The San Francisco Bay Area's Approach to System Management

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TRANSPORTATION SYSTEM MANagement is not new. Initially conceived as interim, short-term strategies to address capacity constraints, the concept has evolved to signify a comprehensive approach to planning and operating a transportation system. Today, system management generally implies efforts to make the best use of an existing system over the long run. It encompasses maintenance of existing infrastructure; efficiency improvements such as those achieved through deployment of Intelligent Transportation Systems (ITS) technologies and operating agreements; and strategic capacity expansion on the margins.

In an effort to advance the idea of system management, transportation partners in the San Francisco (Calif., USA) Bay Area have developed the Management Strategy, an umbrella structure covering the region's multilevel system-management activities. This feature gives an overview of the Management Strategy and explores several themes evident in its development and implementation.

I. OVERVIEW OF THE BAY AREA'S MANAGEMENT STRATEGY

The Management Strategy is a collection of principles, supporting activities and projects representing efforts to manage the region's transportation system. The principles form the theoretical foundation to guide planning and investment decisions. Supporting activities include working committees, planning studies, the development of analysis tools such as capital-asset management programs and the development of processes, such as funding programs for management projects, that provide a foundation for project development, delivery and coordination. The relevant projects include a range of services and infrastructure such as incident-management programs, arterial and freeway operations systems, and traveler information systems.

Management Strategy Theory

Though Bay Area transportation partners began to implement individual management projects as many as 20 years ago, work on the management strategy as a comprehensive framework began in 1993. Necessary precursors to that effort corresponded with the change in climate marked by the Intermodal Surface Transportation Efficiency Act (ISTEA). They include defining the Metropolitan Transportation System (MTS) and establishing the Bay Area Partnership. The MTS, defined in 1991, is the set of roadways, transit services and transfer points that is considered essential to regional mobility and thus is the proper focus of the expanded regional authority granted under ISTEA. At approximately the same time, leaders from the region's transportation agencies formalized their partnerships to facilitate cooperative decision making.

Early activities to develop the Management Strategy concentrated on articulating broadly acceptable core principles developed in 1993 and shown in Figure 1. This step was important for establishing a common language and providing a focal point for continued development and implementation of management projects. Significantly, however, the core principles posit that system management extends beyond such systems to include strategic capital investment. The Bay Area has most successfully linked the Management Strategy to capital investment in the 1994 and 1998 Regional Transportation Plan (RTP) updates and in the most recent programming cycle, all of which have prioritized system maintenance and rehabilitation based on assessments of transit and roadway needs.

The second step in developing the Management Strategy was to translate the core principles into concrete strategies and subsequently into projects. The Partnership created the Systems Operations and Management (SOM) Committee to oversee this process. In 1994 the Metropolitan Transportation Commission (MTC) and the committee sponsored a series of workshops to develop specific management strategies in three corridors: the I-80 corridor, to maximize benefits of a new high-occupancy-vehicle (HOV) lane; the I-880 corridor on ramp metering; and the Silicon Valley SMART corridor (I-880/Hwy. 17) that had already formed an alliance to develop a multijurisdictional freeway and arterial management system. The workshops reinforced the corridor as the logical unit for management efforts and established institutional alliances, informally dubbed corridor management teams. The teams from the original workshops continue to exist today and have provided models for implementing projects in other corridors.

Projects and Supporting Activities

Over time, MTC has increasingly sponsored projects that aim to provide consistent service to system users regionwide. The earliest such projects were call boxes and roving freeway tow trucks for incident management. The region's real-time traveler information system, TravInfo, and a single transit information telephone number were the next such projects to be implemented. In addition, two new projects are poised for implementation: TransLink, a smart card that will be a unified fare medium for the region's 26 transit operators, and TranStar, a regional-transit, trip-planning database. In each case, successful implementation and operation of the project requires the support of partner agencies.

At the same time, with the support of corridor management teams, MTC has supported project development and implementation at the corridor level as the

opportunity has presented itself. For example, in 1992 MTC established arterial programs with dedicated funding and an oversight committee to promote signal timing as a transportation control measure. Over time, the committee has increasingly focused on multijurisdictional projects oriented toward corridor management. Indeed, several high-profile multijurisdictional signal-coordination projects were scheduled to come online in 1999. More recently, MTC set aside a portion of Federal Surface Transportation Program (STP) and Congestion Mitigation and Air Quality Improvement (CMAQ) Program funding to encourage management projects that address management at a corridor level.

Although the region has seen a proliferation of management projects over the past few years, advancing the Management Strategy requires continuing, concentrated efforts on a number of fronts: demonstrating the benefits of multijurisdictional projects, making the case to devote resources to management projects in the face of competing needs for expansion and system maintenance and encouraging partners to work toward consensus on operating strategies that hinge on resolving conflicts of interest.

II. MANAGEMENT STRATEGY THEMES

The second part of this feature is devoted to exploring several salient themes that thread through the Management Strategy and are evident in the overview:

- Federal and state policy as enablers;
- Importance of the corridor framework;
- Need for new institutional structures to meet management needs;
- Importance of dedicated funding; and
- Appropriate spheres for resolving the conflicts inherent in system management.

These themes are by no means unique to the Bay Area's efforts to develop a comprehensive Management Strategy. This discussion simply illustrates how the themes have manifested themselves in the Bay Area and summarizes some of the measures taken to address them.

Federal and State Policy as Enablers

Federal and state legislation have played an important role in allowing and encouraging MTC to implement system-management projects over the past two decades. ISTEA was a key factor motivating MTC and the Partnership to articulate the Management Strategy as a comprehensive program. State legislation also has played an important role, particularly in project implementation.

ISTEA introduced three changes to the planning and programming environment that allowed the Bay Area to develop a formal management strategy while also advancing individual projects:

- The ISTEA management systems reinforced the legitimacy of a management emphasis in planning, programming and project development;
- A renewed emphasis on cooperative planning provided the impetus to form the Partnership, a necessary precursor to the Management Strategy and key arena for project development and implementation; and
- Increased local decision making coupled with flexible funding has allowed the region to foster multijurisdictional management projects.

The state was an early leader in supporting system-management projects, even prior to ISTEA. In 1987 state legislation made MTC the Bay Area's Service Authority for Freeways and Expressways and initiated a popular incident-management program of call boxes and roving tow trucks. This was one of the region's first cooperative-management projects, with MTC, Caltrans and the California Highway Patrol jointly responsible for implementation. At approximately the same time, the state established the Transportation System Management funding program. The Bay Area relied heavily on this program to fund early arterial signal-interconnect and timing projects as well as the Caltrans Traffic Operations System for freeway management.

In the best case, state and federal policy work together. This was the case in 1998 when significant new state programming capacity materialized at the same time as the generous reauthorization of the STP

Figure 1. Core principles of the Management Strategy.[1]

1. Streets, highways and transit service should be planned, operated and priced as if they were integral elements of a single system.
2. The transportation system should be designed to provide convenient access to jobs and services, to move goods efficiently and reliably, to facilitate the interregional movement of goods and people and to shelter the region's communities and its natural environment from traffic overload.
3. Despite limited resources, the region can effectively resolve the conflict between these goals if it adopts a strategy of system management that is tailored by corridor and time of day. Specifically:
   a) The strategy should emphasize movement of people during peak commute hours and movement of vehicles during off-peak;
   b) When considering the supplementary capacity necessary to serve the commute peak, priority should be given to projects that will enhance the operation and coordination of mass transit, provide incentives for ridesharing and transit use and increase the capacity and continuity of the arterial street system; and
   c) When considering operational improvements necessary to improve the flow of traffic, priority should be given to those corridors that play a critically important role in freight movement.
4. Operational improvements alone will not be sufficient to maintain mobility. Major capital investment, coupled with innovations in pricing and technology, will be required. Therefore it is essential to coordinate planning for management and investment.

Note: The principles have been modified from those originally conceived by David Jones to reflect changes in the emphasis strategy over time.

Table 1. Chronology of the Bay Area Transportation System Management Strategy.

Year	National and state policy (enablers)	Develop Management Strategy Theory	Supporting activities	Project implementation
Pre-ISTEA era				
1980–1995			Regional pavement shortfall and transit capital replacement needs documented for the region for the first time. (1981/82) Developed Pavement Management System program to help local jurisdictions. (1985)	
1986–1990	State legislation allows MTC to oversee installation of call boxes as region's Service Authority for Freeways and Expressways. (1987)		State Transportation System Management program provides funding for arterial signal projects and Freeway Traffic Operations System (TOS). (1988) Construction mitigation programs in I-80 and I-880 funded with freeway reconstruction funds. (1988/89)	Freeway incident management program initiated: SAFE call boxes and freeway tow truck patrol program. (1988) Product development begins on TransLink regional transit ticket. (1989)
Early ISTEA era				
1991	ISTEA introduces era of local decision making, flexible funding, emphasis on management.	MTS defined.	Arterial Operations Improvement Advisory Committee formalized.	
1992			Bay Area Partnership established to promote cooperation among agencies. RTSOP, TETAP programs initiated to fund arterial signal upgrades and retiming.	Transit Telephone feasibility study.
1993		Core Management Strategy and precepts defined.	Establish Partnership SOM Committee to oversee Management Strategy.	TranStar transit trip planning demo.
1994	Federal guidelines for management systems issued.	Corridor framework recognized; workshops establish management teams for I-80 and I-880 corridors.	RTP emphasizes maintaining the existing system. Regional CMS builds on Management Strategy. Bay Bridge Pricing study.	Design of TravInfo real-time traveler information system initiated. Silicon Valley SMART corridor project initiated.
1995			Importance of performance measurement; travel time and reliability recognized as important customer-oriented measures.	Freeway Service Patrol evaluated and found highly cost effective.

Table 1. Chronology of the Bay Area Transportation System Management Strategy. *(Continued)*

Year	National and state policy (enablers)	Develop Management Strategy Theory	Supporting activities	Project implementation
ISTEA principles established				
1996	Responsibility for coordination of regional transit services assigned to MTC (SB 1474).	SOM Committee becomes Partnership Planning and Operations Committee, to integrate system management with planning.	ITS Early Deployment Plan completed.	Caltrans TMC and TravInfo become operational; TravInfo incorporates transit telephone number. TranStar transit trip planning system complete for three operators.
1997			Extend capabilities of transit capital replacement model, Finance Plan. Arterial funding programs increasingly emphasize multijurisdictional projects.	Electronic toll collection implemented on Carquinez Bridge. Ramp metering initiated on I-880.
1998	Reauthorization affirms commitment to ISTEA principles of cooperation and flexibility. SB 45/STIP programming capacity available for expansion projects for first time in six years; frees up federal funding for other purposes.	Federal Flexible Funding Strategy adopted; dedicate regional STP/CMAQ to system rehabilitation (75 percent) and system management and operations projects (25 percent). Distinguish corridor management strategies from region-wide programs that provide customer service and assistance to partners.	RTP employs corridor framework; emphasizes system maintenance. Partners develop corridor management plans to identify projects for funding. Arterial Operations Advisory Committee increasingly active; defines Arterial Management Strategy to prioritize strategies; initiates technology transfer seminars. Studies include: impacts of I-880 ramp metering on local roads; Central Contra Costa study to forecast impacts of ramp metering on local roads; I-880 Truck Access study; Pilot Project explores collection of travel time data.	Continued work on I-80 operations strategy vis-à-vis HOV lane. Supplementary surveillance system developed to fill gaps in TOS data collection. Fast track effort to bring 150 TOS detector stations online. ETC deployment delayed due to software integration complications.
1999			Begin development of arterial MTS database. "Concept of Operations Report" implemented to ensure operation agreements for multi-jurisdictional signal projects. Begin development of regional ITS architecture.	Several multijurisdictional coordination projects to become operational: Hesperian, San Pablo, Silicon Valley SMART Corridor. Award TransLink smart card contract. Enhance TranStar transit trip planning system and include all operators. Extend I-880 ramp metering.

and CMAQ funds under the Transportation Equity Act for the 21st Century (TEA-21). This confluence allowed the Bay Area to pursue an investment strategy guided by the core Management Strategy principles. The region used state-controlled funds for system expansion projects and directed the more flexible funds to system maintenance and rehabilitation and system-management and operations projects.

Importance of the Corridor Framework

The relevance of the corridor framework in project implementation was confirmed by the initial series of workshops centered on the I-80 HOV lane, ramp metering in I-880 and the Silicon Valley SMART corridor. The corridor framework captures vehicle- and person-flows and leads naturally to the cross-jurisdictional integration necessary to plan and operate streets, highways and transit services as a single system. In addition, corridors form the basis for many major capital planning studies, as with the formerly required Major Investment Studies.

To more strongly integrate the Management Strategy with regional planning and programming, MTC extended the corridor framework to the 1998 Regional Transportation Plan (RTP) and the STP and CMAQ program in the 1999 Transportation Improvement Plan. Thus, the 1998 RTP places the region's long-term investments in the context of 16 travel corridors, rather than nine counties. MTC extended this concept to the region's STP and CMAQ program by requiring partners in each of the RTP corridors to develop sketch-level corridor-management plans to provide a similar context for programming. The plans identified candidate projects for STP and CMAQ funding that had been set aside for system-management projects.

Need for New Institutional Structures to Meet Management Needs

Although the corridor may be the logical management unit, it is clearly mismatched with existing, formal institutional structures that are fit to modal and political boundaries. The mismatch may be due in part to the legacy of most transportation agencies as planners and builders rather than operators and system managers. Though the Bay Area has generated some corridor-management teams that have persevered, our cross-jurisdictional forums are inherently unstable. They are secondary to city, county and agency boards that tend to be project or study based and often require concerted efforts to maintain.

For example, arterial signal-funding programs have given priority to multijurisdictional projects for several years. This has gone some distance in increasing cooperative arterial operations as evidenced by three new, high-profile arterial-management projects, the Silicon Valley SMART Corridor and the Hesperian Avenue and San Pablo Avenue signal-interconnect projects. Yet, multijurisdictional projects are unquestionably more complicated to deliver. All three projects have faced delays and struggled to finalize cooperative agreements establishing responsibilities for construction and inspection.

Further, MTC has found that the appropriate scale for TravInfo, ridesharing and other programs designed to provide consistent service to customers is region-wide. As a regional agency, MTC can meet some of the challenges faced by these multijurisdictional projects. In particular, MTC can act as a project "champion," ensure consistency of service throughout the region and capitalize on economies of scale. However, MTC has repeatedly faced opposition in funding region-wide projects without a dedicated funding source. Though strong in theory, regional obligations and commitment to integrated system-management fragment at the finance level, where institutional pressures demand staff from county agencies deliver as much money as possible to their jurisdictions.

Importance of Dedicated Funding

Early efforts to assess the receptivity of partners to system management identified the lack of dedicated funding as a significant barrier to project development. It is perhaps ironic that MTC finds itself establishing dedicated funding for system management, when we have consistently advocated for single, flexible pots at both the federal and state levels. Yet this strategy may be necessary to encourage institutions to place system management on equal footing with project planning and construction.

It is safe to say that over the course of seven years, arterial funding programs have successfully encouraged and shaped signal-interconnect and retiming projects. MTC has funded approximately 150 signal upgrades, interconnect and retiming projects under these programs.

In 1998, the region dedicated a share of STP and CMAQ funding authorized under TEA-21 to broader-range types of system-management projects, hoping to achieve similar results. It is difficult to evaluate the success of this strategy at this time for two reasons. First, having just finalized the program, it is too soon to know how projects will fare in implementation. Second, the process was admittedly imperfect in its first incarnation.

Appropriate Spheres for Resolving Conflicts Inherent in System Management

Not surprisingly, the history of the Management Strategy unfolds along a continuum. Efforts began with more neutral strategies and have reached slowly toward more controversial ones. Initial management projects included roving tow trucks and call boxes and analyses of capital investment needs for transit vehicles and pavement, strategies for which there are "few losers." Other early efforts included arterial signal improvements; as these projects have become increasingly multijurisdictional over time, they have gradually taken on and satisfactorily addressed more significant conflicts of interest.

In contrast, ramp metering has been implemented only in fits and starts. As a region, we are still struggling to come to terms with the magnitude of the conflict between protecting flow on the freeway and the operations of local streets. While ramp-metering infrastructure has been installed in several Bay Area corridors, it is currently operating only in the I-880 corridor and in Santa Clara County. In other corridors, announcements of intent to meter have been met with outcries by local jurisdictions. In the I-680 corridor in Contra Costa County, local jurisdictions initiated their own study and framed their response by forecasting the impacts on local streets in 2010.

Finally, promising management strategies that involve major policy trade-offs or threaten other societal objectives

must be reconciled in other forums. Most notably, the RTP provides a forum for balancing financial resources against competing transportation needs for expansion, system maintenance and system management. The RTP and major corridor studies also can address controversial strategies such as gateway management, in which strategic decisions are made to expand or limit capacity at natural "gateways" so as to protect metropolitan corridors from traffic overload or protect outlying areas from unplanned development. Pricing strategies, perhaps the most promising management strategies in terms of impact, must be resolved at the legislative or electoral level, far beyond our sphere of direct influence. MTC has tried and, thus far, failed to garner legislative support for peak-period variable pricing on the Bay Bridge.

SUMMARY

The Management Strategy represents the Bay Area's effort to develop a comprehensive framework for system management. The region's experience developing the principles of the Management Strategy and implementing management projects has revealed themes that characterize transportation system management more generally. By exploring several such themes in this feature, we hope to illustrate how they have surfaced in the Bay Area and, more importantly, how the region has attempted to address them once recognized. Specifically, we have explored efforts to link system management with planning and programming by extending the corridor framework, those to compensate for inadequate institutional structures, those to provide a carrot with dedicated funding and those to identify proper spheres for resolving conflicts. In every case, our efforts to address the themes are works in progress, to be adjusted and refined as we continue to gain tools and experience. ■

Reference

1. Jones, D. "Conceptual Outline of a Management Plan for the Bay Area Transportation System," 1993.

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