New Transportation Planning Paradigm: Constraints-Based Planning in Response to Declining Transportation Funds and Growing Interest in Sustainable Communities and Climate Change

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Traditionally, cities and counties plan transportation facilities to provide uncongested traffic operations for decades into the future. Under the traditional planning paradigm, transportation projects are selected based on criteria like functional classification, design standards, and ability to provide acceptable operating conditions, as defined by measures such as level of service (LOS)[1], through a determined horizon year. Once a design is developed to meet these objectives, funding is obtained and the project is constructed.

However, as funding for transportation projects becomes scarcer, more often than not, this traditional planning paradigm is unrealistic. Funding availability to construct a project can no longer be assumed. This has already been well established in regional transportation planning process, but has yet to take hold at the individual city and county level. Moreover, with increasing congestion in urban areas, designing facilities that would meet target LOS thresholds in the long-term is becoming cost prohibitive.

Beyond funding shortfalls, the traditional planning paradigm is becoming outmoded for cities and counties as transportation professionals begin to recognize factors aside from automobile operations—including the experience of nonmotorists, preservation of open space, and most recently, climate change—as important considerations in planning transportation facilities.

This article promotes replacing the traditional transportation planning process with a constraints-based approach that addresses new funding, environmental, and political realities. The authors focus on widespread funding shortfalls as evidence that the traditional planning paradigm for cities and counties is failing. To demonstrate how transportation planning could better adapt to funding constraints, the authors present a case study from California, where a new constraints-based approach is could be applied to make the most effective use of limited public investment. Lastly, the article highlights how the new paradigm can be expanded to address issues of growing importance, including transportation system performance for non-auto modes and climate change.

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[1] Level of service (LOS) is a qualitative measure describing the operating condition of transportation facilities. For roadways, LOS ranges from A (the best) through F (the worst) and is measured through the perspective of the driver.. In general, LOS A represents free-flow conditions, and LOS F represents severe delay under stop-and-go or congested conditions.

NOTE ON THIS ARTICLE'S FOCUS ON LOCAL PLANS

The main focus of this article is on the transportation plans that are developed at the local level by cities and counties in a comprehensive planning process, rather than on regional transportation plans. The authors focus on Transportation Elements (as these local plans are often called), since these are fully informational documents that provide the public with a vision of what their community will look like in 20-to-30 years in terms of land uses, transportation infrastructure, and roadway operations. While regional transportation plans include lists of projects to be constructed over a 20-to-30 year time horizon, they do not convey the level information that local Transportation Elements include, such as projected peak hour traffic operations. In this article, the authors promote a different approach to the comprehensive planning process to bridge the gap between the vision set forth in local Transportation Elements and communities' ability to achieve their vision.

TWO TRANSPORTATION PLANNING PARADIGMS

The new planning paradigm proposed here differs from the traditional approach in a few important ways. Below, we review the typical steps of both approaches. To illustrate the differences, Figure 1 provides a simplified schematic of the "traditional" and "new" planning approaches. Table 1 details the individual steps taken by each planning paradigm.

Figure 1. Traditional and New Transportation Planning Processes

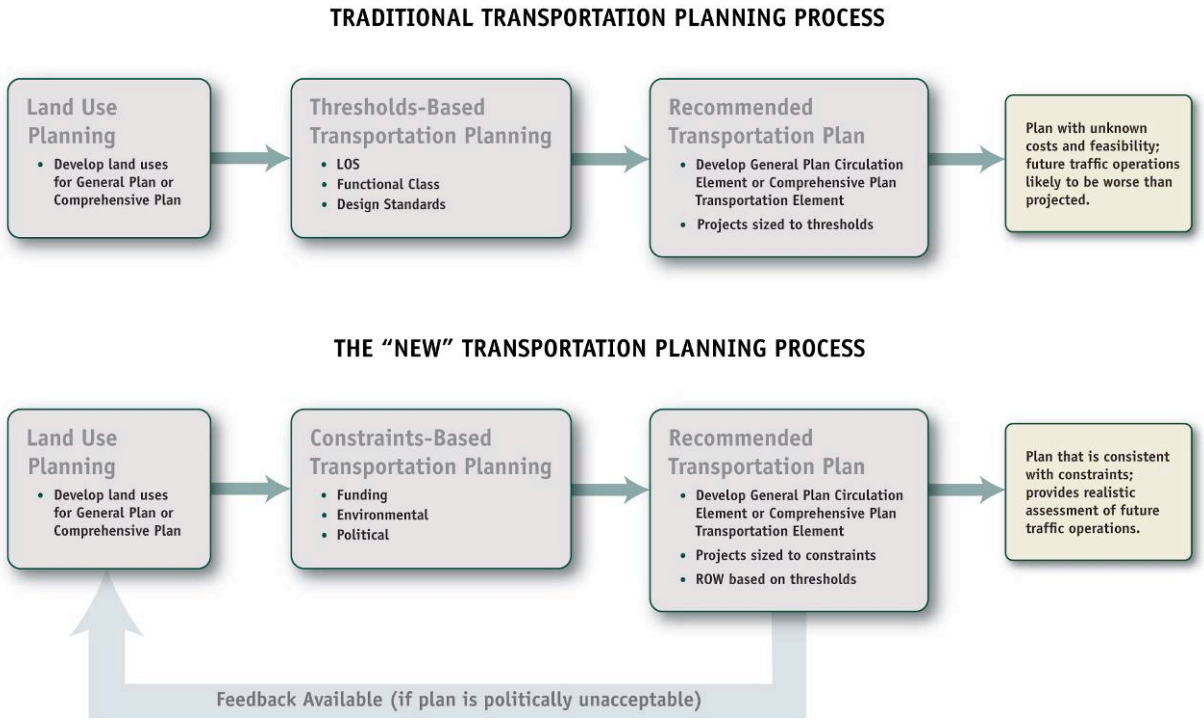


Table 1. Steps in the Planning Process Under Each Planning Paradigm

Old Planning Paradigm	New Planning Paradigm
1. Develop land uses for long-range planning document (e.g., General Plan or Comprehensive Plan).	1. Develop land use plan for long-range planning document (e.g., Comprehensive Plan).
2. Forecast how new land uses will affect future traffic operations.	2. Forecast how new land uses will affect future traffic operations.
3. Evaluate transportation infrastructure needed to accommodate future land uses and achieve desired performance level. Considerations include: • LOS • Functional Class • Design standards	3. Identify key constraints to capacity expansion: • Funding (most likely amount available through planning horizon year) • Political (community values related to quality of life) • Environmental (desired natural and human environment conditions that can be adversely affected by vehicle travel)
4. Develop transportation plan (e.g., Comprehensive Plan Transportation Element) that achieves performance measures without regard to cost or feasibility.	4. Evaluate transportation infrastructure needed to accommodate future land uses and achieve desired performance level. Considerations include: • LOS by mode • Vehicle miles of travel (VMT) • Functional Class • Design Standards
End of process – Adopt plan.	5. Develop **draft** transportation plan (e.g., Comprehensive Plan Transportation Element) that achieves performance measures.
	6. Analyze feasibility of draft plan in terms of constraints.
	7. If transportation plan is infeasible, adjust one of the following: • Land plan – modify to require less capacity expansion • Funding mechanisms – identify new revenues • Project design – modify design to be less costly (e.g., substitute buses for light rail, arterials for expressways) • Performance measures – reduce operating expectations
	8. Develop updated transportation plan based on adjustments to Step 6.
	Adopt plan only when considered feasible.

Traditional Planning Paradigm

The traditional planning paradigm is a linear process. Local jurisdictions begin by developing land uses for Comprehensive Plans or General Plans[2], which accommodate expected growth in population and employment over a 20- to 30-year period. Once these land uses are established, engineers and planners forecast how the planned land uses will influence future traffic operations in terms of meeting specified performance measures. . In many communities, LOS is the only performance measure used. They then determine the capacity expansion projects necessary to achieve these performance targets in a designated horizon year.

As shown in Figure 1 and Table 1, under the traditional planning paradigm, the adopted transportation plan (often called the Transportation Element) is unconstrained by financial or environmental feasibility. The plan's true costs (e.g., financial, political, and environmental) are often not considered until years later when implementation is well underway. Considering these constraints so late in the process makes it difficult for decision makers to revisit the plan and modify as necessary when problems are revealed.

This linear process results in transportation plans with uncertain costs and unknown feasibility. In most cases, this means that the plan will not deliver on stated performance objectives, such as maintaining a LOS threshold. Instead, future traffic operations will be worse than reported because capacity expansions identified in the plan will not be fully constructed due to insufficient funding during implementation or unforeseen political/environmental obstacles.

New Planning Paradigm

Unlike the traditional process, the new planning paradigm is an iterative process designed to develop a financially-solvent and politically/environmentally feasible transportation plan. Similar to the traditional process, engineers and planners begin by developing a land plan. However, in analyzing the transportation impacts of the land plan, the constraints (e.g., funding, political, and environmental) to mitigating those impacts are also acknowledged. In developing a transportation plan, planners and engineers are limited to the most cost-effective improvements that can fit within available constraints. This framework requires that decision makers acknowledge constraints early in the process.

If a jurisdiction cannot afford all of the capacity expansion projects required to meet the performance objectives established in its long-range plan, the new planning paradigm specifies that a jurisdiction consider changing one or more of the following plan elements:

- Refine the land use plan to fit within identified constraints.
- Increase revenues by identifying new funding mechanisms.
- Change the design of proposed projects (roadway or transit) to reduce costs.
- Decrease expectations about the transportation system's future operating performance (i.e., lower the LOS threshold).

[2] These long range planning documents are called Comprehensive Plans in most of the country although they are called General Plans in California. For brevity, the rest of the article will refer to these documents as Comprehensive Plans.

By requiring that a transportation plan's feasibility be examined prior to adoption, the new planning paradigm provides a more realistic view of future traffic operations, making the planning process more transparent. This approach also provides decision makers with a more complete list of options, including the tradeoffs associated with changing various components of long-term plans.

FAILINGS OF THE OLD PLANNING PARADIGM

For many reasons, the traditional planning paradigm is no longer sufficient. Lack of funding for transportation projects, probably the most concrete cause of its failure, is the focus of this article. However, the traditional planning paradigm also fails to address other concerns (such as accommodating other modes and climate change) that are becoming a focus of transportation planning, but often run counter to the goal of optimizing automobile operations.

Vanishing Funds

Today's scarcity of transportation funds stems from a variety of origins, including:

- Failure of key transportation revenues to grow with inflation.
- Increased costs to maintain the existing transportation system.
- Diversion of traditional highway revenues to other uses.
- Growing competition for public funding from other government programs (e.g., education and social services).

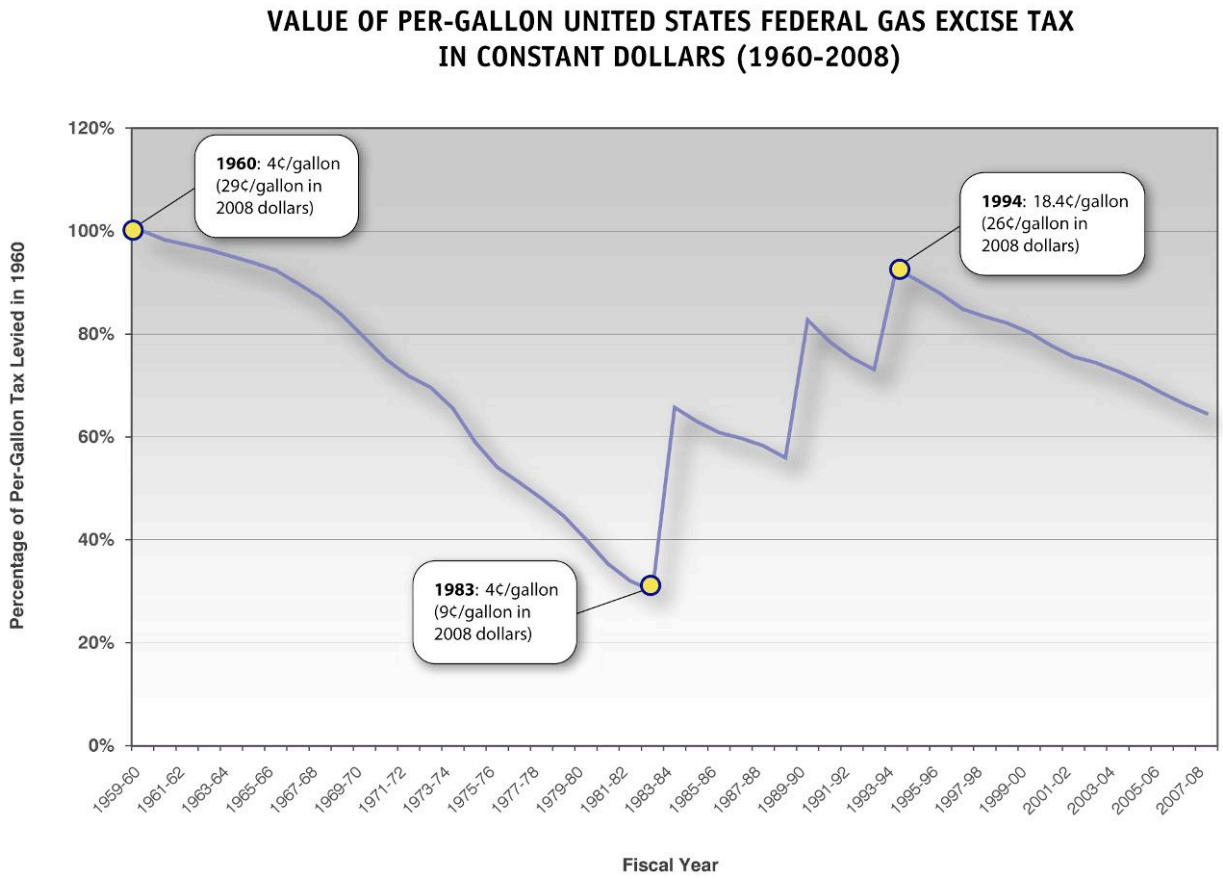
Below, some of the root causes of transportation fund scarcity are discussed. The following section describes how fund scarcity is affecting transportation project delivery.

Transportation Revenue Erosion

A common reason cited for the transportation funding shortfall is that the most traditional source of funding for transportation—the fuel tax—is shrinking. While the federal fuel tax has grown substantially in nominal terms—from $0.04 per gallon in 1960 to $0.184 per gallon today—in real terms, this funding source has not kept pace with inflation. Figure 2 shows how the per gallon federal gasoline tax rate fared relative to inflation between 1960 and 2007.

Most state gas tax rates have also failed to keep pace with inflation. Between 1992 and 2003, only three states raised their gas tax rates sufficiently to maintain purchasing power (Puentes and Price, 2003).

Figure 2. Value of Per-Gallon United States Federal Gas Excise Tax in Constant Dollars (1960-2008)



Looking into the future, the erosion of transportation revenues will likely persist even if the gas tax is raised. Rising fuel economy and the potential adoption of new sources of energy for transportation also threaten transportation finance. As fuel efficient vehicles and those that run on alternative fuels become more prevalent, the amount of gas tax collected per VMT would further decline under the current regulatory structure.

Two other key factors to keep in mind are that rehabilitation costs are also rising along with competition for public funds from other programs such as social and educational. In many states, maintenance and rehabilitation costs exceed available revenue, which continues to be spent on capital projects. The growing competition for public funds will exacerbate this problem. For example, in California, like much of the nation, transportation infrastructure is not the priority in government spending as it was back in the 1950s and 1960s. Comparing state infrastructure expenditures at two snap-shots in time—fiscal years 1965-66 and 2002-03—transportation reduced its share of capital outlay expenditures from over half (52 percent) to less than a quarter (22 percent). Over the same period, the portion of capital outlay expenditures devoted to K-12 educational infrastructure increased from 9 percent to 69 percent (Hanak and Baldassare, 2005).

The Effect of Funding Shortfalls on Regional Transportation Planning

To assess how much the changing funding picture is affecting transportation project delivery, the authors reviewed regional transportation plans (RTPs) prepared by several metropolitan planning organizations (MPOs) around the country. RTPs identify regional transportation needs over a 20- to 30-year planning horizon and prioritize projects (often capacity expansions) to meet these needs based on available funding and regional goals. The transportation needs identified in RTPs tend to be heavily influenced by anticipated population and employment growth, as defined in comprehensive plans developed by the cities and counties of a region.

Federal law requires that RTPs include only projects that fit within reasonably anticipated funding levels. As a result, many MPOs curtail project lists, as not all projects would fit within anticipated revenues. When unconstrained project lists are quantified, RTPs can serve as a barometer for how much funding constraints are being overlooked by the cities and counties developing comprehensive plans. The authors identified eight RTPs that quantify the gap between their unconstrained project list and the level of reasonably anticipated funding in the planning horizon. As shown in Table 2, the review of these plans yields that regions are identifying major shortfalls in funding to construct desired projects.

Table 2. Funding Shortfall for Capacity Expansion Projects Identified in Selected RTPs

Region	Planning Horizon Year	2007 Population *(millions)*	Highway		Non-Highway		Unfunded Projects/ Resident
			Funded	Unfunded	Funded	Unfunded	
			($billions)				
Broward County, FL (1)	2030	1.6 M	$2.12	$1.94	$4.39	$0.94	$1,800
Minneapolis/St Paul, MN (2)	2030	2.6 M	$6.24	$25.61	$0.87	$1.03	$10,246
Pittsburgh, PA (3)	2035	2.7 M	$1.91	$6.25	$0.24	$9.90	$5,981
San Diego, CA (4)	2030	2.8 M	$17.33	$24.56	$7.77	$5.04	$10,571
Seattle, WA (5)	2030	3.3 M	$54.26	$19.01	$50.93	$19.89	$11,787
Detroit, MI (6)	2030	4.8 M	$4.00	$0.00	$2.10	$15.10	$3,145
Arlington, TX (7)	2030	4.9 M	$35.40	$39.70	$12.10	$8.60	$9,857
Chicago, IL (8)	2030	8.2 M	$14.00	$10.80	n/a	n/a	$1,317

1. Broward County Metropolitan Planning Organization, 2008.
2. Metropolitan Council, 2008.
3. Southwestern Pennsylvania Planning Commission, 2008.
4. San Diego Association of Governments, 2008.
5. Puget Sound Regional Council, 2008. Of the $54 billion in highway projects labeled as funded under the Seattle plan, $21 billion (about 40%) relied on generating additional revenues, both at the local levels including new local developer fees and sales taxes, and at the state level including a 15 cent increase in the state gas tax rate by 2015 and other 15 cent increase by 2025.
6. Southeast Michigan Council of Governments, 2008. While the Detroit plan shows no unfunded needs for highway capacity expansion projects, unfunded needs for highway maintenance and rehabilitation needs exceed $20 billion.
7. North Central Texas Council of Government, 2008.
8. Chicago Metropolitan Agency for Planning, 2008. Highway value include both highway and non-highway projects.

Of the surveyed regions, the North Central Texas Council of Governments in Arlington identified the largest gap between available funding and unconstrained needs. Capacity expansions identified as needs by local jurisdictions, but which would not fit within the region's anticipated transportation revenues totaled more than $40 billion. The magnitude of this shortfall suggests that operating performance targets (e.g., LOS standards) established in local comprehensive plans would not be achieved unless jurisdictions take actions prescribed by the new planning paradigm, like: raising new revenues for transportation; modifying project design to reduce costs; or amending land plans to allow for less development.

Considering funding shortfalls on a per-resident basis, regions like Minneapolis-St. Paul, San Diego, and Seattle have the largest funding gap (in excess of $10,000 per resident). In Seattle, each resident would have to pay almost $12,000 to fully fund identified projects. Clearly, the cities and counties of the region may want to lower residents' expectations regarding how the transportation network will operate in the future.

Responses to the Funding Shortfall

Interestingly, while many view the current lack of transportation funding as a major obstacle in the planning process, few have recommended tailoring the planning process to account for this shortfall. In the past few years, some landmark reports have been released, including the National Transportation Policy and Revenue Study Commission *Transportation for Tomorrow* report, the Transportation Research Board's *Special Report 285: The Fuel Tax and Alternatives for Transportation Funding*, and the National Chamber Foundation's *The Transportation Challenge: Moving the U.S. Economy*. Some of the recommendations included in these reports are listed below.

- Provide innovative finance opportunities, including public-private partnerships, joint-powers authorities (Meyer et. al., 2006; National Surface Transportation Policy and Revenue Study Commission, 2008; National Chamber Foundation, 2008).
- Reinforce current user fees with actions including indexing the gas tax to inflation (Meyer et. al., 2006; National Surface Transportation Policy and Revenue Study Commission, 2008; National Chamber Foundation, 2008).
- Raise the gas tax by 25-40 cents per gallon (National Surface Transportation Policy and Revenue Study Commission, 2008).
- Charge additional user fees by implementing mileage-based fees and tolls (Meyer et. al., 2006; National Surface Transportation Policy and Revenue Study Commission, 2008; National Chamber Foundation, 2008).
- Shift highway taxes and other broad tax revenues to fund public transportation (Meyer et. al., 2006; National Surface Transportation Policy and Revenue Study Commission, 2008).

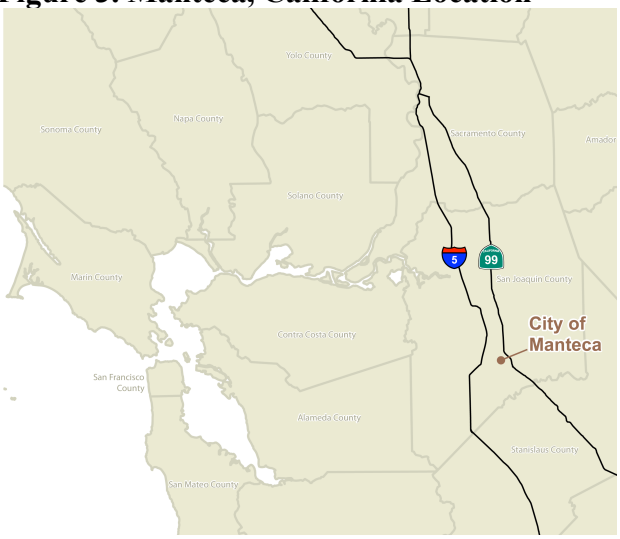
While implementation of these recommendations would improve the transportation funding landscape, they all rely on major policy changes that have garnered little political support. The authors question whether the transportation community will ever realize the full package of policy changes it seeks. After all, the political arena has failed to deliver any significant reform in transportation funding for over two decades. With the price of gasoline having surged to over

$4.00 per gallon recently and in 2008, the adoption of substantial additional user fees seem unlikely. Given this context, this article proposes a new transportation planning paradigm that adapts to what is likely a permanent shortfall in transportation funding.

Case Study - City of Manteca, California

In early 2008, the City of Manteca began updating its transportation impact fee program. Recognizing that the city's current transportation impact fees are insufficient to fully mitigate the transportation impacts that would result from development anticipated in the 2023 General Plan, City leaders are rethinking the traditional planning paradigm.

Figure 3. Manteca, California Location



Background

Manteca is located in San Joaquin County in California's Central Valley. Once a small farming town, the city now has about 65,000 residents and in recent years has transformed itself into a suburb of the San Francisco Bay Area. In addition to the influx of new residents, Manteca is currently experiencing rapid growth in the service and industrial sectors. The swift pace of development in the past ten years has not been accompanied by an equal increase in new roadway capacity, which has lead to increased levels of traffic congestion.

While the city experienced a boom in development in the early 2000s, it relied on a transportation funding program originally developed in 1989. For the most part, this issue was overlooked because the city (and to a lesser degree the state) had built a system with adequate reserve capacity for a small farm town or suburban center. However, as the development boom began to fade, city staff realized that they were facing an increasingly large funding shortfall with a shrinking pool of new development over which to spread the cost of infrastructure to meet the city's target operating threshold (LOS C on most transportation facilities, except for some facilities where land or funding constraints exist and LOS D is accepted).

Planning Paradigm Opportunity

In January 2008, Manteca's Community Development Department released a Development Services Action Plan, which quantified the necessary development fee levels to maintain the City's desired roadway LOS standards. Overall, the plan found that the transportation system prescribed in the City's 2023 Comprehensive Plan was unlikely to be funded under the current regulatory framework (City of Manteca, 2008): "There is a disconnect between land use utilization patterns in the adopted [Comprehensive] Plan and the financial reality of constructing the infrastructure necessary to accommodate that utilization."

The Development Action Services identified that dwelling-unit equivalent (DUE) fees necessary to fully mitigate the transportation impacts of planned development would be about $37,000. This compares to the current fee of about $5,400 per DUE for transportation infrastructure (San Joaquin Partnership, 2008). That fee would be added to other fees to cover other necessary infrastructure for a total fee of $62,000 per DUE.

Realizing that this impact fee level is well above what is desirable to charge in Manteca, the Development Action Services Plan proposes an amendment to the City's Comprehensive Plan. In pursuing this amendment, decision makers can choose between several options in how they want to plan a financially-solvent transportation system without raising fees to the levels suggested in the Development Services Action Plan:

- Reduce roadway performance expectations by lowering the circulation element target threshold to LOS D or E – this would require less transportation infrastructure to be built, but would allow for higher levels of vehicle delay.
- Amend the Comprehensive Plan land use element to reduce the amount of development. Under this scenario, Manteca would remain a smaller community through 2023.
- Modify the design of planned transportation facilities to reduce costs – this would mean constructing less expensive transportation infrastructure than some of the projects listed in the Comprehensive Plan.

BEYOND FINANCE—EMERGING CONSTRAINTS SHIFTING THE PARADIGM

Transportation professionals are increasingly being asked to plan transportation facilities to serve multiple, and often conflicting, objectives. Two examples mentioned here are providing a transportation system that is appealing to non-auto modes and which minimizes greenhouse gas emissions. Both of these goals can run counter to providing uncongested roadway operations. Under the new planning paradigm, these emerging constraints would be considered when developing a transportation plan.

Accommodating Walk and Bicycle Modes

The traditional planning paradigm focuses on a single mode: the automobile. However, while comprehensive plans endeavor to maintain smooth roadway operations, they often support competing values, like creating bicycle and pedestrian environments, increasing transit ridership, maintaining open space, and attracting residential development in the urban core.

Despite these multiple objectives, most long-range plans apply vehicular LOS as the primary design criterion for transportation facilities (Litman, 2007). Jurisdictions often require that transportation facilities be designed to achieve a specific vehicular LOS without recognizing how roadway size influences urban form. However, with increasing congestion, this typical practice becomes more problematic, as the size of infrastructure needed to maintain desired performance thresholds like vehicular LOS can increase as well.

Some communities have begun considering the experience of non-motorists as a constraint in their planning paradigm. For example, the City of Davis, California allows downtown roadway facilities to operate at LOS F during peak periods. City leaders lowered the vehicular LOS policy to maintain a downtown that is inviting to pedestrians. Moreover, Chico, California in its ongoing comprehensive planning process, is considering a standard that no roadway exceeds four-lanes. This standard is being considered in part to ensure that roadways maintain a character conducive to non-auto modes. As Chico continues with its comprehensive planning process, this constraint may affect where development is planned and what level of vehicular LOS city leaders accept.

Concurrency programs are also being developed to be more multi-modal in their focus. Redmond, Washington is in the midst of making substantial modifications to the structure of its concurrency program. Rather than analyzing only vehicle trips passing through a screenline or an intersection, Redmond is looking to base its concurrency assessments on a project's generation of person-miles of travel (PMT). The concurrency program would evaluate how a development's PMT generation by a variety of modes (private vehicles, transit, non-motorized, etc) compares to the carrying capacity of the infrastructure in place for each mode (roads, transit vehicles, sidewalks, etc). The end goal of such a program is to consider how development impacts the level of service experienced by all modes. For example, if a development causes a district's pedestrian travel demand to exceed its pedestrian infrastructure capacity, then the project would be required to fund additional pedestrian infrastructure to maintain stated pedestrian service objectives.

Climate Change

There is growing interest at the national and state levels to reduce the volume of greenhouse gases (GHGs) emitted by the transportation sector. For example, the 2006 passage of California State Assembly Bill 32 (AB 32) mandated that California reduce carbon emissions 20 percent by 2020. As cars and trucks account for 28 percent of these emissions (United States Environmental Protection Agency, 2008), AB 32 made apparent the need for transportation planning to consider GHG emissions. Just as the Clean Air Act introduced the idea of air quality conformity into RTPs (with the constraint being criteria pollutants), it is conceivable that the something like "carbon conformity" could be in our future.

In evaluating the connection between transportation and climate change, research by one of the authors found that GHG emissions tend to be lowest when vehicle speeds are 40 to 50 miles per hour under stable flow conditions. Unfortunately, the optimal vehicle travel speeds for minimizing GHG emissions do not dovetail with typical LOS policies included in comprehensive plans especially when applied to expressways and freeways.

Presently, LOS policies included in comprehensive plans tend to consider volume-to-capacity ratios, vehicle delay, and vehicle density. Speed, one of the most important metrics from a GHG emissions perspective, is often overlooked. However, LOS policies have a strong influence on the prevailing travel speeds of automobiles, and thus also influence the amount of GHGs and air pollutants that are generated.

Given this new context, it is likely that carbon emissions may someday become a constraint that limits the extent to which our transportation system can be expanded, just as revenue budgets do today. Using a new transportation planning paradigm, transportation professionals would estimate from the offset of the long-range planning process how feasible projects are from a climate change perspective.

LESSONS LEARNED

Chronic shortfalls in funding and evolving policies that are shifting planning priorities are leading to a sea-change in the way we plan. Conventional transportation planning does not result in feasible or financially-solvent long range plans. To create plans that are both feasible and solvent, jurisdictions will need to apply the following new planning paradigm tools:

- Refine the land use plan to fit within identified constraints.
- Increase revenues by identifying new funding mechanisms.
- Change the design of proposed projects (roadway or transit) to reduce costs.
- Decrease expectations about the transportation system's future operating performance (i.e., lower the LOS threshold).

In the end, the new planning paradigm is a toolbox that should be used by jurisdictions as appropriate to achieve the ultimate goal of sustainable planning.

CONCLUSION

This article promotes a new approach to planning that adapts to the constraints—financial, political, and environmental—pushing transportation planning in a new direction. The new planning paradigm is an iterative process designed to develop a financially-solvent and politically/environmentally feasible transportation plan. By requiring that the feasibility of a transportation plan be examined prior to adoption, the new planning paradigm provides a more realistic view of future traffic operations, allowing decision makers to consider up front the tradeoffs between urban development, revenue generation, project design standards, and transportation system performance. Ultimately, the new transportation planning paradigm seeks to make the planning process more transparent. The case studies presented here provide evidence that this new transportation paradigm is emerging organically, as funding shortfalls necessitate a change in the way we plan.

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