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Systems-Level Approach to Sustainable Urban Arterial Revitalization

Case Study of San Pablo Avenue, San Francisco Bay Area, California

Christopher R. Cherry, Elizabeth Deakin, Nathan Higgins, and S. Brian Huey

Many cities in the United States are facing challenges associated with antiquated urban arterials, whose purpose has changed greatly since their development. Once considered the main streets of the city, with thriving businesses and attractive residential development, many have deteriorated over the decades for a number of reasons, including shifting demand for housing and retail development and the construction of parallel high-speed urban expressways. Because of the complexity of the problems associated with these arterials, a great challenge of transportation and land use planners is to develop a systems-level approach to revitalize and reinvent these arterials in a manner that encourages environmental, economic, and social sustainability. Presented is a methodology to revitalize multimodal urban arterials that includes land use planning, traffic and transit operations management, street redesign, and community participation to improve the conditions of such arterials. Analysis is carried out by using these principles on San Pablo Avenue, a major arterial in the San Francisco Bay Area in California. By using these analysis techniques, land use and transportation recommendations are made that will facilitate sustainable development along this corridor.

Urban arterials serve a variety of purposes in cities throughout the country. Some are high-capacity, high-speed thoroughfares whose main purpose is to move vehicles a large distance across an urban area. Other multimodal arterials serve neighborhood communities and act as a dense retail and residential corridor through the urban area, with a secondary purpose of providing a high level of capacity for vehicle movement. Many times these arterials were developed around transit, before urban expressways and high levels of motorization. Thus, the development patterns do not cater to private automobile use, and there is often a conflict between providing a high level of service to auto users and providing neighborhood scale shopping and residential land uses. Often, there is a disconnect between city planning and transportation engineering, whose goals have a tendency to conflict.

This paper provides a multidisciplinary, systems-level framework through which to analyze a complex urban arterial that must serve multiple purposes.

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SYSTEMS-LEVEL ANALYSIS

When developing a strategy to improve an arterial, it is important to consider all aspects that have a connection with the arterial. Transit investments can be much more effective if they are coupled with land use improvements near transit stations. Conversely, transportation investments can be rendered ineffective if contradictory land use improvements are implemented. Both transportation and land use improvements can be blocked if there is inadequate community outreach and involvement.

Land Use

Land use along multimodal corridors is often infused with many types of uses, through either unplanned historic development patterns or deliberate planning strategies to develop commercial corridors. Often the land use plans and zoning ordinances for these corridors are not developed specifically for the corridor, and unreasonable requirements (such as minimum parking requirements) are imposed on potential developers. As a result of organic development patterns, many of the infill opportunities for development or redevelopment along an urban corridor include small, irregularly shaped lots that are not conducive to the general ordinances set forth by planning agencies. As a result, development is difficult, and most developers choose to develop more unrestrained parcels on the urban fringe.

To develop a transit-oriented corridor, bus stop or station areas must be developed with easy connections to an assortment of trip attractions, including residential, retail, and service land uses. This mixed-use development should be centered around major transit stations or transfer points but not necessarily along the entire corridor. Land use control is a powerful tool with which to influence the effectiveness of transportation investments. If transit-oriented development is allowed near transit stations, large increases in ridership can be experienced. However, land use controls that allow suburban-style development along urban corridors can effectively negate the effects of any public transportation investment.

Traffic Operations and Street Design

For a major arterial to be a vibrant place where people would like to live and shop, traffic and transit must operate efficiently. There must be high levels of accessibility for both automobiles and transit; however, many aspects of these two modes conflict. Transit must operate

with high levels of service, with minimum delay caused by traffic signals or congestion. The pedestrian environment must be conducive to walking and bicycling. Sidewalks and bus stops must have adequate amenities to encourage connectivity between trip generators.

Traffic must flow smoothly, and high-speed traffic must be calmed to improve the pedestrian environment. Congestion should be limited wherever possible, or priority treatment should be given to transit to reduce the adverse effects of auto congestion on mixed flow transit modes. Optimization of signal timing to account for buses and simulation of geometric changes to improve bus performance can be powerful tools for evaluating prospective level of service changes from different priority treatment strategies. Pedestrians should have adequate crossing opportunities, and signals should allow adequate crossing time. Finally, nonlocal traffic should be diverted, whenever possible, to limit the negative externalities of noise, pollution, and congestion.

Community Outreach

Perhaps the most important aspect of urban arterial revitalization is community outreach. Local interest groups have the power to make or break development or transportation improvement projects, and their input must be considered from the beginning or before the conceptualization of any project. Developers or public agencies spend large sums of money on the beginning processes of projects, only to have them defeated by community members. Developers, public agencies, and community groups should have a predictable channel through which to communicate. Focus groups with interested parties, residential surveys, and merchant interviews are effective ways to determine the needs of interest groups before implementation of a transportation or land use project.

CASE STUDY OF SAN PABLO AVENUE, CALIFORNIA

Background

San Pablo Avenue is an urban arterial near the east shore of San Francisco Bay in California. The study area spans 8 mi and runs through five cities—Oakland, Emeryville, Berkeley, Albany, and El Cerrito—and two counties, Alameda and Contra Costa (Figure 1). San Pablo Avenue is designated as CA-123 from Oakland to Cutting Boulevard in El Cerrito. The avenue lies parallel to and within a half-mile or less of I-80, and before the Interstate was built it was the main north-south thoroughfare through the five cities in the study area.

Land uses and urban design vary substantially along San Pablo Avenue. Along the Oakland stretches of the avenue are many four- to six-story apartment buildings interspersed with one- to three-story commercial buildings with housing on upper floors. In Berkeley and downtown Albany, two- to three-story buildings, again with first-floor retail and upper-story housing, are interspersed with small-scale single-story retail, auto dealers, and auto repair shops. El Cerrito's downtown is along the avenue, with single-story retail and a small mall as the predominant land uses. Through these three cities, most of the retail and housing units are oriented to the street with little setback and only occasional off-street parking. Farther north along the avenue, the older single-story retail is interspersed with minimalls, fast food drive-ins and big-box retail, each with its own parking lot. In the last decade or so, multifamily housing developments have replaced older retail and parking at locations scattered along the avenue.



FIGURE 1 Map of San Pablo Avenue study area.

For most of the length of San Pablo Avenue, the road is two lanes in each direction with turning lanes at major intersections. Sidewalks line both sides of the street for its entire length, and on-street parking is permitted in most locations. In Berkeley, a tree-lined median developed in the 1960s divides the thoroughfare and limits cross traffic at many intersections. The city of El Cerrito has recently installed a median as well. Other areas include a two-way left-turn lane.

Average daily traffic (ADT) ranges from about 15,000 at the northern terminus of the study area to 27,000 around its busiest intersection (1). Thirty-seven bus routes are operated on at least part of San Pablo Avenue by four different transit properties: AC Transit, WestCAT, Vallejo Transit, and Golden Gate Transit. Many of these routes also connect to BART and AMTRAK stations. During peak periods, as many as 20 buses per hour travel on key San Pablo Avenue blocks. The most significant recent investment in transit has been the implementation of the 72 Rapid bus service operated by AC Transit. This bus serves the length of the study corridor from Oakland to Richmond and provides high-speed, high-quality, limited-stop service to the corridor.

The study area of San Pablo Avenue is a complex corridor where five cities, two counties, and the state department of transportation all have authority over their particular jurisdiction. AC Transit, the predominant transit property for Alameda and Contra Costa Counties, has authority regarding bus stops. The Alameda County Congestion Management Agency (ACCMA), created in 1995 to coordinate traffic management and transportation investments for Alameda County, has built a working agreement among the involved jurisdictions through which ACCMA administers San Pablo Avenue traffic signals through its East Bay SMART corridors program (1), which has produced a rich field of data with which to work.

Land Use on San Pablo Avenue

Zoning

Zoning requirements along San Pablo Avenue are similar to zoning along many urban corridors throughout the United States; however,

because San Pablo Avenue runs through several cities, there are subtle differences that make development along the avenue quite heterogeneous. Much of the avenue is zoned for high-density residential, retail, or mixed-use development. The maximum floor area ratio along the avenue varies from 3.0 to 7.0 in its densest areas (at the southern portion near downtown Oakland). One of the major issues arising from high-density development along San Pablo Avenue is the lack of integration of dense development fronting the avenue with the low-density single-family dwellings immediately behind those high-density developments. Community opposition has stopped several dense developments and has discouraged developers and planning agencies from allowing such development because of difficulty integrating high-density development into medium- and low-density neighborhoods (2). Figure 2 shows a mixed-use development that elicited such a response.

Form-Based Zoning

Much of the conflict about new development is centered around the building dimensions themselves and is less about use. An overwhelming majority of residents along San Pablo Avenue recognize a need for more high-density housing in the area. Likewise, they want more neighborhood-serving retail development along the avenue. However, the zoning ordinances and land use plans place a large emphasis on the land use and institute generic building envelopes that allow the scale and setbacks of buildings along the avenue to be discontinuous and heterogeneous. Buildings that are designed to conform to the zoning ordinances often do not take into consideration the needs of the immediate neighborhood. As a result, developers risk defeat when their plans are approved by the planning agency, but the form of the building is not consistent with the needs of the neighborhood. Form-based zoning ordinances have been developed and successfully implemented in several cities in the United States; these focus on a standard building design that is agreed on in advance by all interested parties. These zoning ordinances include standard setback requirements and building lines to ensure continuous street frontage. They also include standard height and step-down requirements to ensure that the building fits into lower-density neighborhoods without constructing large

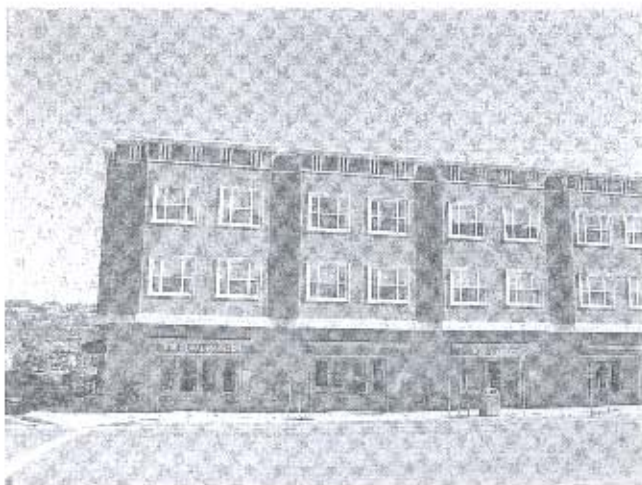


FIGURE 2. Example of mixed-use development on San Pablo Avenue.

blank walls or privacy-invading windows into neighbors' yards. The most powerful feature of form-based zoning is that once all interested parties have agreed on a design, the approval process of development plans can be streamlined to expedite development. Figure 3 shows an example of a form-based zoning requirement in Virginia.

Parking

Parking availability is one of the most powerful demand management tools available to a transportation planner. "Plentiful free parking can counteract the total benefits achieved by virtually all other trip reduction tactics, frustrating efforts to mitigate transportation problems through such programs," according to Shaw (3). However, parking is a major contributor to economic development. Researchers have found that workers generally will change modes when encountering stricter parking regulations, but shoppers will generally change their destination to shopping centers with better parking (4-6). Thus, the strategy should be to provide adequate short-term parking for shoppers and good transit service for long-term shoppers or commuters.

Parking requirements are one constraint that makes it difficult to develop vacant lots on San Pablo Avenue. Planning agencies generally adopt parking generation rates based on the ITE parking generation manual (7), which has been criticized for its presentation of statistically insignificant parking generation rates (8). Most of the parking generation rates are based on suburban land uses, in which personal automobile use is much higher and all parking generation rates are based on the assumption of unlimited free parking. Multimodal urban arterials do not exhibit the same level of personal automobile use, but developments are required to provide the same amount of parking. For instance, areas along the corridor have census tracts with 50% to 77% zero-vehicle households, but zoning requirements still require new development to have one parking space per residential unit.

Because of the widespread adoption of these parking generation rates, many urban development projects become fiscally impossible because a large portion of a small lot would have to be devoted to parking, or small-scale developments would have to invest in structured parking. Moreover, because a large number of vacant lots on San Pablo Avenue are long and narrow, the only possible way to build a parking lot is to build the building at the back of the lot and build the parking lot in front of the building. This exacerbates the problem of discontinuous building frontage, degrading the pedestrian environment. A typical vacant lot on San Pablo Avenue is about 50 ft wide and about 120 ft deep. Figure 4 illustrates the infeasibility of developing urban structures with suburban parking requirements.

This figure illustrates the difficulty building high-density retail, commercial, or residential development. For this building to be feasible, the building footprint would have to be reduced to occupy only half the lot, or about 5,000 ft², thus reducing the parking requirement while providing more space for parking cars. Additionally, if there was no back entrance, the parking lot would have to be developed in front of the building. This parking ordinance discourages potential development.

Adequate parking protects neighborhoods from parking spillover and is directly related to the regional competitiveness of a retail district. Merchants along the corridor cite parking as one of the

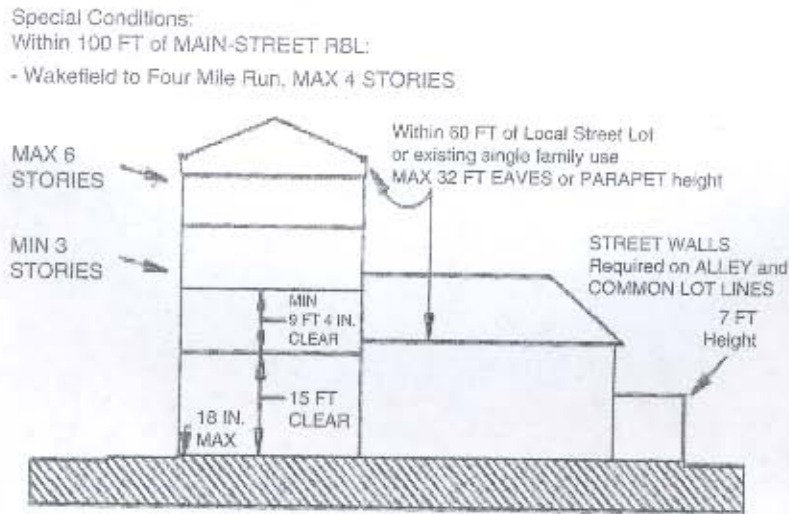


FIGURE 3 Arlington, Virginia, form-based zoning requirement (RBL = required building line).

major deficiencies of the avenue, so convenient and appropriate levels of parking must be provided for employees and shoppers. Forcing developments to devote half of their already small lots to parking is unreasonable, especially on a corridor with high levels of mixed-use development and transit service.

Several strategies have been developed that hold large potential for some of the difficulties of providing parking on San Pablo Avenue. These include the construction of shared parking lots at shopping or commercial districts, in lieu parking fees for construction of public parking lots, parking exemptions and reductions, and parking maximums (9, 10). These strategies can reduce the demand associated with overabundant parking, reduce parking supply by sharing space and utilizing parking more efficiently throughout all periods of the day, and enable development of more pedestrian accessible

environments by reducing the amount of land devoted to parking, thus reducing parking demand even more.

TRAFFIC, TRANSIT, AND PEDESTRIAN IMPROVEMENTS

San Pablo Avenue is a California state highway and is under the jurisdiction of the California Department of Transportation (Caltrans). However, it runs through several cities, and the street design varies slightly from city to city. On-street parking lines all sections of the avenue, two lanes run in each direction, and major intersections have designated left- and right-turn lanes. Sections of the street along the study corridor have two-way left-turn lanes, whereas others have

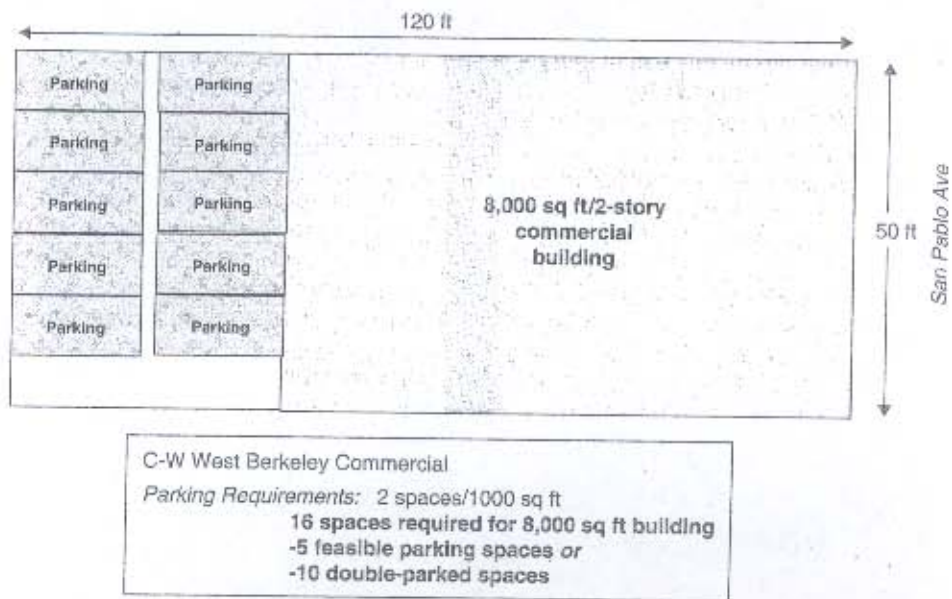


FIGURE 4 Example of parking requirements of typical infill lot.

raised medians. All sections of the study area have sidewalks of varying width and quality.

Pedestrian and Transit Amenities

Pedestrian

For a transit corridor to be successful, the pedestrian environment must be accessible and pleasant. Most of the sidewalks along the corridor conform to the Americans with Disabilities Act (11), having adequate sidewalk widths, ramps, and limited obstructions (12). Some areas of the corridor have very long cross-street crossings, particularly in southern parts of the corridor, where cross streets intersect San Pablo at acute angles. Adequate crossing time must be given at these signalized intersections or pedestrian refuges or bulb-outs must be provided to ensure safe passage of pedestrians across and along the corridor. Based on sidewalk width, lateral separation, on-street parking utilization, and vehicle speed and volume counts, a pedestrian level-of-service (LOS) analysis (12) gives most major nodes along the corridor an average LOS of C. This indicates that the area is adequate for pedestrians but does not attract as many pedestrian trips as possible. The major deficiency, per this analysis, is the high volume of traffic at busy intersections.

Transit

The investment in the San Pablo Rapid Bus service has provided high-quality bus shelters and transit information, including real-time arrival information at many of the stops. Many sections of the avenue, particularly the more recently developed areas of Emeryville and El Cerrito, have adequate pedestrian scale lighting. The Rapid Bus service provides appropriate lighting at some of its stops but inadequate lighting at several other stops. All San Pablo Rapid stops should have the same amenities unless there are physical constraints to providing those amenities. Several Rapid stops have been poorly placed and obstruct the sidewalk, creating a more hostile pedestrian environment. Innovative shelter design should be implemented to fit the shelter into the existing pedestrian environment and reduce obstructions.

Optimizing Traffic Flow: Passive Transit Priority Signal Optimization

Signal timing schemes often are developed to minimize vehicle delay and vehicle stops. Vehicle delay is an appropriate proxy for delay imposed to a person in many urban areas where average vehicle occupancy is close to one. However, in transit corridors, such as San Pablo Avenue, one should weight buses more heavily than automobiles because of their high load factors. To achieve the highest people-moving capacity of the arterial, which minimizes delay to all people, TRANSYT-7F signal timing software was used to develop and demonstrate a passive transit priority signal optimizing scheme (13).

Two distinctly different kinds of transit priority can be modeled with TRANSYT-7F. Passive priority relies on inexpensive geometric and signal timing changes that can significantly decrease the delay and number of stops for transit vehicles while minimizing negative effects on the normal traffic flow. Active priority uses different detection techniques to give extra green time to the transit movement when the transit vehicle comes at the end of its green phase.

Active priority takes green time from undersaturated cross streets. However, many of the intersections on San Pablo Avenue are highly saturated on all approaches. This reduces the effectiveness of active priority because it imposes more delay on cross-street traffic and buses. Passive priority simply requires optimizing the signal timings while properly weighting the transit movements to account for the fact that they carry many more people than do cars and trucks.

For this analysis, the congested morning peak period was chosen as the study period. For the morning peak, a fixed-time signal timing plan was developed, by making the assumption that the north and south thoroughfares already get the maximum allotment of green time. Assuming that the arterial is already allotted its maximum green time allows elimination of active priority strategies since their effectiveness is limited when the side streets are already receiving their minimum green and there is no green time to spare. Additionally, the assumption was made that all the cycle lengths will be the same so as to create a corridor with good progression and good passive transit priority. The existing cycle length varies from 60 s to 120 s, and the optimized signal timing plan will have a fixed cycle length of 100 s.

The base case was modeled, the new cycle length was modeled without bus weighting, then weighting was added to buses for a third case. The improved signal timing plan does not provide a large disadvantage to the normal traffic flow while providing significant benefit to the flow of buses. The optimized conditions with weighted buses reduce bus passenger delay by 33% from the existing conditions. The total stops were reduced substantially, by 41%, and the travel time was reduced by 9%. These improved measures of effectiveness come at the expense of cross-street and low-weight vehicles (single-occupant vehicles), but the total systemwide person-hour delay, number of stops, and travel time are reduced significantly (Table 1).

Geometric Changes to Improve Bus Performance: Microsimulation

Microsimulation models give analysts the ability to investigate the effect of geometric changes on traffic operations. A Paramics microsimulation model was developed to simulate the morning peak traffic conditions along both San Pablo Avenue and the parallel freeway, I-80, by using data provided by Caltrans and ACCMA (14, 15). Hourly traffic counts, continuous speed, and travel times were provided for San Pablo Avenue and I-80. By using these data, a network was developed and calibrated that included San Pablo Avenue, the I-80 freeway, and all interchanges along the segment and those portions of major arterials that connect San Pablo Avenue with I-80. The existing signal timing as well as the optimized signal timing schemes were modeled (13).

Once the network was fully built, an express bus route was inserted into the network. This route follows the San Pablo Rapid bus route (72R) operated by AC Transit from Downtown Oakland to Contra Costa County Community College in the city of San Pablo. The route and associated bus stops were entered into the model so that improvements could be measured in travel time improvements to the bus service, in addition to the vehicle travel time.

The model was calibrated by following procedures documented in the literature (16-19). The calibrated network was used to produce base case measures of effectiveness and then simulated several alternative infrastructure and signal operation improvements for San Pablo Avenue.

TABLE 1 Comparison of Measures of Effectiveness Among Simulated Signal Timing Alternatives

Performance Measure	Total Travel Time (vhph)			Total Delay (vhph)			Total Stops (vph)		
	Buses	Other	System Total	Buses	Other	System Total	Buses	Other	System Total
Existing; no bus weight	23	1,505	1,528	6	794	800	884	91,970	92,854
Optimized; no bus weight	22	1,307	1,329	5	596	601	578	64,521	65,099
Optimized; bus weight	21	1,340	1,361	4	629	633	519	69,278	69,797
Percentage difference from existing conditions									
Optimized; no bus weight	-4	-13	-13	-17	-25	-25	-35	-30	-30
Optimized; bus weight	-9	-11	-11	-33	-21	-21	-41	-25	-25
Benefit of bus weight	4	-2	-2	17	-4	-4	7	-5	-5

vhph = vehicle hours per hour, vph = vehicles per hour.

Although the travel time for the buses improves slightly under the new signal scheme, the passive priority timing alternative does not give the express bus any advantage over cars because the bus still operates in mixed flow lanes. To give the express bus an advantage, geometric alternatives were simulated in which a queue jumper lane was added at each intersection with long queues during the peak period. These are the intersections where the bus stands to gain the greatest increase in travel time.

Intersections with slow approaches and residual queues were identified by using data from previous studies (14), and those intersections were improved by widening the approach and taking width from the existing lanes. The two-through-lane, 24-ft cross section (12 ft per lane) was widened by 6 ft to make a three-through-lane, 30-ft cross section (10 ft per lane). In the northbound direction, four queue jumper lanes were added at the most problematic intersections. In the southbound direction, eight queue jumper lanes were added at the problematic intersections. The queue jumper lanes were added to the shoulder side of the roadway to facilitate easy entrance to the bus bay on the far side of the intersections. The additional space required for the queue jumper lanes can be taken exclusively from the existing right-of-way by restriping, limiting on-street parking, narrowing the median, or widening the road (by narrowing the sidewalk). Many of the on-street parking spaces have very low levels of utilization, especially during the morning peak before retail businesses open (12). Utilizing this space for queue jumper lanes could be a better use of this road space, at least for portions of the day.

The addition of queue jump lanes did not significantly improve travel time along the entire corridor, because of conflicts with the mixed-flow traffic and bus stop configuration. However, for one intermediate trip, from the El Cerrito Del Norte BART station to Broadway and 14th Street in Oakland, a statistically significant (99% confidence level) 3.5-min travel time decrease is found when queue jumpers are added, in addition to a smaller standard deviation (1.53 versus 2.37). This time savings becomes more significant given that the destinations are two of the heaviest boarded and alighted stops on the 72R route (20, p. 21). The smaller standard deviations observed are also of considerable importance because they imply that arrival times are more consistent when queue jumpers are added; they result in less disparity between the bus schedule and actual bus arrivals. Previous studies looking at the performance of the 72R route have pointed to the on-time performance as an area of difficulty (20). Both on-time performance and travel time performance to highly serviced areas are of main concern to express bus operators and their patrons. Although the travel time performance of the 72R

may not be vastly improved by the addition of queue jumpers in the study, the time that is saved will benefit a large number of riders.

Traffic signal timing models and network simulation models can be effective tools not only in traffic operations and management but also for transit planning and street design. By using data available from state departments of transportation, local governments, and simple field observations, this study shows that alternative bus priority schemes and simple geometric improvements can be evaluated easily, once the models are calibrated. Such improvements can be a low-cost, highly effective way to improve the performance of urban arterials such as San Pablo Avenue.

COMMUNITY INVOLVEMENT

The end users of the system are the ones whom public agencies are meant to serve. There are many stakeholders in transportation or development decisions, and many times these stakeholders have the power to stop or alter the outcome of specific projects or plans. Thus, it is in every party's best interest to be involved in the decision-making process from the earliest phases of project implementation. In the case of San Pablo Avenue, the revitalization process is a long-term endeavor.

Developer Interviews

Developers can offer tremendous insight into land use markets as well as some of the hurdles that must be overcome to construct a successful development. In the case of San Pablo Avenue, developers that specialize in infill development were interviewed regarding some of the difficulties with developing in the Bay Area as well as some of the current market influences (27). Planning agencies encourage mixed-use residential development with first-floor retail. Developers cite the tremendous housing demand and the low retail demand along many sections of San Pablo Avenue as a major difficulty when developing a parcel. Retail space is often vacant long after all the residential units have sold. Forcing developers to incorporate a mix of uses in all large-scale developments increases the cost of the residential development in an already expensive housing market. Rather than requiring mixed-use development along all sections of San Pablo Avenue, nodal activity centers should be designated around major transit stops and transfer points. Mixed-use development should be required only at these activity centers, and high-density residential development should be filled into the intermediate areas.

Most developers stated that parking minimums were too high and parking should be market driven. Some developments have a higher market for parking space than others. Generally, the developers recognize that parking is needed and that their developments appeal to different markets with varying parking needs. Restrictive parking policy reduces the marketability of some developments. Some planning agencies along San Pablo Avenue have been more lenient and responsive than others along San Pablo Avenue, and this has led to rapid development in some cities and slow development in others. Streamlined permit approval processes and community involvement processes could significantly reduce the cost of development along the avenue, thus reducing the cost to the residents and making the avenue a more attractive place to live.

Merchant Interviews

Interviews were carried out with merchants at key activity centers on San Pablo Avenue. Their impression of the avenue, key problems, and reasons for locating on San Pablo Avenue were investigated. Most merchants enjoy the amount of activity on the avenue, as it is one of the busiest north-south corridors in the East Bay. Although they dislike the traffic and congestion, they appreciate the exposure they bring. Merchants had mixed feelings about the bus investments. Most did not think that it improved the business in the area, and few of their employees or customers use the service. Most thought that parking infrastructure is inadequate (especially those without their own lots), and they would like more available parking. One of the greatest benefits of interviewing merchants is that one can identify accurate trip generation patterns (i.e., when and how many customers frequent their establishment). This could aid the planning process in the future when the impact of such development is determined.

Community Surveys

Surveying residents of the immediate neighborhoods surrounding San Pablo Avenue can give a sense of what types of services are demanded and what services are used. Important demographic information can be collected, and travel patterns can be identified. More than 500 residents were surveyed in neighborhoods surrounding San Pablo Avenue, spanning all demographic groups. Most people said they choose to live on San Pablo Avenue because it is affordable and it has convenient transportation access. Very few people think that the avenue has an attractive design. Most people use the avenue as a transportation corridor to access the parallel freeway or to access shopping or restaurants. One of the most frequent responses to a question related to possible improvements is the desire for more restaurants or cafés along the avenue. The greatest problems associated with the avenue are mostly related to appearance, as residents cite that many areas are dirty and rundown. Because of the mixed-use development and high level of transit service, more than 54% of residents choose to commute to work by an alternative mode of transportation. Overall, community surveys can be an effective tool with which to identify travel patterns and residential choices and desires of a community.

Focus Groups

To identify some of the more subtle interests of communities, focus groups should be conducted. Respondents of the community survey

were given an option to participate in neighborhood focus groups to discuss specific issues related to their communities. Some interesting insights came from these meetings. Focus groups reinforce the desire for more neighborhood-serving retail and restaurants. One of the perceived problems along the avenue is a large amount of auto uses (garages, gas stations, etc.); however, most residents use those services on a regular basis. Although city planners might recommend phasing out these uses, residents rely on them and would prefer that they improve their façades and operating procedures, minimizing noise and other annoyances. There are successful examples of attractive auto uses near residential developments that are assets to the community. Interestingly, in the survey many people mentioned that their favorite places along the avenue are big-box shopping developments, but in the focus groups, they mention that they like the shopping opportunities of such a development but they dislike the design. Although focus groups can sometimes be biased, depending on who participates, these subtleties are difficult to capture with other, less biased methods of attaining community attitudes.

CONCLUSION

Redevelopment of an urban arterial whose original purpose is obsolete is a difficult task. Many parties have a stake in transportation and land use improvements, and it is vitally important to look at the revitalization process from a systems perspective. Transportation improvements will have limited effect with inconsistent land use improvements. Expensive transit investments coupled with suburban land use requirements result in marginal increases in transit ridership. Conversely, land use improvements without adequate transportation infrastructure yield congestion and spillover effects that alarm neighborhood organizations and other stakeholders. Stakeholder input is vitally important at all stages of the development process, particularly early in the process, so there is little at stake when the desires of stakeholders are negotiated.

This paper identified several important tools related to land use planning, transportation operations and design, and community involvement and applied them to the analysis of San Pablo Avenue. Land use plans must be specific to a particular corridor, and within that corridor, areas of activity or high transit access must have incentives or mandates to develop in a transit-oriented manner. This includes providing incentives for high-density mixed-use development with lower parking requirements that reflect high levels of transit access. Parking should be consolidated and shared between uses. Different land uses have different parking requirements at different times of the day, so parking should be utilized as much as possible throughout the day. This consolidated parking can be funded by using in lieu fees, and the reduction of scattered parking lots will make access by both auto and transit easier and more efficient. The permit process should be streamlined to encourage development. This can be done by using form-based zoning that the community agrees on beforehand, limiting the risk to developers and encouraging community participation at the beginning of the development process.

Streets should be designed to encourage pedestrian accessibility. Transit amenities should not be obtrusive and should be built into the pedestrian environment. Simulation tools are a powerful resource with which to test and optimize traffic signal operation and geometric changes to the roadway. Improvements can be quantitatively analyzed with a minimum amount of investment, and their effect on transit, traffic, and the pedestrian environment can be analyzed.

Community involvement is of utmost importance. Surveys and interviews of stakeholders, including developers, residents, and merchants, can give unparalleled insight into the market conditions driving development and commerce as well as peoples' motivations for residence location and travel. This gives all parties a forum in which to express their opinions and needs. As community members are gaining more influence in the decision-making process, their views are becoming more critical during policy development.

San Pablo Avenue is an excellent example of a corridor that used to serve a very different purpose than it does today. There are tremendous opportunities for infill development and densification, but many of the opportunities are not economically feasible because of uncertain planning processes and unreasonable requirements. As a result, the avenue is dotted with vacant or underutilized parcels that severely reduce the attractiveness of the street. Developers choose to invest in easier greenfield development on the urban fringe, perpetuating unsustainable growth and transportation patterns. Changes in transportation engineering and city planning practices are required for streets like San Pablo Avenue to undergo true revitalization.

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