Chapter 5A

Transportation Trends & Performance

Overview of Performance and the Land Use-Transportation Connection

Introduction

Because the MTP/SCS is a long-range plan, the degree to which it enhances the performance of the region's transportation system and improves mobility and access for residents of the region over time are key measures of success. This is especially important to ensure more efficient vehicle and freight movement, and improve mobility options for cost, health, environmental, or other reasons.

This chapter is divided into three sections to fully describe the performance of the transportation system planned for in this MTP/SCS: Chapter 5A provides an overview of the land use-transportation connection; Chapter 5B describes the performance of the roadways in terms of vehicle miles traveled and roadway congestion and delay; and Chapter 5C discusses transit and non-motorized travel (i.e., bicycling and walking).

Chapter 5A provides background for Chapters 5B and 5C and is divided into three sections. The first section describes the indicators critical to evaluating performance of the transportation system and how the MTP/SCS performs on them (Overview of Transportation Performance Indicators); the second section describes the analytical framework and modeling tools used to measure these indicators (Technical Analysis Framework and Tools); and the third section describes the primary relationships between land use and transportation that influence these indicators (Land Use-Transportation Connection).

Transportation performance indicators—the basic relationships between land use, the transportation system, and travel outcomes—have been a focus of the entire MTP/SCS process. Technical work and public outreach have spotlighted tradeoffs in investment options and have strived to balance growth and conservation. The three alternative scenarios presented at the MTP/SCS workshops in the fall of 2010 included data characterizing the land use and transportation inputs, and the travel outcomes that could be expected from each of those scenarios. The development of the MTP/SCS described in this plan drew from various elements of each of the three scenarios. Chapter 2 provides a description and Appendix G-1—Public Workshop Scenarios and Workshop Results provides more detail on the development of these scenarios.

Transportation plans often focus on improving mobility through investment in transportation infrastructure and services. Measures of mobility, such as the percent of travel using a particular travel mode or mode share, travel time, and travel delay provide valuable information about how well current and planned transportation systems function. Through the course of the entire MTP/SCS planning process and SACOG's ongoing Congestion Management Process (CMP), the performance focus has been on the following critical indicators:

- vehicle miles traveled (VMT) on the region's roadways;
- the level of congestion and delay for all modes, but especially roadway congestion;
- transit ridership and the share of trips made by transit modes; and
- travel by non-motorized travel modes (bike and walk) and the share of trips made by those modes.

In part, the focus on these indicators began with the adoption of the Metropolitan Transportation Plan (MTP) for 2025 in July 2002, and continued through the update of the last MTP in 2008. The 2008 MTP was the first comprehensive update of the long-range transportation plan after the adoption of the Blueprint vision in 2005, and the first in the Sacramento region based firmly on the Blueprint's smart growth planning principles. One over-arching performance result of the 2008 MTP was the reversal or amelioration of several persistent and worrisome historic trends:

- VMT growth continuing to outstrip population growth—the 2008 MTP promised a reversal of this trend, with VMT per household declining by 6 percent or more.
- Roadway congestion growth far in excess of growth in VMT—the 2008 MTP promised a significant reduction in the growth rate of congestion in the region, but congestion was still expected to exceed population growth for the foreseeable future.
- Transit ridership increases, but not by much—the 2008 MTP promised a tripling of transit trips, and 35 percent increase in the productivity of transit services.
- Declining non-motorized mode share—the 2008 MTP promised a reversal of this trend, with non-motorized trips per capita increasing by 26 percent or more.

This chapter picks up this story where the 2008 MTP left off. The main performance questions addressed by the MTP/SCS are:

- A lot has changed in the region (as well as in California, the nation, and the world) since the adoption of the last MTP in 2008. To what extent does this MTP/SCS account for and address changes in the economy, changes in regulations and planning requirements, and changing expectations and priorities for SACOG member agencies and residents of the region?
- To what extent can the MTP/SCS improve on the transportation performance promised in the 2008 MTP? The MTP/SCS planning effort focused more attention on the land use-transportation connection than the 2008 MTP, and required a much higher level of effort on the part of all SACOG's member agencies and planning partners to maximize the connection between the land use pattern and the multi-modal transportation system.
  - For roadways, the MTP/SCS emphasis is placed on addressing existing bottlenecks and congestion points in the freeway system, and in right-sizing surface street improvements on the arterial street system.

- For transit, the MTP/SCS emphasis is on concentrating the most frequent, highest-capacity transit services in corridors with the greatest ridership potential, and limiting expansion of transit service in areas where land use patterns would not support frequent, high-capacity transit.
- For bicycling, the MTP/SCS emphasis is on expanding the network of Class 1 separated bike paths and Class 2 bike lanes and providing alternate, attractive bike routes in corridors where existing routes are non-existent or extremely unattractive to use.
- For walking, the MTP/SCS emphasis is on supporting compact land uses, with a good mix of complementary land uses and a street pattern supportive of walking. In combination, these strategies provide the opportunity to make shorter trips, and make a higher share of trips by walking.

Highlights of the performance of the MTP/SCS are:

- Decline in VMT per capita—Expected VMT from all sources in the region decline by 6.9 percent from 2008 levels. (This compares to a 1.8 percent reduction for the 2008 MTP). The VMT generated by passenger vehicles, a subset of all VMT, is forecasted to decline by 8.8 percent from 2008 (compared to a 5.2 reduction in per capita VMT for the 2008 MTP, and an 8 percent increase in per capita VMT for the 2002 MTP).
- Decline in congested VMT per capita—For the first time, the long range transportation plan for the SACOG region is forecasted to result in a decline of 7 percent in the amount of congested vehicle travel per capita. This is the first long range transportation plan which is forecasted to result in a decline in this metric. (This compares to a 22 percent increase in the 2008 MTP, and a 58 percent increase in the 2002 MTP).
- Increase in travel by transit, bicycle and walking—The MTP/SCS is forecasted to increase trips per capita by transit, bicycle or walk by 32.8 percent. (This compares to an 8.1 percent increase for the 2008 MTP).
- Increase in Productivity of the Transportation System—The MTP/SCS roadway system will be more efficiently used, with the proportion of VMT in the optimal use range increasing. The MTP/SCS is also forecasted to more than double the productivity of the region's transit system, from about 33 boardings per service hour to over 70. This improvement in transit productivity will substantially increase the amount of service which can be funded through passenger fares.

Technical Analysis Framework and Tools

In evaluating the performance of the MTP/SCS and the ongoing CMP efforts, two points of reference are used for each key indicator:

- What have the historic trends been for each indicator? How do the projections for the MTP/SCS affect the historic trends? For each key indicator, the best historic trend data are presented, along with future projections for the MTP/SCS.
- How does the MTP/SCS, taken as the combined effects of a more efficient and compact allocation of growth, and the proposed package of transportation investments to 2035, compare to what would have unfolded using the prior growth projections and the 2008 MTP?

Forecasting and Analysis Tools

The main tools used for the transportation analysis of the MTP/SCS are SACOG's land use scenario software and databases, and regional travel demand model. SACOG has been at the forefront of development and application of travel demand modeling tools, and throughout the Blueprint project SACOG undertook research and analysis activities to evaluate and improve the ability to capture land use-transportation interrelationships using computer models.

SACOG utilized its regional travel demand model to compare the MTP/SCS 2035 conditions to the existing conditions for the 2008 base year. SACOG's primary model is the Sacramento Regional Activity-Based Simulation Model (SACSIM). SACOG periodically updates and improves SACSIM, and releases versions of the model and data for use by member agencies when the MTP is adopted, with versions numbered according to the year the version was finalized. SACSIM07 was used for the 2008 update of the MTP. SACSIM11 was used for the analysis of this MTP/SCS.

SACSIM includes four sub-models for predicting travel demand. The major sub-model is DAYSIM, which is an activity-based tour sub-model for predicting household-generated travel. DAYSIM is an advanced practice[1] demand micro-simulation, which represents travel activities as tours, or series of trips, connecting the activities a person engages in during the course of a normal day. DAYSIM allows for much more detailed representation of key factors influencing household-generated travel, such as detailed characteristics of land use in the region, age of residents, household income, cost of fuel, and other factors.

SACSIM also includes a more conventional, state-of-

[1] Advanced practice travel demand modeling is defined in TRB Special Report 288, "Metropolitan Travel Forecasting: Current Practice and Future Direction".

practice[2] sub-model for predicting commercial vehicle travel. Two classes of commercial vehicles are modeled: two-axle commercial vehicles, and three-plus-axle commercial vehicles. Two-axle commercial vehicles include a wide range of vehicles, from a passenger vehicle which might be used to transport a computer repair person and their tools and equipment to an office to perform a repair, to a relatively small truck delivering produce to a restaurant or store. Three-plus-axle commercial vehicles also include a wide array of vehicles, from medium-sized delivery trucks to large, 5-axle tractor-trailer combinations. The common element tying these vehicles together is that they are used to transport goods and services, and are not used for personal (household-generated) travel.

SACSIM also includes sub-models for predicting air passenger ground access to the Sacramento International Airport, and for predicting external travel, including travel by residents of the region to locations outside the region, residents outside the region traveling to locations within the region, and travel which goes through the region, but does not stop within the region.

Travel demand for vehicle or passenger trips estimated using SACSIM are combined for assignment to detailed computer representations of the region's highway and transit networks using software and programs. The resulting assignments are used for evaluation of VMT on roadways, and evaluation of congested travel.

The analysis period of SACSIM is a typical weekday. A typical weekday is intended to represent weekday conditions during a non-summer month (i.e., a time period when most workers are at work, rather than on vacation, and when schools are normally in session). Where annual or other time periods are required, typical weekday estimates of travel are scaled up to represent those time periods. Within the typical weekday are four demand periods: A.M. peak period (7:00–10:00 a.m.); midday period (10:00 a.m.–3:00 p.m.); P.M. peak period (3:00–6:00 p.m.); and the late evening/overnight period (6:00 p.m.–7:00 a.m.).

[2] Ibid.

Demographics

Demographics are a key factor influencing travel behavior. As mentioned above, SACSIM relies on a more detailed representative population file for its micro-simulation of travel demand. The representative population files are prepared using open source PopGen software, developed by Arizona State University. The 2005-2009 sample American Community Survey data by Census tract were used to control and validate the 2008 base year representative population file. Control variables at tract level included: number of persons per household; number of workers per household; household income; age of householder; and age of person within household. For 2035, the 2008 demographic controls were adjusted to reflect changes to population, household size, age of householder, and household income, which were forecasted by the Center for Continuing Study of the California Economy, and approved for use in the development of this plan by the SACOG Board in April 2010. Forecasts projected:

- Household population in the SACOG region increasing by 305,000 from 2008 to 2020, and 871,000 to 2035;
- The percentage of persons 65-year-and-older increasing from 13 percent in 2008 to 18 percent by 2020, and 22 percent by 2035; and
- Average household incomes rising by about 10 percent across the region by 2035, compared to 2008.

The Center for Continuing Study of the California Economy forecast is described in greater detail in Chapter 3.

Costs of Travel

Another key factor influencing travel behavior is the relative cost of different forms of travel. The time period from 2005 to the present has seen unprecedented volatility in fuel prices, reaching a historic high in September 2008. Recent releases of long range projections of fuel prices by the U.S. Department of Energy[3] and the California Energy Commission[4] have both responded to the volatility of fuel prices and changes to the global market for energy by showing scenarios with much higher high prices than in earlier releases of these reports.

As part of its work to implement technical aspects of SB 375, SACOG with other state MPOs worked to develop consistent consensus future projections of fuel prices for use in each respective region's implementation of SB 375 greenhouse gas reduction targets. Prior to this coordination effort, each MPO made its own projection. SACOG used this consensus future projection in the preparation of the

[3] Department of Energy, "Energy Outlook" series provides forecasts and projections of prices for gasoline and diesel.

[4] California Energy Commission "Integrated Energy Policy Reports" series provides forecasts and projections of prices for gasoline and diesel.

MTP/SCS: for 2020, fuel prices were assumed to increase to $4.74, and by 2035 to $5.24 (both stated in 2009 dollars). Part of the same MPO technical coordination effort resulted in a consensus for projecting the most likely passenger vehicle fleet fuel efficiency to use for SB 375 implementation, based in part on changes to vehicles required by California's Pavley rule, authorized by AB 1493 in 2002. For SACOG, 2020 passenger vehicle fleet efficiency was assumed to be 25.5 miles per gallon (mpg), increasing to 29.3 mpg by 2035 (compared to 20.6 mpg in 2008). The combination of the fuel prices and fleet fuel efficiency, along with estimates of the costs of maintenance and other operating costs (but not insurance or depreciation), resulted in projected auto operating costs of $0.27 per mile by 2020 and $0.29 by 2035 (compared to about $0.19 in 2008).

Land Use-Transportation Connection

The Sacramento region's Blueprint, completed in 2004, relied on a growing body of research on the land use/transportation connection. The Blueprint relied on the latest research at that time to forecast the effects on travel outcomes (i.e., VMT, transit mode share, congestion, and non-motorized mode share) based on changes to future land use patterns. Since that time, the body of research and knowledge on the land use-transportation connection has expanded and matured. The latest research results were published in a 2010 meta-analysis (i.e., a rigorous review and compilation of studies) by Robert Cervero and Reid Ewing in the Journal of the American Planning Association.5 The meta-analysis examined the following land use/transportation factors:

- Regional Accessibility is a way of quantifying how connected a given area is to the existing development, and is usually stated as the number of jobs within an average auto commute time. It is a measure of how many activities are within a reasonable drive time from a place of residence. In areas within the existing urbanized area, regional accessibility is usually higher, and in outlying areas or areas on the urban edge, it tends to be lower. This factor has the strongest potential effect on VMT—a 10 percent increase would result in a 2 percent decline in VMT for residents of an area.
- Street Pattern/Urban Design refers to how walkable a given area is, based on characteristics of the street pattern in that area. It is usually measured as the density of intersections in a given area. The greater the number of intersections, the smaller the blocks and the more potential walking connections there are in that area. Although other factors affect walkability and walk mode share, (e.g., presence/absence of sidewalks, pedestrian amenities on the street, traffic volumes on streets, presence/absence of crosswalks, treatment of pedestrians at signalized intersections.) street pattern has been used in research as a proxy for walkability, in part because it is relatively easy to assemble data. In terms of VMT reduction, street pattern is the second strongest factor.
- Mix of Use refers to the inclusion in an area of a range of complementary land uses, which allows for more activities (i.e., working, shopping, school) to be contained within that area. Good land use mix allows for reductions in VMT through shortening of vehicle trips or shifting to other non-vehicle modes of travel such as walking. The most common measures of mix of use combine the relative proportions of residential, overall jobs, retail and other residential-supporting land uses into an entropy formula, which translates the balance of land use mix into a 0 to 100 scale.
- Proximity to Transit refers to the distance from a residence to the nearest transit station or stop, with VMT declining, and both walking and transit use increasing, as distance to the nearest transit gets shorter.
- Residential Density refers to the number of persons or dwellings clustered into a given area. Conceptually, density is quite easy to understand—the number of persons or housing units located in a given area. However, because there are different definitions of area (e.g., net acreage, gross acreage, total area) the effects of density are often over- or under-stated. The Ewing and Cervero meta-analysis controlled for differences in definition of density across the studies they reviewed.

Table 5A.1 provides a summary of the results of the Ewing/Cervera meta-analysis of land use/transportation factors and travel outcomes. The table provides the elasticity of the travel outcomes for each land use/transportation factor, which is the percentage change in the outcome for each 1 percent increase in the factor. So, an elasticity of -0.2 means a change of -0.2 percent in the outcome, for a 1 percent increase in the factor.

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5 Ewing, R. and Cervero, R., "Travel and the Built Environment: A Meta-Analysis", *Journal of the American Planning Association*, Vol. 76, No. 3, Summer 2010.

Table 5A.1

Land Use/Transportation Factors and Travel Outcomes

	Travel Outcome		
Land Use /Transportation Factor	**VMT**	**Walk**	**Transit**
Elasticity (Change in Travel, with respect to 1% increase in Factor)[1]			
Regional Accessibility	-0.20	+0.15	n/a
Street Pattern/Urban Design	-0.12	+0.39	+0.23
Mix of Use	-0.09	+0.15	+0.12
Proximity to Transit	-0.05	+0.15	+0.29
Residential Density	-0.04	+0.07	+0.07
Change in Travel Outcome, with 10% Increase in Factor			
Regional Accessibility	-2.0%	+1.5%	n/a
Street Pattern/Urban Design	-1.2%	+3.9%	+2.3%
Mix of Use	-0.9%	+1.5%	+1.2%
Proximity to Transit	-0.5%	+1.5%	+2.9%
Density	-0.4%	+0.7%	+0.7%

[1] Ewing, R. and Cervero, R., “Travel and the Built Environment: A Meta-Analysis,” Journal of the American Planning Association, Vol. 76, No. 3, Summer 2010.

Source: SACOG, September 2011.

Although it is tempting to assume that the relationships shown in Table 5A.1 are discrete dials that can be adjusted to achieve pre-defined results, there are many factors that confound attempts to isolate individual effects. Self-selection bias is a major confounding factor, which is poorly accounted for in most of the research. Self-selection bias refers to the fact that personal preference affects where someone chooses to live and the travel choices they make. Individuals who like walking may gravitate to walkable environments in their place of residence or place of work, and some of the land use-transportation relationships which are shown in research based on travel surveys may simply be measuring these preferences. Replicating in new areas the high walk share observed in existing well-mixed, walkable neighborhoods may not be possible, simply because the existing areas may have attracted a unique population of individuals who prefer walking.

Further, interactions among the land use-transportation factors themselves are very difficult to control, and many factors are highly correlated. For example, many areas with good street patterns (i.e., higher intersection densities) are also more dense, simply because block and lot sizes are smaller. Research has also recognized that the combined effects of many factors is not always equal to adding up the individual effects of each factor—there may be ceilings on some of the combined results. On the other side, some of the combined effects may be greater than the sum of the individual effects. For example, evidence from transit-oriented developments suggests that the combined effects of density, proximity to transit, and street pattern around rail stations with frequent service may far exceed the reductions in VMT and increases in walking and transit travel suggested by Table 5A.1.[6] Although some factors are known to have greater potential influence (e.g., regional accessibility on VMT), making significant changes to those factors may actually be difficult.

[6] TCRP 128, “Effects of TOD on Housing, Parking, and Travel.” Transportation Research Board, 2008.

Land Use-Transportation in the MTP/SCS

Table 5A.2 provides a summary of key land use-transportation factors in the region, comparing the 2035 changes from the MTP/SCS to 2008. The factors are tabulated by Community Type (see Chapter 3 for a more detailed description of the Community Types).

- Regional accessibility increases by 31.3 percent overall, with all Community Types increasing by 29 percent or more, relative to 2008. Center and Corridor Communities have the highest level of regional accessibility in both 2008 and 2035 in the MTP/SCS—in both years, accessibility to jobs is nearly 50 percent higher for residents of these areas, compared to the regional average. Accessibility to jobs declines for the remaining area types, with residents of Rural Residential and Lands Not Identified for Development in the MTP/SCS having the lowest accessibility in both 2008 and 2035 at 60 percent or more below regional averages. This reflects the fact that Center and Corridor Communities are centrally located in the region, and in general are surrounded by urban development. Developing, Rural Residential, and Lands Not Identified for Development in the MTP/SCS are located on the urban edge, or completely outside the urbanized area. Developing Communities, to the extent they are at the edge of the urbanized area, have access to jobs on only one side. These locational factors drive down regional accessibility, and, by extension, drive up VMT generation.
- Street pattern follows a similar pattern as regional accessibility, with Center and Corridor Communities being the highest in both 2008 and 2035 in the MTP/SCS. Center and Corridor Communities are more likely to be in older developed areas of the region, with smaller-block, grid-patterned street networks. These older street patterns are, all other things being equal, considered to be more walkable than more curvilinear, cul-de-sac dominated street patterns in more recently developed areas.
- Mix of use is highest in Center and Corridor and Established Communities, largely because these areas are located near jobs and commercial centers. In 2008, Developing, Rural Residential, and Lands Not Identified for Development in the MTP/SCS were very low in measured mix of land use, with all below 14 of 100 on the SACOG mix index[7]. In general, measured land use mix is low in these areas, because they are predominantly residential, with very little commercial, school or other supportive non-residential uses within one-half mile of places of residence. The biggest change in mix of use between 2008 and 2035 in the MTP/SCS occurs in Developing Communities—this change is reflective of a significant amount of growth and consideration of land use mix in the planning for these areas.
- Proximity to transit, as expected, is greatest in Center and Corridor Communities, with distance to the nearest transit station or stop averaging less than one-quarter mile in 2008, and declining to about one-eighth mile by 2035 based on the MTP/SCS. Overall proximity to transit also improves, declining from 0.72 miles in 2008 to 0.55 miles by 2035.
- Residential density increases overall by 27 percent, but the changes are focused on two Community Types: Center and Corridor Communities, which increase from about 10 dwellings per residential acre to about 15 units; and Developing Communities, which increase from 1.3 dwellings per acre to about 4.5 units. The other Community Types changed by less than 10 percent.

[7] SACOG's mix index measures the degree to which the regional balance in total jobs per household, retail jobs per household, service jobs per household, and K12 school enrollment (i.e. school capacity) is provided within a one-half mile radius of the place of residence.

Table 5A.2

Land Use / Transportation Factors and the MTP/SCS

	Community Type				
Land Use / Transportation Factor[1]	**Centers / Corridors**	**Established**	**Developing**	**Rural Residential**	**Region**
2008					
Regional Accessibility[2]	561,970	391,325	254,496	132,585	379,598
Street Pattern/Urban Design[3]	115	87	64	17	83
Mix of Use[4]	37	33	14	10	31
Distance to Transit[5]	0.21	0.55	1.22	2.91	0.72
Residential Density[6]	10.1	3.8	1.3	0.2	1.5
2035 MTP/SCS					
Regional Accessibility[2]	729,235	515,642	351,964	196,759	498,359
Street Pattern/Urban Design[3]	111	90	67	20	86
Mix of Use[4]	38	35	28	11	33
Distance to Transit[5]	0.12	0.42	0.7	2.65	0.55
Residential Density[6]	15.0	4.1	4.5	0.2	1.9
Change from 2008					
Regional Accessibility[2]	+29.8%	+31.8%	+38.3%	+48.4%	+31.3%
Street Pattern/Urban Design[3]	-3.5%	+3.4%	+4.7%	+17.6%	+3.6%
Mix of Use[4]	+2.7%	+6.1%	+100.0%	+10.0%	+6.5%
Distance to Transit[5]	-42.9%	-23.6%	-42.6%	-8.9%	-23.6%
Residential Density[6]	+48.5%	+5.7%	+240.5%	+6.0%	+27.1%

1 All numbers are population-weighted averages for residences in each community type.
2 Total jobs within 30-minute drive from place of residence.
3 Intersection density, stated as intersections per square mile, within 1/2-mile of place of residence.
4 SACOG mix of use index, 0 to 100 scale with 0 = homogenous, 100 = perfect mix of use.
5 Shown as average distance from place of residence to nearest transit station or stop, in miles.
6 Dwelling units per net residential acre, within ½-mile of place of residence.

Source: SACOG, September 2011.