives of local governments that can differ from regional planning goals.

Boarnet investigated the development of housing at 232 station-areas across Southern California, and compared the intensity of housing with that allowed under local zoning (Boarnet & Crane 1997). He found that municipalities behave as if they prefer to use rail transit stations for economic rather than residential development. There is a stronger trend toward commercial rather than residential zoning that is consistent across existing and proposed rail lines, whether in central or suburban communities.

Residential development appears to be a secondary goal, at best. Left to their own devices, almost every city wants the train to bring people into town in the morning rather than send them elsewhere (in order to maximize the fiscal and economic benefits).

Boarnet suggests that this creates an imbalance in the form of an excessive number of employment and shopping “destination” stations relative to the number of residential “origin”' stations. And he doesn’t believe that California is unique.

The cross-jurisdictional economic competition that makes transit-based commercial development attractive in Southern California is also characteristic of many other urban areas. The tensions that prompt municipalities to think first of their own economic development have, if anything, grown stronger over time.

In a follow-up paper, Boarnet suggests that local fiscal concerns are evident in a broad range of planning activities beyond transit-oriented development (Boarnet & Crane 1998).

Anecdotal evidence suggests that local competition for regional shopping malls and big-box retailers is becoming increasingly intense. In the past, researchers have studied incentives for fiscal zoning focusing on attempts to increase the local property tax base. In California, and likely in other states also, fiscal pressures are increasingly focusing on land uses that generate sales tax revenue. Fiscal competition now is over commercial uses, and the ramifications of these new fiscal pressures are not fully understood.

Boarnet undertook a more detailed study of TOD implementation in San Diego that has the oldest of the current generation of light rail lines (Boarnet & Compin 1999). He found, through detailed interviews with planning directors, that cities along rail routes, though sympathetic to regional rail planning objectives, have approached TOD from a perspective of local goals, opportunities, and constraints.

The lesson from San Diego County is that progress towards TOD goals is often incremental. TOD projects are the results of a number of local governments acting in their own interests, pursuing opportunities as they present themselves, and working within local constraints. The legacy of preexisting land uses (and rights-of-ways) is an important determinant of TOD implementation. Placing rail lines along high-growth corridors can be expensive, especially when those corridors do not have suitable existing rail rights-of-way. Whether TOD benefits, such as an increase in transit ridership, outweigh the cost of placing a line along a high growth corridor is open to question.

Boarnet and a coworker also modeled the effect of general neighborhood land use variables (extent of grid street pattern, population density and retail and service job concentrations) on nonwork automobile trips, using southern California travel diary data (Boarnet & Sarmiento 1998). None of the land-use variables was found to be significant either individually or jointly, which is consistent with the findings of Crane. Based on the results, they conclude:

We are not yet ready to make transport policy based on the link between nonwork travel and land-use patterns. The primary lesson to emerge from this study is that any link between land use and nonwork trip generation is a complicated one.

The authors suggest that several issues need to be addressed in further research: New Urbanists designs are at a neighborhood scale, whereas nonwork trips cover much larger areas; the possibility that persons choose their residential location based in part on how they wish to travel; and the complexity of non work trips, i.e., trip chaining.

Robert Cervero

Robert Cervero is professor, Department of City and Regional Planning, University of California at Berkeley. He and his coworkers have conducted many studies of the relationship between travel patterns and urban design features, both in the United States and abroad. Cervero has published extensively in transportation and planning journals, and has written several books on the topic of the land use and transportation problem.

Cerver's perspective is clearly one of support for a menu of government policies that can have some impact on urban form in ways that will reduce the effects of automobility. Yet, he tempers his enthusiasm for these efforts with a pragmatic assessment of what has been experienced and can be expected in terms of actual outcomes.

Cervero comments on the concern expressed about light rail systems (1998a):

Proposals to build and extend fixed-guideway systems, especially light rail, in the United States have triggered a wrath of criticism. Even cities that show great promise, such as Portland, have come under attack, and with some justification. The track record with new rail systems in the United States leaves a lot to be desired. Studies show that new-generation rail systems have failed to produce the ridership that was promised and ended up costing more than was forecast.

Although the reasons for transit's poor showing over the years are many, the gross under pricing of automobile travel—especially along heavily trafficked corridors where transit is most needed—heads the list. An absence of coordinated and comprehensive planning, carried out on a regional scale, is also to blame. Putting a point-to-point rail system in a sea of spread-out, auto-oriented development is hardly a recipe for successful and sustainable transit. Quite simple, too often across America, transit and cityscapes have been way out of synch.

Of course, transit investments that are out of kilter with how our cities and regions grow do nobody any good. Running trains and buses that fail to draw people out of drive-alone cars does little to relieve traffic congestion, conserve fuel, or reduce pollution. The best prescription for filling trains and buses, and winning over motorists to transit, is to find a harmonious fit between transit systems and the cities and suburbs they serve.

Cervero also comments on bus rapid transit, debunking what he terms the myth that bus transit is incapable of shaping urban form and attracting high-rise development around stops:

Besides buses being stigmatized as a second-class form of conveyance, the conventional wisdom holds that buses repel development because of their negative-byproducts: diesel toxins that spew from tail pipes. Experiences around busway stops in Ottawa and Curitiba should put this myth to rest. In both cities, some of the priciest condominiums anchor sites adjacent to busway stops. Retail and office developers also flocked to busway corridors in both cities. Good quality service—whether vehicles are propelled by electricity or fossil fuels, or whether they roll on steel wheels or pneumatic tires—will spawn compact development. It is the accessibility premium that attracts real estate development, not the type of transit equipment. In fact, compared to freeways and even rail corridors, busways produce relatively low ambient noise levels. Its inherent flexibility advantages and superior adaptability to spread-out patterns of development make bus transit—especially when combined with dedicated busways—a potentially stronger shaper of growth patterns than rail transit in some settings.

Cervero has also reviewed TOD in California which he has actively sought to promote through government polices (1998b):

Despite successes, the track record with TOD in California has not always been positive. Far more growth in the Bay Area has been auto-oriented than transit-oriented, despite BART's 25-year presence. A number of stations along Sacramento's light rail line have attracted big-box retail projects; despite repeated efforts by the Sacramento Regional Transit Authority to promote TOD, in the final analysis, the prospect of localities receiving large sums of sales tax revenues won out over regional concerns, like TOD.

In a separate study, Cervero and a co-author estimate that only about 9 percent of the residents from the three BART-served counties lived within a half mile of a BART station in 1990 (Bernick & Cervero 1996). And 1990 Census journey-to-work data indicate that only 18 percent of these station-area residents commuted by rail transit. Multiplying these two percentages led them

to conclude that fewer than 2 percent of 1990 commute trips within the three counties were by station-area rail users.

Doubling the number of station-area rail users would have a pretty small impact on current commuting and environmental conditions in the Bay Area.

The two authors suggest that more than singular measures, such as transit-based housing are needed if outcomes are to be more than minimal.

Transit-oriented development matters when bundled together with other supportive policies.

They call for fundamentally different settlement patterns and pricing arrangements for driving:

Putting more suburban jobs in office towers near rail instead of sprawling business parks would no doubt make these numbers more impressive. So would dramatically raising the price of fuel and parking (so that motorists pay for externalities they create, including time losses and air pollution).

Urban villages, they suggest

...would tap the synergy of orienting the future growth of both ends of the commute trip—homes and workplaces—to rail, in addition to retail shops, restaurants, entertainment centers, and other urban uses. Land-use initiatives, like transit-supportive development, by themselves are clearly no panacea to today's congestion, air quality, and social equity problems.

Randall Crane

Randall Crane is associate professor of urban planning, environmental analysis, and economics at the University of California, Irvine. He has done extensive modeling and empirical analysis of the possible influence of urban design factors on travel behavior, and has authored several papers and is co-authoring a book with Marlon Boarnet on the subject which is due to be published in September 2000.

We refer here to only two papers, in which he summarized the results of his work (Crane 1998, 1999). Crane's concern is that much of the analysis that purports to support the belief that changes in urban form can shape travel behavior is problematic. It does not, in his opinion, have a strong behavioral foundation. Crane has attempted to improve the research on TOD by isolating the separable influences of urban design on travel.

Individuals make choices based on their preferences for benefits obtained by travel and on the relative costs of making different trips and of taking different modes. Past empirical research about the influence of neighborhood design on travel has neglected the role of costs in choosing among trips and modes.

Crane believes that individual design elements, such as grid street patterns, traffic calming features, and a concentration and greater mix of uses, may both increase and decrease car trips and VMT. Walking trips may be similarly affected. Crane cites the example of shopping:

People may shop more often if stores are nearby, and they may make so many shopping trips that they drive more miles.

Crane believes the net effect of urban design features on travel is uncertain at best, and that actual outcomes depend on specific details of implementation at each location, not on their intrinsic traffic-affecting properties.

There is no evidence that New Urbanist's designs influence travel behavior at the margin. They remain a wobbly foundation indeed for current transportation policy.

Crane comments on previous research involving the effect of urban design on travel:

Any empirical work of this nature is problematic given the enormous complexity of the behavior to be explained and the great difficulties of conceptualizing the interaction of travel and the physical character of the city.

Anthony Downs

Downs is a senior fellow in the Economic Studies Program at the Brookings Institution (Washington, D.C.). He has analyzed and commented on the patterns and problems of American urban areas for more than three decades. His recent books include strategies to address traffic congestion and the renewal of large older central cities. He has also written on the problem of urban sprawl. Downs' perspective is often conditioned by what he feels is politically possible and feasible in the American system.

Downs often uses simple spatial models to elucidate his points. He did so to estimate the effect on transit commute mode share of a major radial mass transit system serving the central city's employment center (Downs 1992). He concluded that

...even an extensive rapid transit system serving many high-density housing clusters near their stops would carry only relatively few suburban commuters. The results would be minor in comparison to the economic and political efforts required to build and maintain the transit systems and create high-density clusters.

Downs subsequently extended this analysis by estimating the size of the TOD areas and rail transit system required to accommodate the population growth experienced by the average Metropolitan Statistical Area over one million in

population in the decade of the 1980s (Downs 1994). He found that the system would have to be much larger than the actual systems in either the Washington, DC, or the San Francisco Bay metro areas, yet those areas have much larger total populations than the population used to calculate the model.

Realistically, it may not be feasible to accommodate all or even most urban growth in transit-oriented developments. The feasibility of applying them on a large scale is weakened by the high cost of building the rapid-transit links among them. However, Calthorpe's TODs should be viewed as building blocks that could be used to handle some significant part of growth in the range of visions except the unlimited low-density vision.

In a contribution to a multifaceted discussion of sprawl, Downs sounds a rather pessimistic note about government's ability to adopt tactics that effectively address the growth problems plaguing many metro areas (Downs 1998).

Effectively adopting any of these tactics, or certainly most of them, would require a strong region wide implementing body. Yet hardly any US metro areas have been willing to consider doing this. Nor is it certain that these tactics would overcome a region's growth related problems. For example, I am positive that traffic congestion will get worse almost everywhere, no matter what tactics anyone adopts. Until advocates of limited future sprawl can overcome the metropolitan majority's belief that the benefits of sprawl outweigh its social costs, they are not likely to notably reduce sprawl's dominance.

Kenneth Dueker

Ken Dueker is professor of Urban Studies and Planning and director of the Transportation Studies Center, Portland State University. He directed the Center for Urban Studies at PSU from 1979 to 1998. His areas of research interest include transportation and land use interactions.

Dueker and his PSU colleagues have been closely monitoring the impacts of Portland's light rail transit system and its TOD strategy. Just as the State of Oregon has been a testing ground for strong growth controls, Portland is a laboratory for TOD. Its Eastside light rail line, the first in a planned metro-wide radial network focusing on downtown Portland, opened in 1986. Portland has gone to considerable lengths to encourage development that supports light rail.

Dueker has used data for the first 10 years of operation to research the impacts of the rail line on development patterns, choice of residential location, freeway traffic, and transit ridership (1999a). In a presentation at a 1999 conference (1999b), Dueker reported that:

What we have found is that light rail alone has not been sufficient to change development patterns appreciably.

He sees an apparent self-selection in housing location choice. People who are already prone to use transit are willing to relocate to areas accessible to light rail, but rail has not had an impact on traffic congestion.

What we're observing is that the peak period for highway traffic is widening, and that non-peak and weekend travel on light rail is where the growth in transit riders is occurring.

And Dueker has concerns about the transit component of Portland's TOD.

A lot of bus lines, including express bus lines, have been discontinued, and a lot of people have been forced onto light rail and to make transfers. Light rail in suburban service has problems. When you get 15 miles out, you're almost an hour by light rail to downtown, because it has to stop at every stop. I think that express bus service could do a better job for the suburban commute.

Dueker confirms that Portland's success at controlling growth is somewhat clouded by its proximity to Clark County in Washington State, which is a bedroom suburb just across the Columbia River (1999c). Clark County is the most rapidly growing county in Washington State, with an annual population growth rate that surpassed even the high range of forecast population. Its 1999 population accounted for approximately 25 percent of the Portland-Vancouver urbanized area.

Reid Ewing

Reid Ewing is with the Surface Transportation Policy Project in Washington, D.C. He formerly was associate professor, College of Engineering and Design at Florida International University. He has authored books on development practices and transportation and land use innovations, as well as research dealing with travel patterns in Florida communities and their land use relationships (Ewing, et al, 1994). Ewing wrote a lengthy paper from the "anti" sprawl perspective as counterpoint to a "pro sprawl" paper by Peter Gordon (Ewing 1997). We quote from that paper.

We include Ewing because he is a thoughtful proponent of strategies to minimize auto externalities. Ewing believes that sprawl, that he defines as suburban development lacking accessibility and open space, is not a natural response to market forces, but a product of subsidies and market imperfections. His solution is active planning as it is practiced "almost everywhere but the United States."

Ewing's analysis of Florida suburban communities found that regional accessibility, not land use density, is the most significant land use variable. In other words, land use patterns that recognize that density is not feasible but provide more services in closer proximity can reduce some auto trips. Ewing also recognizes that

As suburban areas grow, the central city becomes less and less accessible. At some point, emergence of other centers is beneficial.

He favors "good" development over "bad." He cites Florida's best practices as an example of an initiative to upgrade the quality of development, "wherever" and "whenever" it should occur. Cluster development, which concentrates housing and commercial in walkable areas while preserving a large part of the land area as park or natural open space, is one approach.

Peter Gordon

Peter Gordon is professor of planning and economics in the School of Urban Planning and Development and the Department of Economics, University of Southern California. Gordon, often together with his colleague Harry Richardson, has authored numerous research papers addressing the forces shaping the growth of major metro areas and associate travel patterns.

Gordon (& Richardson's) general premise is stated in the first sentence of his "pro" sprawl article:

The revolution in information processing and telecommunications is accelerating the growth and dispersion of both economic activities and population, possibly moving towards the point where 'geography is irrelevant' (Gordon & Richardson 1997).

Gordon has a blunt opinion of high-capacity transit and TOD.

Low densities make high-capacity transit systems unattractive and therefor wasteful of all resources utilized, including energy. Because the spreading out of cities reduces markets for conventional public transit (especially fixed rail, which is spatially inflexible and usually oriented downtown, it should be no surprise that the U.S. transit industry has been in decline for most of the 20th century. Massive subsidies have not helped. New federally assisted systems have not added to mass transit; instead, they have replaced flexible bus routes with costly fixed-routes to a few downtown areas, while the growth of jobs and population has been in the suburbs and in the smaller cities. At the same time transit fleets in general are under used, and the new systems have added to costs without attracting riders from cars.

Citing Cervero and Downs, he says:

It appears that 'Neo-traditional' neighborhoods do not make much of a difference.

Genevieve Giuliano

Giuliano is professor and vice dean, School of Policy, Planning and Development, University of Southern California. She has investigated the land use and travel impacts produced by the high accessibility that modern roadway systems create, and the effectiveness of land use policy on reducing congestion and the environmental costs of automobility. Giuliano has also contrasted the land use-transportation relationship in Europe and the United States.

Because of the federal highway program of the 1950s through the 1970s, she observes that Metro areas are marked by well-developed transportation systems (Giuliano 1995):

Even a large investment (such as a new freeway segment) will have only an incremental effect on accessibility. Moreover, the decentralized land use pattern of today's metro areas has reduced differences in accessibility among locations.

Giuliano also observes that rail transit continues to have strong public support, in spite of "rather overwhelming evidence" that transit investment is not an efficient means for affecting land use patterns (1). She cites Los Angeles as the most extreme example of this view.

Planners expect this massive program (originally a $78 billion rail-transit investment) to increase the proportion of commuters who use transit from 4.5 percent to 19 percent by the year 2010, through the generation of high-density and mixed-use development along transit lines. To test whether their expectations were reasonable, the regional planning agency sponsored a study using a transportation forecasting model to determine the effect of various land use scenarios on transit use. Results show that by relocating 75 percent of all forecast employment growth and 65 percent of all population growth in the 5-county region to transit-station areas, 7 to 10 percent of commuters would use transit. Study authors conclude that even if anticipated land use changes were to occur, travel patterns would not change very much, because the overall regional pattern of land use would not change very much.

Giuliano does not view land use policy as an effective means for reducing the environmental impacts associated with private vehicle use (Giuliano 1999):

Significantly less private vehicle use would require substantial increases in densities from existing levels and a reversal of development trends that have been in progress for many decades. I do not think such increases in density can be achieved, and increases in density that might be achieved would have at

best very little effect on private vehicle travel. The trends in car use and decentralization are powerful (even in Europe where government land use controls are stronger and where tax and pricing policies favorable to car ownership and use are not present). They are supported by changing economic structure and rising affluence, and there is no reason to believe that fundamental shifts away from these trends will occur in the future. The greatest success in addressing automobile externalities has been realized by regulating the car, rather than the driver.

Susan Handy

Handy is Assistant Professor of Community and Regional Planning, School of Architecture, University of Texas at Austin. Part of her research was done at the Institute of Transportation Studies, University of California at Berkeley.

Handy was the first researcher to question the suggestion by supporters of New Urbanism that traditional urban form (rectilinear street patterns, sidewalks, accessibility to transit service, and proximity to a mix of commercial establishments, including jobs) discourages automobile dependence (Handy 1991). She points out that there is a tension between providing local services and regional transit links:

- *The ability of residents to live and work in the same place is limited by numerous constraints, including the match between employee qualifications and employer needs, dual wage earner households, job security, etc.;*
- *The growing variety and complexity of lifestyles requires a number of services that can't be supported by a small neighborhood population;*
- *Residents may choose not to use local services if they have easy access to other areas, and if other factors that affect destination choice play a role. These include price, quality of service, habit, etc.; and*
- *Services evolve over time as the size and character of the population changes; what is sufficient to encourage use of local facilities now may be insufficient in the future.*

In a series of papers (Handy 1992, 1996a, 1996b, 1996c), she addresses the effect of TOD design elements on mode choice, particularly pedestrian travel to nonwork destinations, in San Francisco Bay area and Austin neighborhoods. In the most traditional Austin neighborhood, 95 percent of residents live within walking distance of the neighborhood commercial center. She both surveyed and modeled the travel behavior of residents.

Handy finds that certain design aspects can encourage walking trips but the savings in travel from substitution for driving are likely to be small. For San Francisco:

The evidence does not support the popular belief that neo-traditional style development will help reduce levels of nonwork travel (Handy 1992).

For Austin:

The total savings in automobile travel appears to be on the order of 8 km per adult resident per month—a drop in the bucket when average driving per month is approximately 2000 km per household (Handy 1996a).

Handy, based on further detailed analyses of the San Francisco neighborhoods, suggests that some land use policies may help provide alternatives to driving, but their effectiveness in reducing total travel will be at least partially offset by the range of choices available to residents of a metropolitan region (Handy 1996b).

A greater range of choice seems to be associated with greater trip frequency; a greater range of choice may induce some trips that would not have been made given more limited choices. And the greater the range of destinations visited, the longer the average trip, such each additional destination is farther away.

Handy suggests that the overall policy goal—namely that of reducing auto travel—toward which much of research on the link between urban form and travel behavior is directed, should be reconsidered (Handy 1996c).

Land-use policies are likely to have only a marginal impact on travel given the extent of existing development and the relatively small increment that new growth represents. Certainly it is important that any development that occurs be designed appropriately so as to minimize the need for automobile travel, but other strategies to manage travel demand, such as pricing strategies, are also needed.

Richard W. Longstreth

Longstreth is an architectural and urban historian whose interest is in understanding the role of the retail marketplace in shaping the modern metropolis. In a comprehensive study (Longstreth 1997), he has traced the evolution of the regional mall in Los Angeles in the mid 20th-century, and how these shopping centers, together with the rapid growth of private vehicles, shaped the land use and travel environment of the city and region.

His book is an observational and deductive work, relying on photographs, maps, and historical records found in newspapers and other documents. From

this evidence, Longstreth sees relationships and patterns that lead him to draw several conclusions about the importance of retail in the building of Los Angeles and post-auto cities generally:

...(M)ost historical studies of how the automobile has affected the landscape imply, at least, that the process was un- or even anti-urban, ultimately leading to decline and decay in the city. Such characterizations, however, ignore the inherently urban circumstances affecting change in the commercial sphere. Los Angeles reveals that the automobile was not an isolated cause but one of several factors that contributed to a recasting of metropolitan form rather than its destruction.

Just as Los Angeles is one of the major population, business, and cultural centers of the nation, so retail development is a key indicator of urban form and identity. No other single component of the city attracts so many people so frequently and for so many reasons. No other more frankly reveals current attitudes toward public assembly and decorum. No other so clearly reflects change both in market conditions and consumer taste. No other embodies more fully the unyielding impact of motor vehicles on the landscape.

At a time when "sprawl" is becoming a code word for urban ills, much as "congestion" and "overcrowding" were two generations ago, we need to be careful not to condemn in wholesale fashion the environment created in recent decades. My argument is not to defend all that has been developed in the recent past, nor is it against the strategies for change, but only that we should not repeat the mistake of previous generations who dismissed cities of the nineteenth and early twentieth centuries as wastelands. Only through understanding the modern metropolis can our choices for the future be informed, rational, and productive.

Daniel Luscher

Luscher is manager, economics and policy analysis, Acurex Environmental Corporation, Mountain View, CA. The paper summarized here is based on work done at the J. F. Kennedy School of Government, Cambridge, MA.

Luscher's work is unique because it directly addresses a central public concern: congestion. He estimated the congestion reduction benefits of TOD in the San Francisco Bay area using a simple spatial model (Luscher 1995). His analysis focused on residential development and did not directly address the role of TODs in altering commercial development patterns. Luscher found that, employing optimistic travel behavior modification assumptions, that redeveloping the area around most of the existing rail transit stations, coordinating similar development around feeder bus routes, and clustering one-fifth of the region's population in these areas would reduce vehicle

miles traveled by 5 percent. The strategy would offset about three years of VMT growth.

Luscher concludes that TOD would not have a significant impact on the Bay Area's congestion problems but may have collateral benefits.

It is clear that TOD is inappropriate as the foundation of a congestion reduction strategy for the Bay Area. To the extent that TODs are a part of a larger scale rethinking of urban design, they are likely to have worthwhile non-transportation benefits, such as an enhanced sense of community and the preservation of open space on the suburban fringe.

Douglas Porter

Porter is president of The Growth Management Institute, Chevy Chase, MD, and a planning and development consultant. He has written and edited books on growth management, and was the author of the Transit Cooperative Research program study of transit-focused development in 23 U.S. cities and metro regions (Porter 1997, 1998). We excerpt and summarize here some of the conclusions he reached in the latter research.

Porter was interested in the effect of TOD-supportive policies on development around light and heavy rail station areas. He did not probe for actual transportation benefits. What he observed were actual patterns of development that, in some cases, were the result of governmental efforts over several decades. His analysis suggests that transportation and land use planners, who have expectations that TOD can reduce auto dependency, must recognize the realities of the real estate markets, public attitudes, and the nature of rail lines themselves.

Especially along light rail lines, development opportunities will be influenced by changes in the development industry and its primary markets, increasing deference to neighborhood groups regarding development impacts, and the generally lower intensity of use of suburban rail stations compared to stations along heavy rail lines. Unlike experience with heavy rail systems, non central business-district stations on light rail lines are more likely to attract relatively small, uncomplicated projects (Porter 1998).

Porter found that the intensive development that has taken place has occurred mostly in central business districts and some midtown and inner suburban locations.

Except in older cities and downtown area, development falls short of the density and design thresholds needed for generating significant transit ridership; transit-focused development still remains more a concept than a reality in most regions. The primacy of the automobile and the desire of most

North Americans to live and work in low-density surroundings strongly dissuade market forces and governmental policies from producing densities and forms of development most supportive of transit.

Jonathan E. D. Richmond

Jonathan Richmond is a fellow at the Taubman Center for State and Local Government, Kennedy School of Government, Harvard University. Richmond has extensively studied light rail systems built in the U.S. since 1970. He recently published a review of the capital and operating costs, and the ridership levels, of these systems (Richmond 1998a). His findings correspond with earlier work by Pickrell who found that costs typically were underestimated and ridership was overestimated.

Richmond has also investigated the reasons rail systems are highly popular in spite of considerable evidence that they do not perform well (Richmond 1998b). This may be his most interesting and useful work for TOD planning. It is only possible to distill the essence of this work into a few selected quotes, since space limits a thorough review.

Transportation as a problem is most basically understood as a static concept—a derived demand. But transportation is part of a complex and dynamic system of elements that overlap and interact in a plethora of ways at a given point in time and whose interaction patterns shift over time in response to those interactions.

The public-sector response to transportation problems has focused on transportation facilities and not the underlying problems.

There are frequent references to the need for a 'balanced' transportation system. The idea of 'balance' is attractive because it simplifies complex ideas into a physically based metaphor.

The train is seen as necessary part of a balanced system, excluding the possibility that rail service may not be appropriate for all cities. The vast per capita expenditures on the rail system take away opportunities for the more productive use of scarce resources.

The artificially created 'urban village' does not reflect the richness of today's multifaceted and overlapping urban possibilities. Residents will remain attracted to exploiting the overlapping richness of the city with automobiles in ways that remain beyond the ready capabilities of public transport.

The assumption that people will use local facilities in a village-like community setting and that they will cycle to the train station along dedicated landscaped cycle routes is easy to make if you do not appreciate the web of complex

interactions for work, shopping, and leisure that automobility has created throughout the metropolis.

Recognizing that transportation is inevitably tied in an intricate web of overlaps with all other urban functions and with the rich morass of human life complicates the planning task but makes it more likely to succeed.

The successful transportation planner of the future must move from attempting to shape lifestyles in ways that cannot succeed in a democratic society to instead appreciate the many dimensions of how people have chosen to live and interact across space and how this relates to their aspirations for life in the future. And then accommodate their wishes in environmentally responsible ways.

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APPENDIX B: GLOSSARY OF ACRONYMS	
ATM	Automated Teller Machine
EAG	Expert Advisory Group
EIS	Environmental Impact Statement
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GAO	General Accounting Office
ICSC	International Council of Shopping Centers
ISTEA	Intermodal Surface Transportation Efficiency Act
ITS	Intelligent Transportation System
KB	Knowledge Base
MIS	Major Investment Study
MPO	Metropolitan Planning Organization
MTP	Nationwide Personal Transportation Survey
NWTIPP	Nonwork Travel Improvement Planning Process
PSRC	Puget Sound Regional Council
PT	Project Team
TAZ	Transportation Analysis Zone
TEA-21	Transportation Efficiency Act for the 21st Century
TCRP	Transit Cooperative Research Program
TOD	Transit-Oriented Development
U.S. DOT	United States Department of Transportation
VMT	Vehicle Miles of Travel

APPENDIX C:

ABOUT THE RESEARCH TEAM

DICK NELSON

Dick Nelson is president and senior researcher at Integrated Transport Research, a Washington State nonprofit corporation. He is also a Research Associate at the Mineta Transportation Institute. His recent work has focused on the integration of land use and transportation, specifically the concept of transit-oriented development. From 1977 through 1992, he was a member of the Washington State House of Representatives, where he worked to establish state laws that address growth management, state transportation planning, the linkage of transportation and land use, incentives to use transit and carpool, and transportation demand management. Over the past two decades, he has been a member of numerous state and local boards, commissions, and advisory committees related to transportation. He earned the Sc.D. from Massachusetts Institute of Technology and the BS from the University of Washington.

JOHN NILES

John Niles is founder and president of Global Telematics, a contract research and policy consulting firm based in Seattle, Washington that focuses on the interaction of transportation and telecommunications. In addition, he is a Mineta Transportation Institute Research Associate. Lately, the focus of his work has been the response of transportation policy to the network economy. He has led research studies on telecom-driven travel reduction for several Metropolitan Planning Organizations and the United States Department of Energy. He is a member of the Telecommunications and Travel Behavior Committee of the Transportation Research Board and participates in the Washington State Telework Coalition. He earned the M.S. from the Graduate School of Industrial Administration at Carnegie Mellon University and the S.B. from Massachusetts Institute of Technology.

AHARON HIBSHOOSH

Aharon Hibshoosh is a Professor in the Department of Marketing at San José State University and Research Associate at the Mineta Transportation Institute. He received the Ph.D. at University of California, Berkeley and the B.A. at Hebrew University in Israel. He has written many publications in diverse areas of marketing and applied economics, and has developed a variety of forecasting systems and quantitative tools and systems for regional planning and for urban and rural businesses. Research interests in support of

transportation planning include retail site location decisions, and consumer activity choice and time budgets.

RHYS ROWLAND

Rhys Rowland is a Planner in the Director's Division of the County of Santa Clara, California, and a graduate student in Urban and Regional Planning at San José State University. He earned the B.S. in Environmental Studies and Urban Planning from San José State University in 1997.

PRE-PUBLICATION PEER REVIEW

San José State University, of the California State University System, and the Mineta Transportation Institute Board of Trustees have agreed upon a peer review process required for all research published by the Institute. The purpose of the review process is to ensure that the results presented are based upon a professionally acceptable research protocol.

Research projects begin with the approval of a scope of work by the sponsoring entities, with in-process reviews by the Mineta Transportation Institute Research Director and the project sponsor. Periodic progress reports are provided to the Research Director and the Research Associate Policy Oversight Committee (RAPOC). Review of the draft research product is conducted by the Research Committee of the Board of Trustees and may include invited critiques from other professionals in the subject field. The review is based on the professional propriety of the research methodology.