# Getting a Handle on the Impact of Technological and Societal Changes on Travel in 2030

## Examination of Paradigms to Guide the Forecasting Process and Transportation System Response

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## Introduction

We all realize that the dynamics of travel in the year 2030 will be different from those of today. What we cannot be certain of is *how* they will differ. Will most workers still be compelled to arrive at work at a fixed time, generally between 8:00 and 8:30 am, each day? Will we still live in the same kinds of neighborhoods and shop at regional malls for back to school clothes as we do today? Will gasoline be plentiful and cheap? Will we still be content using private vehicles for nearly every trip? Will freight primarily move by truck, rail or air?

Clear answers to these questions would go a long way toward helping policy makers handle difficult choices that will be confronted in the next few years. Will vehicle and highway technology solve congestion and make a big impact on travel safety? Will shifts in societal attitudes increase support for major highway construction or large transit projects?…highway only?…transit only?…both?… neither? Will demographic changes generate a public outcry for more buses in suburbia or calls for communities to "take back their streets from cars"? Will the public in 2030 wonder why we didn't build more sidewalks in suburbia sooner or laugh at the folly of the 1990's when we thought that traditional community design was appropriate to an auto-dominated economy? Or should planners anticipate that the future will simply be a variation on the present and budget for future transportation investments along current thinking?

Unfortunately, finding clear answers to questions about societal attitudes and conditions of thirty years in the future is not possible. What is possible, however, is to use past history as a guide to understanding the types of changes likely, becoming somewhat confident of their magnitude, and avoiding the predictive mistakes of the past. Certain guidelines for anticipating the future can be derived from careful examination of how planners in the 1960's correctly forecast certain items that affect travel behavior in the 1990's and misunderstood other phenomena.

## The Errors of Previous Projections

Essentially, the planners in the1960's followed a simple philosophy: "What changes we see occurring today we expect to continue for the next 30 years. What is not obvious we will assume will not change." At its heart, this philosophy of trend projections cannot be criticized. For the Capital District of New York, many things are unchanged. The Hudson is still in the same location it was in 1965. Albany is still the state capital. General Electric is still building turbines in Schenectady. Saratoga County has seen a lot of growth. All of these statements were accurately anticipated from the simple planning philosophy stated above.

While the planning philosophy is reasonably sound, the application of it to factors influencing travel in the 1990's was not. The failure can be found in the superficial nature of the planners' examination of their underlying assumptions. Planners did not explore beneath the surface of what was obvious. Had they done so, they might have uncovered additional factors that proved to have a major impact on society and transportation. A brief outline of correct and incorrect assumptions about stability and change highlights the weakness of the application.

**Reasonably correct assumptions**

**Continued population growth.**
**Suburban orientation of much of new development.**
**Continued stability of personal mode choice being based on time, out-of-pocket cost and convenience.**
**Stability in average trip length (in time) of personal trips.**
**Low gasoline prices in the 1990's.**
**Household income growth, leading to greater vehicle ownership and trip making.**

**Factors totally misunderstood or missed entirely**

**Increased prevalence of one and two-person households and single-parent households.**
**Increased participation of teenagers in the labor force.**
**Increased participation of adult women in the labor force and the effect of two-worker households on travel.**
**Two severe shocks to the gasoline supply (1973-74 and 1979-80)**
**Effects of vehicle technology on travel dynamics (higher speeds at higher vehicle densities).**
**Severe curtailment of the traditional manufacturing base.**
**The relative shift of population to the southern and western sections of the US from the North (dampening local population growth rates)**
**Globalization of the economy, US international military dominance and collapse of European communism**
**Growth of the computer industry and its effects on the economy and national settlement patterns.**
**Collapse of downtown business districts as regional retail centers.**
**Emergence of road rage, aggressive driving and other reactions to congestion and time constraints.**
**Noticeable public support in many metro areas for high cost rail transit systems.**
**Lack of support for significant increases in highway funding, even during periods of economic expansion.**
**The environmental movement, extent of environmental regulations and NIMBY attitudes**
**Negative reaction to the urban renewal and urban highway construction of the 1950's and 1960's and efforts to undo their effects.**
**Lack of public support for completion of the next generation of freeways after the Interstate system**
**The ability to charge developers for traffic impacts under certain circumstances.**
**The dominance of suburb to suburb (rather than suburb-to-city) commutation on metropolitan travel patterns.**
**The emergence of e-commerce, cell phones, telecommuting and other technological advances.**

This brief list indicates that the shortcomings of the transportation planning exercises of the 1960's lie in the limited exploration by the planners of changes that were occurring before the planners' eyes, but were not treated in the planning process. In the Capital Region of New York, Colonie Center and other regional malls were well established by the late 1960's and the fragility of downtown business areas was well understood, but these phenomena were not fully captured in forecasts. Similarly, the environmental movement was gaining momentum before the Capital District's metropolitan planning process was even established but was not considered seriously in forecasts. A more careful examination of current happenings could have led planners to get a better -- although never perfect -- handle on the travel dynamics of the 1990's.

The fault for the limited examination of travel factors at the time may be placed at the feet of those who in good faith institutionalized and standardized the transportation planning process at the time. The "four-step" forecasting process and a new generation of computers allowed planners in every metro area in the nation in the 1960's to test the effectiveness of a wide range of (usually highway) facilities against future demand. Unintentionally, the capability of testing scores of alternative *system* designs led planners to severely constrain the range of future *demand* conditions, typically to a single set, in order to manage the testing process.

Limiting the range of alternative assumptions about the economy, travel behavior and land use to a single, simple set had the effect of excluding any real examination of the dynamics of change occurring in these factors.

The planners' desire to evaluate scores of alternatives similarly led to a restriction in the criteria used to evaluate performance -- limited generally to user costs, accident costs, time costs and construction costs alone.

The unfortunate result was a significant overemphasis in resulting plans on large-scale construction of highway facilities that later proved to be unaffordable, undoable and generally unwanted by the community. In the Capital District, very few of the new ideas included in the first generation regional transportation plan (largely the major highways plan of 1969) have been pursued seriously, much less implemented. The major projects which have been undertaken in the past 30 years have been largely those which could be described as "pipeline" projects -- projects that were in various stages of implementation -- prior to 1969.[1]

Even more recent forecasts have proven to have hit-or-miss successes. David T. Hartgen, in the New York State Department of Transportation's (NYSDOT) 1980 Preliminary Research Report 185, "What Will Happen to Travel in the Next 20 Years?", was on target for some items and off the mark on others.

[1] This is not to say that planners' handle on changing events improved noticeably in the 1970's and 1980's. The Capital District Transportation Committee's second-generation regional transportation plan adopted in 1981 reflected the severely constrained fiscal environment of the day by formally discouraging "big thinking", embracing a "what we have is all that we'll ever have" mentality. This approach was practical but missed the shift in public attitude that increased discretionary funding for at least some big projects in the 1990's. Similarly, planners' forecasts of energy costs in the early 1980's assumed that costs would continue to skyrocket; forecasts of $12 per gallon gasoline by 2000 were included in some studies at the time.

**"Factors Influencing Travel, 1980-2000"**
David T. Hartgen, NYSDOT PRR 185, August 1980

| Factor | Forecast Change | Right or Wrong in Hindsight? |
|---|---|---|
| Car efficiency | 80% gain | generally correct, although much of gain has been exchanged for higher performance |
| Gasoline price | Double in real terms | wrong; dropped 25% in real terms |
| NY State Population | 8% growth | slightly high (6%) |
| Overall travel increase | 45% | slightly low (60%) |
| Gasoline usage | decline 10 to 20% | wrong; virtually no reduction |
| Energy shutoffs | periodic shortfalls | wrong |
| Inflation | 8-12% avg. thru '95 | wrong; 3-4% avg. |
| Women in work force | modest increase | correct |
| Unemployment | Higher than historic | wrong |
| No. of households | steady growth | correct |
| Urban patterns | increasing ruralization | correct |
| Auto ownership | increasing saturation, use | correct |

## How Can We Avoid Repeating Past Mistakes?

**Rules of Thumb**

It is not possible to avoid mistakes in forecasting conditions 30 years out. It is not the purpose of this paper to attempt to make such forecasts. It is possible, however, to get a better handle on possible future conditions and on acceptable transportation system responses by paying close attention to the two statements above.

This paper seeks to provide a disciplined logic with which to approach the task of both forecasting future conditions and articulating public policy choices.

There are two statements that can help guide work on 30-year forecasts of future conditions affecting travel demand and supply. They are:

1. **Most aspects of travel supply and demand relationships will be stable over the thirty year period.**
2. **A few aspects of travel supply and demand will experience fundamental paradigm shifts that will change the relationships.**

Paradigm shifts were a favorite topic of Tom Larson when he served as FHWA administrator in the early 1990's. Essentially, he stressed that paradigms:

**-- are models or patterns through which to interpret and process facts;**

**-- provide sets of rules that allow conclusions and point to action;**

**-- influence our interpretation and even recognition of data;**

**-- are necessary;**

**-- but bias our judgement despite best attempts at openness and objectivity.**

Today, we can look back to the 1960's and understand that the factors adequately anticipated in the planners' predictions of the 1990's (the "reasonably correct assumptions" above) were those than fit statement #1. Those phenomena which were misunderstood or missed entirely are explained by statement #2 -- those which were subject to paradigm shifts that changed the relationships. For example, there is no way in which to explain the shift (decline) that occurred between the 1950's and 1990's regarding societal acceptance of major highway system expansion other than as a paradigm shift.

While we cannot fully anticipate all paradigm shifts, we may be able to structure our approach to the consideration of upcoming change. To help with this discipline, two useful corollary statements can be developed by revising the two statements above.

1. **Travel supply and demand relationships will be stable over the coming thirty-year period when understood at a core level.**
2. **Fundamental paradigm shifts that change travel relationships can be explained by other stable relationships.**

To illustrate the meaning of these corollary statements, consider a simple example. In the 1950's, one could state that *"The car that dominates automobile sales is the full-size Chevrolet. In a rare year, Ford may edge Chevrolet out."* This statement was true for decades. Today, the most popular car in annual sales is typically the Honda Accord, Toyota Camry or Ford Taurus. But by far, the highest selling vehicle model is Ford's full-sized pickup truck.

At first glance, this represents a striking paradigm shift -- away from traditional American auto models to foreign brands and light trucks. But if the phenomena of the 1950's could have been stated at a level closer to the *core* of the relationship, the statement would be as true in the 1990's as it was in the 1950's. Such a statement might have been, *"Sales of new vehicles for private use are greatly influenced by the characteristics of affordability, value, public acceptance and accessibility to sales and service. Firms that convey such characteristics to the consumer public through advertising, extensive dealer networks, reliability and word-of-mouth will continue to see their models near the top of annual sales lists."* This stable relationship explains the apparent paradigm shift away from the "truism" of Ford and Chevy dominance.

Parallels in the field of travel demand forecasting are many. For example, household travel behavior appears to have changed dramatically since the 1960's. But examined at a core level, households' responses to travel needs have changed very little. What has changed is household income, family structure, the number of household members in the work force, settlement patterns and the cost and availability of transportation options. After completing its 1983 household travel survey, the Capital District Transportation Committee compared travel behavior in 1965 with that of 1983. On the surface, average household trip making had increased by 30%. However, when the effects of household size, number of workers, income and vehicle ownership were removed, underlying behavior had changed by only 4% over 18 years. Thus it was more the superficial paradigms and relationships that had changed, but the core relationships proved durable.

In the same manner, goods movement appears to have changed dramatically over the past 30 years, with much greater dependence today upon air cargo and next-day truck delivery. Examined more carefully, however, the increase in freight activity and shift in modes merely reflects changes in technology and economic considerations. The fundamental paradigm remains intact: goods movement is derived from the form and scale of the economy, and modes and firms prosper to the extent that they balance time, cost and reliability to the meet the shipper's needs.

Thus, it is likely that over the next 30 years many superficial paradigms (for example, the Institute of Transportation Engineers' (ITE) empirical estimates of likely vehicle trips generated at single family detached homes) will change dramatically while underlying travel behavior and choice processes change little. The challenge is to accurately articulate the stable relationships to set the stage for exploring the societal factors that will affect the more superficial relationships.

**An Heroic Attempt to Articulate Stable Relationships**

The following statements are posited as stable relationships that are likely to remain stable over the next 20 to 30 years. These statements (for the purposes of planning: "truths") are formulated around relationships closer to the core level than planners tend to operate. These statements should be adequate to accommodate and even anticipate social and behavioral changes, and therefore assist in getting a handle on 2030 conditions. These "truths" are those which appear to be supported by data over a long period of time. By forming an understanding of future conditions and of the effectiveness of future transportation responses from the basis of these "truths", planners today can avoid many (or at least some) of the pitfalls that befell their 1960's colleagues by reducing the effect of unanticipated paradigm shifts.

Stated below, with some trepidation, are a few more than a dozen "truths" to undergird the 30-year travel demand forecasting and travel supply planning processes. These "truths" are intended to describe paradigms that are close to the core -- in other words, paradigms that are unlikely to change in the next 30 years. The reader is challenged to examine these paradigms to identify the circumstances and events that would alter these truths. If they are not truly durable, then any long-range planning based on these statements is quite suspect. If they are not truly durable, then perhaps an alternative wording might capture the core values that are not likely to change.

1. **Travel demand can be understood best through an understanding of the necessary and discretionary activities of individuals and requirements of businesses**. Travel is a derived need and occurs solely to accomplish other goals -- holding a job, obtaining medical care, going to school or church, etc. An individual will be generally willing to defer or eliminate any particular trip if the goal for that trip changes ("Let's eat in tonight.") or if it becomes more attractive to achieve the goal in other ways ("I'll order the new slacks on the Internet rather than going to the mall.") Commercial travel is directly related to the nature of the global economy, location of manufacturing, forms of distribution and levels of consumerism. It too is a derived activity. Even pleasure driving achieves a recreational and relaxational goal. The amount of pleasure driving will be influenced by the amount of time and financial resources allotted to recreation and by the available alternative recreational activities.

   *Careful exploration of possible societal changes -- immigration, aging of the population, family activity patterns, recreational opportunities, single parent households, shared stay-at-home parenting patterns -- is essential to understanding future travel requirements. Similarly, careful exploration of shifts in manufacturing and retail activities, market penetration of e-commerce, growth in discretionary income, anticipated "niche marketing" of motor vehicles and similar economic changes is essential to understanding future travel requirements.*

2. **Technological advances are continuous and have the tendency to increase productivity, not to decrease effort.** Whether it is robotic manufacturing processes or the microwave in the kitchen, technology continually makes it possible to achieve more with less human effort. History has shown that the human effort saved is more often put into other efforts rather than rest. What time we no longer need to spend standing along an assembly line or cooking dinner we use on other activities. The typical American household of 1900 spent much of day and evening and a large part of the weekend engaged in productive activities (earning a living, cooking, cleaning, sewing, studying, etc.). The typical American household of 2000 also spends much of the day and evening and a large part of the weekend engaged in productive ("have to") activities (earning a living through multiple wage earners, cooking, cleaning, shopping, studying, running errands, exploring the Internet, exercising.) Technology has not reduced the level of activity, merely shifted the type of activity.

   *New activities made possible by technology tend to be more flexible and less regular in terms of time of day and location than those activities they replace. Future technological gains can be expected to generate other new, flexible activities to replace older, more predictable activities. This has an implication for complexity in future travel patterns and a diminished emphasis on peak hour commutation in system design. The same is true for goods movement; improved technology will likely result in greater goods movement, allowing large-scale trade volumes from the farthest reaches of the globe, fostering "distributed manufacturing sites" and facilitating greater consumption of goods worldwide.*

3. **On an even more basic level, technological improvements lead to compensatory behavior**. Cruise control does not merely provide convenience, it allows drivers to reduce the attention they pay to operating speed and focus more attention on selecting a CD to insert into the player, for example. Cars with short braking distances and good handling characteristics do not merely add to travel safety, but allow drivers to drive at higher speeds at higher densities while maintaining a certain *perceived* level of safety. Similarly, gains in fuel efficiency over the past 20 years have largely been exchanged for higher vehicle performance. In other words, gains in one area provided by technological advances are partially sacrificed to obtain gains in another area.

   *Thus, it is wise to temper expectations of future windfall gains from advanced vehicle guidance systems, in-vehicle traveler information systems, hybrid electric vehicles or the construction of new roads or transit systems. Much of the direct gain provided by these advanced technologies will be exchanged for other benefits.*

4. **Technological advances are American society's preferred method of accommodating transportation energy and air quality challenges.** Technology has allowed for a dramatic reduction in total vehicle emissions in the US over the past twenty years despite steady increases in travel. Similarly, continuous improvements in the fuel efficiencies of vehicles has allowed manufacturers to meet federal fuel efficiency standards while average vehicle size has continued to grow to meet market demands.

   *Any future, lasting limitations to fuel supply -- or serious political commitments to reducing $CO_2$ emissions -- can be expected to be pursued in the US primarily through technology. Accepting this truth means recognizing that neither diminishing petroleum reserves nor global climate change concerns are likely to force to major shifts in the travel dynamics of the US.*

5. **Technology is most easily embraced if it requires little change to established personal behavior and can be introduced to some people or firms and spread to others**. Anti-lock braking systems, cruise control, rack-and-pinion steering, air bags and other features were first introduced in high-end models and then extended to virtually the entire fleet as costs came down. Electronic tolling has gained acceptance by being optional, allowing market penetration to grow slowly. Similarly, global positioning and tracking devices have entered the travel environment primarily through package delivery firms such as UPS and FedEx. From there, the technology will migrate to other businesses, to high-end personal vehicles and eventually to most of the fleet.

   *As a result, an automated highway system of the General Motors' 1939 World's Fair display is not likely to emerge full-blown through a major public sector investment. But steady advances in collision avoidance systems, vehicle guidance systems and the like very well could lead to incremental creation of virtual automated systems. These would be highways that, through modest investment in reference markers by the public sector and more significant investment by vehicle owners, control is never fully relinquished by the driver, but on-board electronics*

*keep the vehicle in its lane and a safe distance from other vehicles while maintaining a high rate of speed. Further improvements in vehicle safety can also be anticipated, even if the precise technological mechanisms cannot be known today.*

6. **Transportation conditions in current high demand locations can be expected to remain congested in future peak periods and during traffic "incidents", regardless of what actions are taken in the interim. From a different perspective, the transportation system is likely to offer some excess of supply for a considerable portion of the day.** The paradigm of compensating behavior contributes to this paradigm. That is, there is no ability of the public sector to address congested conditions by building such large amounts additional capacity or improving technology sufficiently that it satisfies (a) existing demand, (b) future growth in demand, (c) latent demand that would manifest itself if congestion were reduced and (d) other compensatory behavior such as increased densities. This truth applies to congested New York City subways and to congested Los Angeles freeways. In the Capital District of New York, work by CDTC and NYSDOT Region 1 in 1995 concluded that no feasible amount of highway widening would produce uncongested traffic conditions on the Northway in 2015. The flip side of the coin is that even in the most congested locations, there are and will continue to be parts of the day or week during which supply is ample and travel conditions relatively easy. This too applies to New York City subways, LA freeways and the Northway.

   *Because of this "truth", transportation planners need to re-think the necessity of highway expansions and consider such actions more discretionary in nature. Consideration of expansion of highways and transit systems can and should be pursued as less as solutions to problems (because the problems may not disappear) and more as creation of new opportunities.*

   *A corollary is that actions pursued as problem solutions may introduced new problems. The virtual automated highway described under #5 above may prove to increase hourly lane capacities on freeways during normal conditions but add to the fragility of flow and the magnitude of traffic tie-ups during incidents. (It is unlikely that on-board technology will be able to maintain a flow of 3,000 vehicles per hour on a freeway during a snowstorm. The resulting disruption of flow will exceed that of the pre-technology highway.)*

7. **Personal and commercial travel behavior accounts for congestion through an equilibrium process that will prevent gridlock.** The transportation planning and engineering profession has not fully acknowledged this durable truth. Traffic flows on congested streets in Manhattan and on the congested expressways of LA in a sluggish fashion today – but in a manner quite comparable to that ten and twenty years ago. Congestion may have spread to a larger portion of the highway system, but congestion has not increased in already-congested facilities at the rate of overall activity or travel growth. In the Capital District, recent traffic counts on an important arterial (New Karner Road in the Pine Bush area of Albany) show comparable (albeit congested) peak-period traffic volumes to those of ten and fifteen years ago. This is despite millions of square feet of new retail and

commercial space constructed in the Pine Bush over that period of time and few alternative routes to and from the new activity centers.

Commercial travel fits into this equilibrium process, as well. Long-distance truck drivers frequently schedule breaks to coincide with metropolitan rush hours and resume driving when the worst traffic is past. Package delivery firms budget extra time and vehicles for deliveries in congested locations, focussing less on the absolute cost of such adjustments as on their relative advantage or disadvantage when compared to their competition. As a result, congestion proves to be less of an issue to commercial traffic than one might otherwise expect.

*Exploration of this curious dynamic is imperative. The standard forecasting practice may overstate future traffic congestion (and lead to overstating the economic benefits of highway expansion) by not fully incorporating this equilibrium.*

8. **Whether travel speeds increase or decrease over time, there is a limit to the amount of time an individual or household is willing to spend daily in travel.** While the distribution of the curve of willingness is broad (some people have a low tolerance for time in travel, others a high tolerance), the curve appears to be reasonably consistent over time and from location to location. For commutation, Census journey-to-work information reports only a 5% increase in the median trip length in the US work trips between 1980 and 1990 despite double and triple-digit increases in urban peak hour congestion over the same period.

   *Even as continued increased discretionary income and technological advances permit Americans to pursue new and additional activities, there is likely to be a natural limitation to the amount of additional time spent in travel. Americans are unlikely to pursue (for any long period) new activities at times and locations that force their total time in travel to exceed an internal comfort level. This contributes toward the equilibrium process that accommodates the differences between congested areas and uncongested areas.*

   *Similarly, with work hour restrictions on long-distance truckers, operational or locational adjustments will be made to accommodate travel speed reductions.*

9. **Private sector land use actions are a primary means of accommodating changes in travel speeds in the United States**. The locations of jobs, housing, retail and other activities have shifted significantly over the past 30 years. This has not been primarily due to the need for space; the aggregate buildout capacity of available undeveloped land and redevelopment sites in an area such as the Capital District continues to exceed the expected level of development by a factor of five, ten or twenty to one. Rather, locations have shifted to maintain mobility and accessibility (keeping household or commercial travel time budgets within acceptable bounds) while responding to perceived and real market forces. During periods of transportation system expansion, many individuals trade in travel time savings for "more house" and the expectation of better schools in the suburbs. During periods of limited system expansion and rapid growth in congestion, jobs have moved out to suburbs as well. The new mix of origins and destinations of trips has maintained travel time budgets roughly consistent over time despite the

changing travel environment. In many ways, this statement is a corollary to statement #3 -- land use change is one of the compensatory results of transportation technological change.

*This "truth" has many implications for metropolitan transportation planning. First, it implies that all investment that improves travel time (whether it is highway capacity, a new rail line, traffic signal interconnection or effective incident management) is likely to have a land use spreading effect. It also implies that the lack of transportation system investment to maintain travel times also contributes to land use spreading. Public options that might be expected to constraining land use spreading are largely limited to those which enhance the market attractiveness of already-urban environments while not enhancing the attractiveness of undeveloped outlying areas. Examples would be brownfield redevelopment in a very accessible urban area; improvement of urban (rather than radial, commuter) transit services; streetscaping investments and zoning changes and incentives to create mixed-use urban neighborhoods.*

10. **Unlike their European counterparts, Americans are willing to tolerate a considerable degree of travel inconvenience in exchange for personal freedom and limits to governmental control and taxation.** While there will be grousing and displeasure over poor bus frequency or congestion on an expressway, American society does not tend to expect or demand that government solve a transportation problem simply because one exists – at least not to the degree that European societies do.

    *It is part of the American philosophy and temperament to hold a limited view of the role of government while insisting upon maximum personal latitude. Americans are therefore much more likely to find answers to transportation predicaments on their own and be comfortable with their choices than to call for public sector intervention. This dynamic plays a great role in the equilibrium process discussed above. It also implies that government actions that curtail personal freedom and choice to achieve transportation system objectives will not be received warmly.*

11. **Further, Americans have proven unwilling to indefinitely provide support (public acceptance or public financing) for any purpose unless a compelling argument is made regarding the need, unless success is viewed as likely, and unless the cost of deferring the program is believed to be great.**[2] Transportation program initiatives that have been funded at the federal, state, metropolitan or local levels generally meet these three criteria. Those that do not meet the criteria join many other desirable notions -- universal health care, expanded urban parks, free college tuition and similar concepts -- in a large

[2] Exceptions clearly exist. Taxing or funding decisions made without much public debate do not necessarily meet these criteria. However, the long-term history of taxing and government programs indicates that programs that do not gain and maintain public support eventually lose meaningful access to public funds. Those that do have public support are continued throughout the ups and downs of taxing cycles.

"needed but no funds available" list.[3] Similarly, there are many potential programs to achieve broader societal goals that are not costly monetarily but would restrict personal freedoms or "take away" current benefits. These also fail the public acceptance tests of urgency and likely success in all but extreme (wartime) circumstances. In this category would fall conversion of general-purpose highway lanes to high occupancy vehicle use (a "take away" program) and downtown parking prohibition (personal freedom limitation).

*Transportation planners should test potential policies and investment strategies against these criteria.*

12. **For this reason, pricing mechanisms to regulate travel demand will not be accepted unless certain specific circumstances emerge.** If the public largely accepts the notion of global climate change and its relationship to $CO_2$ emissions and believes that the potential for technology to provide $CO_2$ reductions is tapped out, it may accept the imposition of a gasoline surcharge or carbon tax sufficient to dampen travel levels. However, should technology catch up to the perceived need or should the tax prove ineffective, public support would disappear much as it did for the 55-mph speed limit.

    *Similarly, congestion pricing mechanisms to regulate demand would be likely to achieve public support only if they are viewed as urgent, effective, unavoidable and unobtrusive of government into personal life.*[4]

13. **The public will support reasonable and necessary costs to address problems that rise to a level believed to be serious by most people.** As an example, short of economic, political or natural crises, American society will not tolerate indefinitely widespread evidence of crumbling roads, dilapidated bridges or obsolete subway cars. Support may be cyclical, but a compelling argument for the need, expectation of success and concern about the cost of deferral will repeatedly lead to the provision of funds for necessary repair costs. The same cannot be said for all other transportation program initiatives unless and until a sense of urgency or crisis emerges.

    *On this basis, the transportation profession would be well advised to downplay its estimates of transportation "need", if need is defined as elimination of all physical and functional deficiencies in the nations road, bridge and transit systems. Public support for complete elimination of deficiencies will not be found, making the "need" estimate ring hollow and self-serving. Instead, presentation of "need" based upon public (customer) expectations may be more valuable in advancing the policy debate on transportation programs and funding levels.*

14. **Those programs that find public support do not necessarily provide direct benefits to all individuals.** Public transportation continues to enjoy broad

[3] It is common for the public to support many concepts that it is not willing to fund directly. In the transportation arena as in many others, this leads to efforts to secure special appropriations from a higher level of government for projects the community, county, metro area or state is unwilling to fund itself.

[4] On the basis of these criteria, it is a tall challenge to move from a HOT lane concept (variable congestion tolling on a new, added lane of an expressway) to charging a congestion price to all highways.

attitudinal and tax support across the country 35 years after the first federal transit act. Public libraries are maintained in most communities. This is despite the fact that a majority of Americans do not ride transit (or visit public libraries) even once during a typical year. Broad support can be attributed to the belief that such services do provide an indirect benefit to the larger community.

*This aspect of transportation policy is largely absent from discussions of alternative actions. For example, transit investment is typically supported based on arguments of ridership, cost effectiveness and congestion relief. In reality, most transit systems carry a small portion of total travelers, are quite expensive and (due to the equilibrium process) are unable to affect congestion levels. Despite this, many are considered successes within the community and are highlighted as significant community assets. They are considered successes not because of their ridership levels, cost recovery ratios or congestion relief; rather they are considered successes because they provide a legitimate travel alternative and contribute to the substance of urban life -- much as other civic institutions and facilities. Transportation professionals must recognize the notion of transportation facilities and services' legitimacy as part of the mix of features of a civilized culture.*

## Conclusions

Each of the preceding statements of durable "truths" must be examined carefully. Some reviewers of previous drafts of this document have contended that these truths derive from too narrow a period of history, that they provide too little acknowledgement of the potential for significant paradigm shifts. Wholesale changes in transportation technology and infrastructure were experienced in the first half of the 20th century. What if the circumstances of the next 30 years reflected such a grand scale of technological and institutional dynamism? It is certainly possible, even if such circumstances cannot be predicted.

But even if just these simple statements above (based on the paradigms of the second half of the 20th century) can be accepted as durable truths -- as core paradigms unlikely to change in the next thirty years -- there is still a substantial amount of change required of the transportation planning process. Among the appropriate responses may be the following:

1. **Recognize that investments in transportation facilities and services are a matter of choice, rather than a question of finding the "right answer."** Planners should dispense with the black-and-white notion of designing intersections based on forecasts of peak hour left turn movements for the year 2030, for example. Instead, planners should follow a shades-of-gray philosophy of "what makes sense", scaling investments to the physical context and system function. Travelers will accommodate whatever choice is made.
2. **Admit that transportation investment decisions are value-laden.** Given the public's ability to adapt to any transportation service improvement or degradation, it is obvious that transportation investments change land use, economic and travel outcomes. This admission should lead to careful, public articulation of values and

desired outcomes. While some policies have been attacked as "social engineering", we must recognize that all transport investments and policies are social engineering -- each action encourages one kind of behavior and discourages another. This admission should also lead to early investment in facilities and services that contribute to desired outcomes and deferral of investments that are largely an accommodation or mitigation of undesirable outcomes.

3. **Elevate customer and taxpayer perceptions as key determinants of the appropriate choices to make.** Far too frequently, engineering rules and limited measures of effectiveness are applied in making public policy choices about transportation. For example, traffic level of service receives an inordinate amount of focus in system plans and in infrastructure renewal projects, despite the fact that surveys tend to indicate that travel time reliability and predictability are valued more heavily by personal and commercial travelers than level of service. Similarly, policy planners should pay greater attention to taxpayer desire and willingness to invest in transit services (if present) and not obsess over a limited number of performance measures in making choices about transit investment.

4. **To the extent possible, explore the likely changes to the more superficial paradigms and factors (such as SUV popularity; the market penetration of telecommuting; the nature of the global economy; the need to travel to a major regional mall to see a movie; patterns of immigration and inter-regional migration; residential, commercial and retail building styles; work hours) that are candidates for subtle -- even radical -- change over the next 30 years.** Which paradigms are those which will change? Can we see the handwriting on the wall already?

5. **Hedge bets by articulating viable and plausible alternative futures that are consistent with the durable truths posited above.** Recognition of uncertainty in predicting the future should lead planners and policy makers to a new perspective on investment. It should lead to less evaluation of static performance (which is the best investment to meet 2030 travel demand?) and more on dynamic change (which one provides an immediate benefit and can be adapted to meet a range of future requirements?). It should lead to greater preservation of future options through corridor preservation and modular construction and less scaling of construction to meet long-range forecasts. It should also lead to restraint in making large public investments to fit particular transportation paradigms that are subject to radical change (such as freight movement, in which modal choice can swing dramatically in response to relatively small changes in technology or fuel cost).

**6.** **Continually articulate and review the durability of the "truths" underlying the planning process.** Public attitudes, economic changes and technology shifts may alter paradigms and may prove that some of the truths listed early are more ephemeral than durable.

Getting a handle on technological and societal changes in this manner has the potential to significantly change the long-range planning and investment dynamic for the better. Making the

change will require a substantial shift in current practices. Such practices include highway design practice (Should we really be building roads to accommodate the 85$^{th}$ percentile speed, regardless of context or established speed limits? Given uncertainty, should the number of left turning vehicles forecast for a particular intersection at 5PM in the year 2030 be a controlling factor in designing a facility today?), public/private infrastructure partnership approaches (Can we amend the public process to be timely to private sector needs?), performance evaluation (Why don't we consider other factors with the same importance as level-of-service?), alternatives evaluation structures (Is there a benefit in an alternative fitting multiple alternative scenarios or having the flexibility to meet unexpected paradigm shifts? Should we be placing greater emphasis on actions that foster the community characteristics cited by the public?), visioning and and forecasting processes (can we be intelligent and foresighted in integrating demographic and technological changes into our travel demand predictions?).

The resulting planning and research agenda is substantial.