

Standardization: Historic Perspectives on Modern California Light Rail Transit Systems

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Since the first TRB Light Rail Conference 20 years ago, California has been the leader in introducing new light rail systems to the nation. Those systems and the impact of standardization in six key areas—light rail vehicles, fare collection, grade crossings, communications, accessibility, and organization—are reviewed. Each property is compared and contrasted in each category, and a brief rationale is given for decisions made to either emulate the practice at other systems or pursue alternative strategies. Current standard practices are summarized. It is concluded that standardization is less likely to be a priority as the individual systems expand.

Nowhere has the light rail renaissance been more pronounced than in California. In San Diego, Los Angeles, San Jose, and Sacramento, California's new light rail systems have provided mobility and transportation alternatives not seen in the state since freeways overtook and banished the inter-urban systems of the past. Although it is all light rail, each California city has taken a unique approach to the mode with a resulting diversity of applications. Yet within this remarkable diversity there has been a surprising amount of standardization.

Historically speaking, each system has been influenced more by the wants, needs, and financial realities of its service area than by the influence of a strong central state government role, such as in New Jersey. Some

would argue that the standardization among the California systems is not really surprising because the light rail renaissance arose from a common approach that emphasized simple and affordable technology. When these systems were being proposed, it was clear that the Metro model (in Baltimore, Atlanta, Miami, and Washington) was not an affordable alternative. In a sense, the California properties, in particular San Diego and Sacramento, demonstrated that light rail was a credible alternative mode. Their success led directly to the acceptance of light rail as a viable technology in Denver, St. Louis, Baltimore, and Dallas. Although this paper focuses on the California systems, Portland, Oregon, also should be recognized as an example of how a basically "low tech" system demonstrated that light rail was an alternative deserving of serious consideration.

San Diego opened its original 15-mi line in 1981. Extensions since then have brought total route mileage to 33. Sacramento opened its 18-mi line in 1987, and an extension under construction will add 2½ mi next year. San Jose opened a portion of the line in 1987 and completed the entire 21-mi route in 1992. Los Angeles opened the 22-mi Blue Line in 1990 and 15 mi of the Green Line in 1995.

For the purposes of this paper the San Francisco Municipal Railway (Muni) has been excluded. Although Muni shares some modern characteristics with the newer LRT systems, it is, by and large, still primarily a streetcar operation. Muni shares the same track gage

with the modern systems and its 600 volt D.C. overhead with San Diego.

ELEMENTS OF STANDARDIZATION

A review of standardization could include virtually every aspect of light rail operations. The focus here will be on the six key issues of vehicles, fare collection, grade crossings, communications, accessibility, and organization. Vehicles are touched on because they represent one of the most visible and expensive components of a new light rail system. Fare collection is covered because it dictates to a great extent the range of possibilities in station design. Grade crossings, defined very broadly, are examined because they are often a new and controversial element in the urban landscape and require retraining on the part of motor vehicle operators and pedestrians. Communications will be covered in the context of the capabilities of each system because it is the range and requirements of communications that often dictate staffing decisions. The method of system access influences everything from vehicle design to station design, and once determined it is difficult to change. Finally, the organization of each property is explored because it often determines the visibility of light rail within the overall organization, the priority it receives, and the agency approach to problem solving.

Vehicles

All of the California properties standardized on a long, single articulated car. San Diego and Sacramento did so in order to purchase a service-proven design currently in production and operation. Both Los Angeles and San Jose specified an articulated car to take maximum advantage of one operator in a single car carrying a maximum number of passengers.

All properties standardized on a double-ended vehicle. In the case of San Diego, Los Angeles, and San Jose, the right-of-way available did not allow for a loop at both ends of the line or for short turn loops. In Sacramento use of a single-end car meant increased right-of-way costs that were not offset by the potential savings in vehicle costs.

While San Diego and Sacramento adopted knee to knee seating (essentially open compartments where four people sit facing each other), Los Angeles and San Jose chose the cab facing forward seating. While a conscious decision in Los Angeles and San Jose, the choice in the two Duewag properties was dictated by the buyer's off-the-shelf preference.

All systems initially prohibited advertising on the vehicles. San Diego chose a new image and red color,

which clearly distinguished light rail from the existing bus operation. San Jose's vehicles were painted to match the buses. In Sacramento the vehicles received a paint scheme similar to the buses but significantly with no logo to identify light rail as a part of the regional transit system. Los Angeles adopted an elaborately detailed paint scheme completely different from that used by any Los Angeles County bus operators.

Fare Collection

San Diego pioneered the self-service fare collection system in California, and every property thereafter has fallen in line with this method. While all properties have standardized on self-service, each has its own method of enforcement. San Diego contracts with the regional transit organization to provide fare enforcement; Los Angeles uses sworn peace officers; and San Jose started with contracted officers to do fare inspection but now has in-house personnel. Sacramento uses in-house union personnel after opening with noncontract in-house personnel doing fare inspection. In all cases the system has worked well, with evasion rates at less than 3 percent for all properties.

All properties but Los Angeles include a prepaid ticket validator as part of the fare collection process. In Los Angeles the fare machines originally accepted only cash but have been reprogrammed to accept the new Los Angeles token. All other properties use tickets as their prepaid fare medium. No property has chosen to install fare vending equipment on board the rail car.

Grade Crossings

Grade crossings have been a focus of attention for all properties. Unlike in other parts of the country, *grade crossing* has been very loosely defined in California. Crossbucks exist where tracks occupy city streets on nonexclusive rights-of-way completely contrary to operating practice outside of California.

Standardization at grade crossings consists mostly of the use of standard signs. Audible warnings, as required by the state Public Utilities Commission (PUC), range from four blasts of a very loud air horn to the ringing of the vehicle's gong. In between these two extremes, San Jose uses an electronically generated horn and San Diego uses a buzzer type low-volume horn commonly called a quacker.

New grade crossings required a new alertness on the part of motorists and pedestrians. What was once a sleepy railroad freight line in San Diego became a busy urban rail system with grade crossing arms lowering frequently throughout the day. Light rail reappeared in

the street in downtown San Diego and created new experiences for cross traffic accustomed only to looking for other motor vehicles. Sacramento also operated in the street but included grade crossings on a one-way street where the train ran contra-flow. San Jose's new experiences included significant median running where essentially left-turn "grade crossings" were created. Los Angeles incorporated all the unusual aspects of the existing light rail systems and added the challenge of operating in an active freight service corridor and around a long one-way loop with a combination of private reservation and shared right-of-way trackage.

The problems encountered by the various properties were diverse. San Jose had to deal with motorists ignoring red arrows and turning left in front of trains. Los Angeles dealt with motorists and pedestrians ignoring down crossing gates and flashing red lights in trying to race the train to a crossing.

As operating experience was gained, each property responded differently to situations that arose, leading even further away from standardization. In San Jose additional signage was added at intersections where left-turn collisions were a concern. Los Angeles began a test program with cameras at selected grade crossings to photograph grade crossing violators. San Diego and Sacramento installed "nearside" signals to minimize gate-down time at crossings where stations were just previous to the crossing.

Communications

Lack of standardization in California is probably best illustrated by each property's approach to what can be loosely termed "communications." While Los Angeles built a control center proudly nicknamed the "Starship Enterprise," Sacramento managed with a paper track schematic and magnets. San Jose installed a supervisory control and data acquisition (SCADA) system to monitor and control traction power and provide information on fare vending machines. San Diego began with a Sacramento-type system but gradually upgraded to provide a certain level of train location information. Some justification for these differences can be found in the number of trains operated (Los Angeles operates twice as many trains as Sacramento, for example), but significantly each property has determined that a different level of oversight and control is necessary.

All properties provide hand-held radios to train operators and supervisors. While San Diego and Sacramento opted for radio chargers in the rail cars, Los Angeles and San Jose had fixed radios mounted in each vehicle.

The complexity of communications led to a direct impact on staffing. Once communications were estab-

lished, the onus was then on the property to provide monitoring. Hence, Los Angeles has an entire closed-circuit television monitoring staff and a control center staffing double that of any other property.

Accessibility

Each property took a completely different approach to accessibility. San Diego initially was not accessible except to people who could readily climb stairs. Sacramento had to deal with accessibility and wrestled with the difficult issue of high platforms on an urban pedestrian mall. San Jose, too, was concerned about access in its stations. Los Angeles, not having to deal with a pedestrian mall and having a downtown subway and elevated stations, had many alternatives from which to choose.

San Diego ultimately installed lifts on each rail car, balking at the cost of retrofitting numerous existing stations. Sacramento settled for what has become known as the *high block* (or mini-high) platform approach first pioneered in Buffalo. San Jose elected to go with a way-side lift activated by the train operator when necessary at each station. Los Angeles, in light of the significant investment planned in right-of-way structures and mindful of a downtown tunnel, opted for high platforms.

Organization

Organization is not normally considered a potential element of standardization, and clearly there was little in common in the way each California property chose to organize. San Diego set up an entirely new organization completely separate from the existing bus transit organization. Sacramento created a Light Rail Department but included several light-rail-related responsibilities (such as station cleaning and right-of-way fending maintenance) within an Operations Support Department, which also had bus-related responsibilities. San Jose created an entirely stand alone Light Rail Division. Los Angeles took all the rail functions and split them among existing bus departments.

Light rail was clearly a high priority and highly visible in San Diego. Completely separate from the existing bus agency, the light rail operation had an opportunity to establish its own image and reputation. As a separate department, light rail in Sacramento was accorded a level of priority, but as only one component of the chief operating officer's responsibility, it did not achieve the regional priority accorded light rail in San Diego.

In San Jose the light rail operation was clearly visible within the organization and received a high priority

when resources were allocated. Because of the differing priorities between the *build* agency (Los Angeles County Transportation Commission) and the *operate* agency (Southern California Rapid Transit District), light rail was highly visible and received a high priority in the region. Within the operating agency, however, because of the fragmentation of the light rail responsibilities, preparing to operate the new rail line was a tedious challenge. The organization was set up among bus transit operating practices, and obvious interrelated areas such as vehicle maintenance and wayside came together only at a very high level and then in competition with bus-related priorities.

Lack of comparable organization structures led to much discussion, particularly in Los Angeles, when staffing decisions were being made. Because the other light rail properties were so differently organized, it was difficult to compare adequately Los Angeles's needs in relation to the other properties. Compounding this situation was the fact that Los Angeles had a level of technology far beyond what existed at any of the other properties.

REVIEW OF STANDARDIZATION ISSUES AND IMPACTS

Although a comprehensive review and analysis of standardization issues and impacts would be a major research paper, it is clear that standardization had had, and continues to have, an impact on the growth and development of light rail in California. Under the California Public Utilities Commission (PUC), certain issues are, in effect, standardized by state decree (General Order 143A as an example, covering everything from construction to operations and maintenance). However, the PUC has shown sensitivity to the needs of the individual properties and has accepted locally generated solutions to situations as long as the solutions met the requirements of the PUC's general orders.

It is clear that having a car with like components has been a benefit to both San Diego and Sacramento. Parts sharing has taken place, and personnel recruited from San Diego were able to reduce the learning curve in vehicle maintenance in Sacramento. Gearbox issues resulting from similarities in design, although not a deliberate attempt at standardization, in effect were concerns for three out of four properties. Although each property started with essentially "clean" image-based vehicles, Sacramento has now diverged from the standard by permitting exterior advertising.

Having a common fare collection system has benefited all properties. There is statewide unity when enforcement needs are discussed at a statewide level. Although only Los Angeles started with the platform as a paid area, San Diego has embraced the concept nearly

systemwide. Just by having a similar system statewide, California has helped reduce the "don't understand the system" fare confusion that still exists among visitors to such cities as Buffalo and Baltimore. As to personnel, the trend has been toward union represented in-house staff for fare inspection. Both Sacramento and San Jose have gone this way after starting with noncontract and outside contracted personnel, respectively.

Grade crossings have become a big issue in Los Angeles, and the trend is somewhat away from standardization, although Los Angeles is now using the electronic horn, originally pioneered by San Jose, for grade crossing audible warnings. An effort to begin some sort of standardization move has started, prompted by the Los Angeles experience, within the California Traffic Control Devices group. While light rail is not subject to the Motor Vehicle Code, the code does cover such topics as motorist signage related to light rail. The nearside experiments in San Diego and Sacramento have been highly successful, and these efforts appear to be leading toward a standard in that area. Basically, the nearside system allows grade crossing gates to be delayed in coming down when there is a station stop between the normal call-on circuit and the actual grade crossing.

Little is changing in communications. Aside from San Diego looking into global positioning and some radio enhancements among the properties, most operators have remained with their basic initial designs.

As expected, accessibility has changed little. Once millions are invested in infrastructure, change comes only at a steep price. The biggest move, and this is one toward standardization, is taking place in San Jose. An alternative to the wayside lifts is being sought there because of dissatisfaction with the time required to use the lift and the resulting delay to service. Tentatively, a variation of the high block approach is planned.

Some of the greatest change both away from and toward standardization is in the area of organization. Los Angeles has taken bold steps toward the San Diego/Sacramento model, while San Jose has backed away and moved into the dispersed mode, with rail functions split among bus departments. Los Angeles has moved aggressively to consolidate rail-related responsibilities under a single regional manager. The merger of the formerly separate agencies and California's recession have encouraged the new MTA to examine closely the way business is conducted.

STANDARDIZATION IN THE FUTURE

The historic perspective on standardization is a mixed bag. On the basis of the traditional approach of equipment standardization, recent history does not bode well for the future. Taking a broader view of standardiza-

tion, however, encompassing all the issues that affect light rail operation, there is more reason for optimism among standardization proponents. Agreement on an articulated car, proof-of-payment fare system, and rail-specific organization; the effect of PUC General Order 143A; and basic agreement on wayside issues, such as track and signals, encourage those that favor basic tenets of standardization.

Lacking a strong state role in light rail, as is planned in New Jersey, it is unlikely that any cost/benefit analysis will extend beyond the local level to consider the potential impact of standardization savings. The sheer

geographic distances and distinctly local perceptions of rail transit work against interagency coordination. As the rail systems, their fleets, and equipment expand, there is less and less incentive to investigate standardization opportunities.

As time goes on the greatest forces for standardization are likely to be the outside influences of the California PUC and the financial constraints of "going it alone." It can be said with certainty, however, as today's decisions become tomorrow's history and the issues of standardization are debated, the light rail renaissance will continue unabated in California.