Light Rail Transit Implementation Perspectives for the Future: Lessons Learned in Silicon Valley

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The implementation of the Tasman Corridor Light Rail Transit (LRT) Project is described from inception through final design. First, the project goals and the system layout and operating characteristics are discussed. Subsequently, developments in the physical configuration, corridor land use, costs, institutional environment, and funding arrangements are presented, followed by the lessons that may be learned from the implementation of the project. The Tasman Corridor is a 20-km (12.4-mi) $530 million light rail extension of the Guadalupe Corridor LRT system in Santa Clara County, California, and is an important part of a multimodal regional transportation network that is planned in Santa Clara County. The Tasman Corridor Project's 2-year final engineering phase is essentially complete. The California and Bay Area economic profiles have changed with significant impacts to housing, business, and defense industries. In addition, the local funding environment has become uncertain. The Tasman Corridor Project offers valuable perspectives for the implementation of the LRT systems of the 21st century.

Since 1974 the Santa Clara County Transit District (SCCTD) has played an important role in serving the transportation needs of the 1.5 million residents of Santa Clara County. With a 33.8-km (21-mi) light rail transit (LRT) system and 72 bus routes, SCCTD serves more than 150,000 passengers a day with light rail that connects residential areas with regional employment centers and express and local bus service. As one of three counties forming the Peninsula Corridor Joint Powers Board, the SCCTD also participates in the 125.6-km (78-mi) CalTrain commuter rail system between Gilroy and San Francisco. SCCTD is also responsible for the implementation of the countywide transportation plan, which includes a commitment to an ambitious rail corridor development plan for Santa Clara County. A critical link in this regional rail network is the Tasman Corridor LRT Project (TCP).

The objective of this paper is to discuss the perspectives gained and lessons learned from the TCP implementation from initiation through final design. First, the accepted goals for the project and the system layout and operating characteristics will be discussed. The developments that have taken place in the physical configuration, corridor land use, costs, funding environment, and institutional arrangements during the period from inception until now will also be presented. Some perspectives on the developments since the inception of the project will be presented, and some comments will be made regarding the effects of these developments as related to the attainment of the project goals and objectives. Finally, some lessons that may be learned from the implementation of the project will be presented.

System Goals and Objectives

The TCP policy oversight committee (POC) and technical advisory committee have developed seven major goals for the project (*1*):

1. *Mobility.* Provide a balanced transportation system promoting safe and efficient movement of people.
2. *Environmental considerations.* Preserve and enhance the environment.
3. *Land use and regional development.* Develop a transportation system compatible with adjacent land uses and consistent with planned regional development.
4. *Economic considerations.* Develop a transportation system providing the most efficient and effective use of limited resources while benefiting the public.
5. *Financial feasibility.* Develop system on the basis of realistic estimate of resources.
6. *Equity.* Provide a transportation system designed to meet the needs of all groups.
7. *Community and institutional considerations.* Maximize community acceptance and political and institutional support.

Each goal is accompanied by specific objectives developed by the project team and the community. The development of the TCP layout and operating characteristics have been based on these goals and objectives.

System Layout and Operating Characteristics

A brief description of the rail system configuration follows. A more extensive description can be found in another paper presented at the Institute of Transportation Engineers' Sixth District Conference in Portland in July 1994 (*2*).

System Plan

The Santa Clara County Transportation Plan, known as T2010 (*3*), provides guidance to the SCCTD and all transportation decision making in the county. The document establishes a program for transportation and land use actions designed to make the transportation system perform more effectively and Santa Clara County a better place to live and work (*3*). As a key component of the transit element, the plan includes the long-range rail master plan as the basis for rail corridor development.

In addition to specific corridor goals, T2010 calls for the development of activity center systems (such as transit-oriented developments and shuttle service) at key locations to support the rail plan and includes a pledge to assess whether rail development plans adequately address systemwide operating issues, intermodal facilities, feeder bus service, and coordination of land use plans. The studies and modeling performed during the preparation of the T2010 plan indicate that transit use would rise substantially if the recommended improvements were made. By 2010, between 6 and 10 percent of work trips would be made using transit, more than doubling the present transit share.

The Association of Bay Area Governments (ABAG) has predicted up to 33 percent growth in employment in Santa Clara County between 1990 and 2010. In addition, ABAG has predicted as much as 8 percent population growth in Santa Clara County between 1990 and 2000. It is clear that this growth in population and employment will increase the demand on the transportation network. As a result of the prospect of this increasing demand, the region has commited to improving the public transit system.

The system as originally foreseen according to the T2010 plan and approved by the transit district board of supervisors in 1992 is shown in Figure 1. The Guadalupe Corridor system was already in operation at that time.

The T2010 rail corridor priorities were established to define clearly the region's priorities for rail corridor planning, design, and implementation. The rail element includes specific corridor completion goals for the years 2000 and 2010 (Figure 1). For 2000, the T2010 plan envisages the completion of the CalTrain Gilroy extension and upgrade, the Tasman Corridor, the Fremont–San Jose Corridor, the Vasona Corridor, and the Capitol/Downtown-Evergreen Corridor (in priority order). As of 1995, the CalTrain project is complete; the Tasman project has completed final design; the Fremont–San Jose corridor has undergone preliminary environmental review; the Vasona project is undergoing environmental review and conceptual engineering; and a preliminary study of the Capitol Corridor segment of the Capitol/Downtown-Evergreen project has been completed.

For 2010, the T2010 plan calls for completion (not in priority order) of four additional rail corridor projects: DeAnza, South San Jose, Stevens Creek/Alum Rock, and Sunnyvale/Cupertino. To date, no studies have been completed on these corridors.

Existing Rail System

The existing 33.8-km (21-mi) Guadalupe Corridor LRT system includes 33 stations, 50 light rail vehicles, and

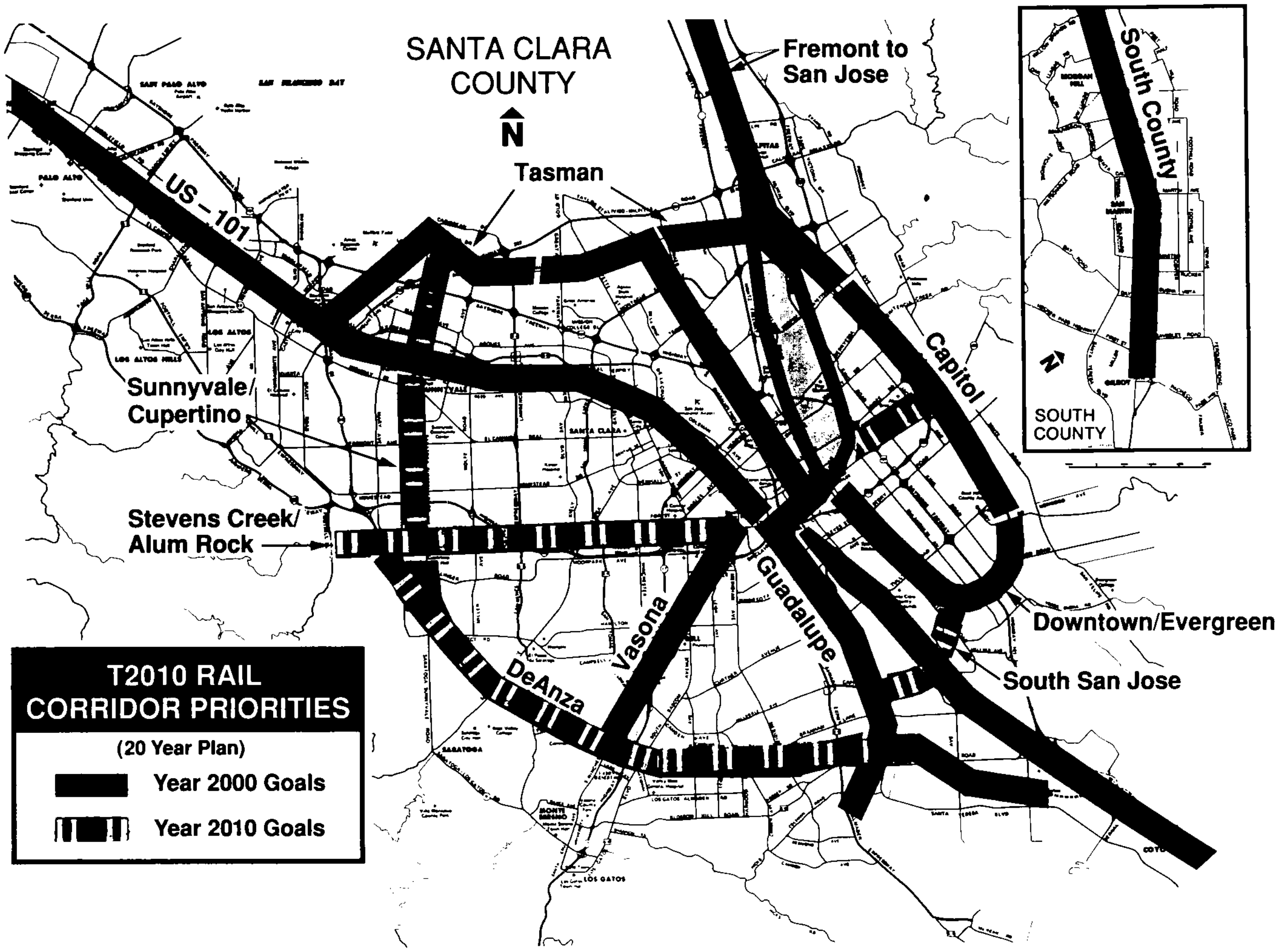

FIGURE 1 T2010 Rail corridor priorities.

11 park-and-ride lots (Figure 2). The first segment, opened in December 1987 (service was extended to the downtown San Jose Transit Mall in June 1988), links downtown San Jose and businesses along North First Street to the industrial centers of north San Jose and Santa Clara. In 1990 LRT service was extended 3.2 km (2 mi) south to the Tamien Station, providing a link to CalTrain, buses, parking, and a new county child care facility under construction. In 1991 service was extended the final 13 km (8 mi) to south San Jose.

Tasman Corridor Project

As recommended in the T2010 plan, a Fremont–South Bay Corridor study was initiated in 1984 by SCCTD and the Metropolitan Transportation Commission, the metropolitan planning organization for the Bay Area. This study included consideration of an extension of the Guadalupe Corridor LRT in what became known as the Tasman Corridor. The TCP POC was formed; it is made up of elected representatives of SCCTD and the five corridor cities.

In 1988 the POC determined that the Tasman Corridor should continue to be studied under the federal alternatives analysis/environmental impact statement (AA/EIS) process, separate from the Fremont–San Jose Corridor. The Tasman AA/draft EIS (DEIS)/draft environmental impact report was issued in May 1991. Final design is now essentially complete, but because of a variety of factors the project may not be fully implemented by the year 2000, as originally envisaged in the T2010 plan.

Corridor Overview

The Tasman Corridor is a 20-km (12.4-mi) east-west extension of the Guadalupe Corridor, with 18 new stations, five new park-and-ride lots, and three intermodal bus transfer centers. The corridor extends through the

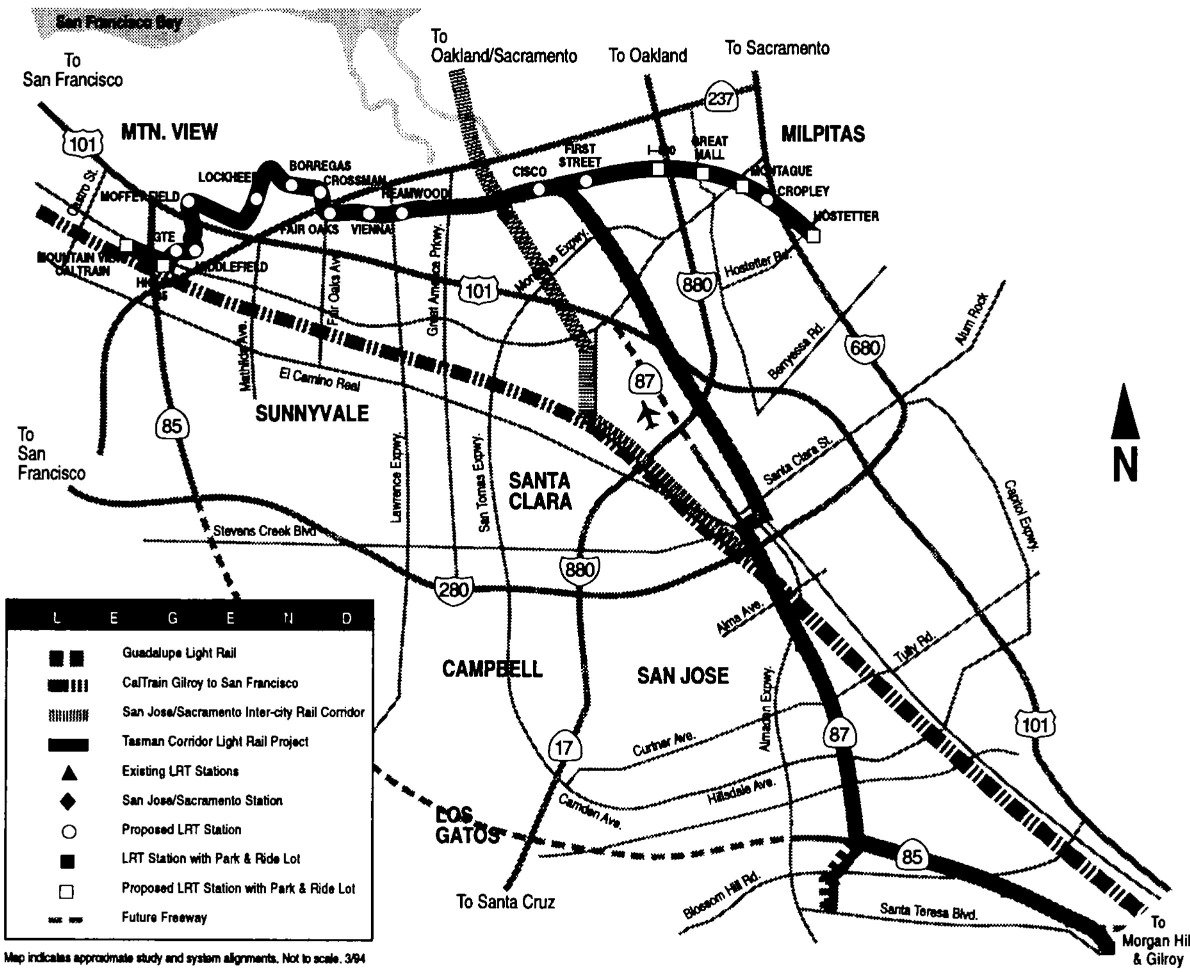

FIGURE 2 Tasman Corridor light rail project schematic.

cities of San Jose, Milpitas, Santa Clara, Sunnyvale, and Mountain View (Figure 2). The purpose of the Tasman Corridor extension is to tap extensive existing residential areas in east San Jose and Sunnyvale and existing and new residential developments in San Jose and Mountain View, including the proposed 850-unit development on the GTE site, and to connect these residential areas with major Silicon Valley employment centers such as Lockheed, the National Aeronautics and Space Administration (NASA), Hewlett-Packard, and other research and development and high-technology manufacturing facilities in the area known as the Golden Triangle.

The east segment of the corridor begins in the established San Jose residential areas near I-680 and continues through the industrial and residential areas of Milpitas, crossing I-880 into north San Jose's employment areas. This segment of the Tasman project joins the existing LRT system on Tasman Drive near North First Street.

Near the Santa Clara Convention Center, the corridor begins its western extension along Tasman Drive through Santa Clara's employment areas and a residential portion of Sunnyvale. Crossing SR-237 at Fair Oaks Avenue, the line continues west to serve Lockheed and adjoining industrial parks. Continuing west, the line parallels US-101 and crosses under the landing path of the NASA/Moffett Field main runway in a depressed section and serves NASA Ames Research Center.

Crossing under US-101, the corridor turns south along an existing railroad right of way, through burgeoning industrial and residential areas in Mountain View. After crossing Central Expressway, the Tasman Corridor joins the Peninsula Corridor Joint Powers Board right of way, paralleling the CalTrain tracks into downtown Mountain View.

Accessibility Impacts

The requirements of the Americans with Disabilities Act (ADA) of 1990 have necessitated changes in the Tasman project design. The existing Guadalupe Corridor uses wayside lifts to provide access for mobility-impaired passengers. During the Tasman Corridor preliminary engineering phase, accessibility options for the Tasman Corridor were reviewed and minihigh platforms were considered as a means to provide level change, based on ADA's level boarding requirements, the desire to retain the existing fleet of LRVs, and the plan to purchase up to 35 new high-floor vehicles. Implementation of wayside lifts similar to those on the Guadalupe Corridor would not have satisfied the ADA requirements if new vehicles were purchased and therefore was not considered at that time.

The final design documents now include high platforms 1 m (39 in.) above the top of the rail for the TCP. Recently, the Tasman Corridor POC voted to take a modified approach to accessibility, which is currently being developed. This approach now includes low 35.6-cm (14-in.) station platforms with minihigh platforms for level-boarding access, and future acquisition of low-floor vehicles.

Traffic Signal Integration

Integration with vehicular traffic is an important achievement for this primarily at-grade LRT system. The corridor consists of several distinct segments with differing impacts on vehicular traffic. The western portion through Mountain View is largely along existing rail corridors. However, the remaining portion of the Tasman Corridor includes seven grade-separation structures, including four existing structures and a new single-column aerial structure spanning two railroads, one expressway, and five arterials. This 2.9-cm (1.8-mi) double-track aerial structure includes two aerial stations and a pedestrian overcrossing. Where not grade-separated, the project includes 30 signalized intersections with LRT crossings, of which 7 are gated LRT crossings (standard railroad gates) and the remaining 23 include LRV control (traffic signals for vehicular traffic and "T" signals for LRVs).

For signalized intersections with LRV control (intersections without standard railroad gates), the design philosophy employed on the Tasman Corridor has been much the same as that used in the postimplementation retrofit of the Guadalupe LRT system (*4*). The Guadalupe system initially experienced accident rates that were higher than expected, largely due to left-turn conflicts between automobiles and LRVs. Whereas the accident rate decreased as the public became familiar with the new LRT system, additional left-turn signal heads, signs, and other traffic control modifications were implemented during a retrofit project. Continuing with the success of the Guadalupe retrofit in reducing accidents, the SCCTD is maintaining a consistent design philosophy for the TCP. On a systemwide basis, this will help to strengthen public consciousness with consistent signing and traffic control patterns. Similar to the current Guadalupe system, the TCP will include

- Separate traffic signal displays, phases, and timing parameters for LRVs;
- A flashing warning sign for left-turn movements similar to the Trolley Coming sign that was part of the Guadalupe retrofit;
- Traffic signal coordination and LRT priority in order to minimize LRT delay, while maintaining acceptable intersection level of service; and
- Railroad gates with standard railroad preemption.

The signal system is being designed with maximum flexibility to allow fine-tuning in close coordination with the California Department of Transportation and the five cities responsible for traffic signal maintenance. As an example, there are three levels of LRV priority (none, partial, and full) that can be varied by time of day and can be operated with or without signal coordination.

Perspective

The design of an LRT system poses complicated problems regarding integration with other modes of transportation and coordination relative to operations among the cities. Even though corridor planning studies are proceeding, the implementation of the individual corridor projects that make up the overall rail system is not occurring according to the original schedule due in part to the present lack of a local funding program. With schedule and priority modifications, the goal of providing improved mobility may then not be attained in the precise manner originally envisaged. Should the projects be completed on a delayed schedule, then changes due to developing in the corridor with corresponding roadway modifications inevitably will take place. These changes ultimately could necessitate significant changes in the design of the LRT system. For example, during a 9-month hiatus between the completion of preliminary engineering and the beginning of final engineering, there were a number of significant changes surrounding the Great Mall in Milpitas. A major roadway extension project was placed on an accelerated schedule, necessitating significant modifications to the Tasman LRT alignment and station locations. Moreover, if the completion of the overall LRT system were to be delayed for an extended period, then land use and development changes would further affect the configuration and operation of the system itself. For instance, the location of stations would be affected as land use densities and configurations change significantly relative to proposed station locations.

Institutional and Land Use Issues

Institutional Setting

From an institutional standpoint, some significant changes have occurred in Santa Clara County during the planning and design phases of the TCP. Since 1974 the SCCTD had been governed by the SCCTD board of supervisors. This five-member body was also the Santa Clara County Board of Supervisors, responsible for all countywide policy making across the broad spectrum of planning, health, social, and law enforcement issues. The board of supervisors/transit district board arrangement functioned effectively for 20 years during the development and expansion of the bus, expressway, airport, and LRT systems.

In 1988 California voters passed ballot Proposition 111, a transportation measure that mandated the creation of county congestion management agencies (CMAs) in all urban counties in California. The function of the CMAs is to oversee the coordinated prioritization of transportation improvement projects on a countywide basis, taking into account local land use decisions. The CMAs can, for example, prevent a city from approving local development projects unless there is sufficient capacity on roadways and transit systems. The Santa Clara County CMA had a 12-member board made up of elected representatives from the city councils of the 16 cities in Santa Clara County, as well as representatives from the county board of supervisors.

There have been many years of discussion regarding the efficacy of having the county board of supervisors also serving as the county transit district board of supervisors. With the formation of the county CMA in 1988, there were two separate governing boards and one advisory commission (the county transportation commission) dealing with countywide transportation issues. In 1992 in the effort to eliminate possible overlapping responsibilities, the voters of Santa Clara County passed a ballot measure advising that the transit district merge with the CMA. Therefore, on January 1, 1995, the SCCTD withdrew from the county government structure and the CMA staff joined the SCCTD staff as an integrated division. Through special state legislation, the transit district board of supervisors and the county transportation commission have been eliminated and the CMA board has become the new transit district board. The intent behind this merger was to streamline countywide transportation planning and policy, with closer ties to the individual cities and local land use decision making.

It should be pointed out that the previous county transit district supervisors were elected on a districtwide basis, with the districts overlapping city boundaries. On the other hand, the new transit district board is made up largely of individual city council members, many of whom are part-time policy makers (particularly in the smaller cities). The new cross section represented on the board will probably change the way in which transportation projects, such as the TCP, are viewed. The new board may have different rail corridor priorities. The broad city and neighborhood representation may also encourage a project to be developed from the bottom up, beginning with neighborhood and city support, within the context of the countywide plan.

Land Use

All Tasman Corridor cities are projected to experience significant growth in population, number of households, employment, number of employed residents, and household income. Specific growth projection data for 1990, 1995, 2000, and 2005 are given for Santa Clara County and for each corridor city in Table 1. As indicated by Table 1, current trends in the corridor cities call for notable growth in population and employment. Table 2 presents current and future build-out residential population and employment data within a 610-m (2,000-ft) radius of specific Tasman LRT station areas. The future residential and employment figures are based on zoning as of May 1991 and do not include the intensified zoning that is described in detail later in the paper. As indicated by Table 2, even without the transit-oriented projects that are now planned, residential population within the Tasman Corridor would increase more than 100 percent while employment in the corridor would increase approximately 12 percent. As further described, major new residential, commercial, and industrial developments are under way in all corridor cities, contributing to the trend for new development in the Tasman Corridor.

SCCTD is working closely with local cities to further integrate land use and transportation. The regional relationship between transit and land use decisions will be strengthened by the new board made up of city council members and the ongoing CMA programs to closely integrate local land use and development decisions with local and regional transportation decisions. In line with the projections in Table 2, actual commercial and residential development along the Tasman Corridor has been occurring at increased densities. The rail corridor gives planners and developers the opportunity to work together to create and approve transit-oriented land uses for mutual benefit, eventually contributing to the success of the developments and the rail system. Efforts already under way in Tasman Corridor cities are described in following sections.

City of San Jose

The city of San Jose has established the *Housing Initiative* (5) to encourage development of high-density hous-

TABLE 1 Tasman Corridor Growth Projections

Jurisdiction	1990	1995	2000	2005	% Change 1990-2005
Santa Clara County					
Population	1,473,600	1,539,950	1,614,550	1,658,100	12.5
Households	525,900	561,950	596,660	617,490	17.4
Household Size	2.72	2.68	2.65	2.62	-3.7
Employment	881,710	980,550	1,069,810	1,145,950	30.0
Employed Residents	815,900	871,000	925,300	950,700	16.5
Household Income	$52,100	$54,800	$58,000	$60,300	15.7
Milpitas					
Population	47,600	53,200	57,900	59,500	25.0
Households	14,210	16,340	18,050	18,740	31.9
Household Size	3.16	3.10	3.05	3.02	-4.4
Employment	37,820	48,510	56,240	60,050	58.8
Employed Residents	25,200	29,100	31,600	32,200	27.8
Household Income	$51,200	$53,900	$56,900	$60,200	17.6
Mountain View					
Population	66,400	69,400	71,500	72,200	8.7
Households	30,220	31,720	32,660	33,080	9.5
Household Size	2.13	2.12	2.12	2.11	-1.0
Employment	68,040	70,470	75,860	79,340	16.6
Employed Residents	43,500	45,400	47,000	47,300	8.7
Household Income	$41,100	$43,900	$49,400	$51,200	24.6
San Jose					
Population	798,000	837,300	882,500	905,200	13.4
Households	271,380	290,700	312,770	342,850	26.3
Household Size	2.96	2.84	2.77	2.74	-7.4
Employment	300,020	355,480	400,660	444,790	48.3
Employed Residents	423,400	456,400	487,900	503,500	18.9
Household Income	$49,300	$52,500	$55,500	$57,700	17.0
City of Santa Clara					
Population	93,400	97,800	101,500	102,600	9.9
Households	37,400	39,510	41,130	41,670	11.4
Household Size	2.42	2.39	2.39	2.38	-1.7
Employment	119,270	129,100	137,940	144,200	20.9
Employed Residents	58,000	60,800	65,000	65,800	13.4
Household Income	$46,800	$47,700	$50,400	$52,600	12.4
Sunnyvale					
Population	120,400	126,500	131,600	132,700	10.2
Households	50,470	53,240	55,560	56,250	11.5
Household Size	2.36	2.36	2.35	2.34	-0.8
Employment	140,990	143,280	146,650	148,610	5.4
Employed Residents	76,200	78,800	82,200	82,700	8.5
Household Income	$49,600	$51,400	$54,500	$56,600	14.1

Source: Association of Bay Area Governments (ABAG), *Projections 90*
Notes: Employment indicates total number of jobs in the area, some of which are held by local residents, and others which are held by workers outside the area.
Estimates are for April 1 of each year.
Household Income is mean household income expressed in constant 1988 dollars

ing near transit. A new general plan land use designation known as transit corridor high-density residential, defined as 30 or more dwelling units per hectare (12 or more units per acre) is applied to sites within 610 m (2,000 ft) of LRT stations. Densities of at least 49 dwelling units per hectare (20 units per acre) are generally encouraged unless a low-density neighborhood exists nearby, which might necessitate a less abrupt transition. The city has also increased the height limit of high-density residential development near LRT stations from 13.7 to 27.5 m (45 to 90 ft).

The new Cisco headquarters includes more than 74 000 m^2 (800,000 ft^2) of industrial and office space for 3,000 employees, supporting the growth of the high-technology communications firm. Included at this large site are pedestrian-oriented design elements next to a proposed LRT station along Tasman Drive. The Renaissance Village housing project is nearby, with 1,500 residential units, a day care facility, and commercial uses.

Passing through a vacant 40-hectare (100-acre) parcel, the Tasman project is establishing the alignment of the future Tasman Drive Connection between San Jose and Milpitas. Studies are under way to determine the best possible mixed use development for this site, along with accommodation of a future LRT station. In this example, the LRT project is establishing the overall transportation corridor location before roadway construction.

City of Milpitas

The city of Milpitas has implemented a major transportation improvement program in conjunction with the conversion of a former Ford Automobile assembly plant to the 120 000-m^2 (1.3 million-ft^2) Great Mall of the Bay Area. The mall is now a dominant destination for shoppers and employees. A pedestrian overcrossing will lead from the new Great Mall LRT Station directly toward the main entrance of the mall. The city's program also includes a Tasman Drive interchange with I-880 and a Tasman Drive connecting arterial between the interchange and Capitol Avenue. This is an example of mutually beneficial coordination among SCCTD, the city, and the developer, reflected by the fact that two LRT bridges are being built as part of the interchange project.

City of Sunnyvale

The city of Sunnyvale's major employers, such as Lockheed and Hewlett-Packard, will continue to employ thousands of commuters in need of transportation alternatives. A comprehensive multimodal transit center at Lockheed is under design to facilitate efficient LRT, bus, employee shuttle, and automobile transfers. Lockheed is the county's largest employer, with 18,000 employees. However, with the downsizing of the defense industry, the number of employees will probably be lower than foreseen during the initial planning of the LRT system.

City of Mountain View

The LRT system will make a direct connection with CalTrain in downtown Mountain View at a multimodal transit center. Construction of a new residential neighborhood is under way, and a network of street connections will combine with the transit hub and recent downtown redevelopment to create a distinctive transit-

TABLE 2 Tasman Corridor Current and Future Station Area Populations

	Residents		Percent	Workers		Percent
LRT Station	**Current**	**Future**	**Change**	**Current**	**Future**	**Change**
San Jose						
Hostetter	4,470	5,700	+27.5	100	100	0
Cropley	4,720	5,890	+24.8	1,080	1,080	0
First Street	1,170	5,150	+340.2	3,080	3,080	0
Champion	0	2,467	+∞	1,450	6,183	+326.4
Milpitas						
Montague	0	0	+0	2,520	3,420	+35.7
Great Mall	900	2,180	+142.2	660	3,600	+600.0
I-880	0	0	+0	1,510	7,010	+364.2
Sunnyvale						
Reamwood	3,430	10,410	+203.4	5,370	0	-100.0
Fair Oaks	3,220	11,640	+261.5	2,340	0	-100.0
Crossman	0	0	+0	6,170	12,290	+99.2
Borregas	0	0	+0	1,620	2,660	+64.2
Lockheed	0	0	+0	19,750	22,250	+12.7
Mountain View						
Bayshore/NASA	0	1,270	+∞	11,030	10,400	-5.7
Middlefield	0	2,330	+∞	6,160	4,640	-24.7
Whisman	1,420	1,420	0	3,060	3,060	0
Evelyn	830	830	0	2,480	2,480	0
Downtown	5,880	8,400	+42.9	3,900	3,380	-13.3
TOTAL	26,520	57,287	+116.0	72,280	80,863	+11.9

Sources: SCCTD, *Tasman Corridor Project Station Area Planning: Phase I*
Paul Ogren, City of San Jose, *Suburban Mobility Initiatives*
Note: **All values are for area within 610 m (2000 ft.) radius of LRT station.**
Future population estimates based on future plans and/or build out of undeveloped land under zoning as of May 1991. Current residents as of April 1989. Current employment as of 1990.

oriented neighborhood environment. The city has also recently approved a new transit overlay zoning designation to further integrate future development with existing and future rail developments. This new designation has already been applied to several parcels adjacent to the proposed Middlefield Station. Studies are also under way to develop 850 new residential units on the GTE site surrounding the proposed Whisman Station.

Perspective

The substantial change in the makeup and possible direction of the new transit district board should affect the future of the LRT system. Priorities may change, and goals and objectives may be reevaluated during the course of project implementation.

The importance of looking at the microscopic impacts of the LRT system on the individual cities as well as the macroscopic impacts on the region should be emphasized. The new transit district/CMA board structure should help heighten awareness of this key relationship.

Land use decisions and the relative success of a transit system are inextricably linked. The ongoing dilemma is usually connected to the fact that transit decisions are made in a forum separate from local land use decisions. It is therefore noteworthy that the formation of the new transit district/CMA board will bolster coordinated decision making about the integration of land use and the LRT configuration and will likely go farther toward attaining the land use and community-related goals established for the project.

To maximize its efficiency and effectiveness, an LRT system must either be located within densely developed areas or facilitate new development or redevelopment of relatively dense, mixed use projects at key activity centers and stations. A proper jobs-to-housing balance must also be located along the corridor so that the system goes where people need to go. In recognition that many LRT riders may be dependent on transit, the demographics of the corridor must be considered carefully so that a balanced cross section of riders is served. And, because many new LRT riders will be former bus riders, a comprehensive analysis and redesign of bus routes must also be included as part of the LRT project so that bus routes do not duplicate new LRT travel patterns.

It must also be recognized that the implementation of an LRT system represents a long-range capital-intensive commitment to transportation infrastructure. In turn, local agencies with land use jurisdiction must commit seriously to making appropriate long-range land use decisions, facilitating the essential types of development required for a transit system to succeed. These local decisions are often seen as unpopular and require regional coordination.

The configuration of the Tasman Corridor alignment is largely dependent on the economic success of significant employers, including Lockheed Martin Missiles and Space, Cisco Systems, and GTE. As a result of the recent recession, defense spending cuts, and military base closures, these types of specific industries have not grown as originally forecast. In fact, most defense-oriented firms have actually decreased their work forces. Long-range planning is essential for a capital-intensive, fixed-guideway system such as an LRT system. However, businesses are driven by short-range, results-oriented economic planning. This situation articulates the difficulty in maintaining a long-range view for transportation while the industries that provide ridership and justification for the system are driven by short-range influences. Thus the need to build flexibility and contingency plans into the LRT system is emphasized.

TABLE 4 Tasman Corridor Cost Update, 1995

Category	Total (Million)	Percent
Existing Vehicle Modification	$8.0	1.5
Civil/Structural Construction	$152.0	28.7
Station Construction	$22.2	4.2
Traction Power System	$22.3	4.2
Signal/Communication System	$17.6	3.3
Engineering/Management	$132.2	24.9
Right-of-Way	$84.5	15.9
Contingency	$40.4	7.6
Financing	$50.0	9.4
TOTAL	$530.0	100.0

Source: SCCTD Tasman Corridor Full Funding Grant Application

Ridership and Costs

Ridership projections were performed in 1992 for the horizon year 2005 when the project was assumed to be in full operation. These figures are presented in Table 3. The projected costs for the Tasman Corridor, as updated in 1995, are given in Table 4.

Costs for the Tasman Corridor Project have increased, but not excessively so. Some of the increase was due to the ADA requirements, which were not originally budgeted. Any increase in cost, however, presents a problem in terms of financial feasibility. As a result of the delay in implementation of the LRT system, the expenditure will be higher than anticipated. As a result of changes in land use and other infrastructure, the projected ridership and revenue levels may not be realized as originally projected. Consequently, the goal of financial feasibility may be attained to a lesser extent than anticipated. It may therefore be prudent to study different scenarios of future land use and infrastructure developments, obtain related cost and revenue projections, and then plan the layout and operating system within this framework.

Funding Issues

Conceptual engineering began in August 1991 upon completion of the AA/DEIS phase and continued through January 1992. Preliminary engineering was completed in August 1992. Final engineering began in May 1993 and essentially was completed in May 1995.

TABLE 3 Tasman Corridor Alternative Operating Characteristics

	Riders			Transfers		
Alternative	Daily	Peak	Off-Peak	Daily	Peak	Off-Peak
Existing	20,000	9,900	10,100	0	0	0
A	31,100	20,400	10,700	35	25	10
B	28,500	19,300	9,200	790	540	250

Meeting the local funding requirements for the Tasman Corridor remains the top priority for the SCCTD and the TCP team. In November 1992 Santa Clara County voters passed *Measure A*, to renew an existing half-cent sales tax for transportation. Nearly 90 percent of the $3.5 billion in revenue projected over the 20-year life of the measure is pledged for financing construction and operation of an integrated countywide rail system. In addition to providing the local matching funds for construction of the TCP, six other light rail corridors are included, as well as express bus, highway, and expressway projects.

However, this 20-year, half-cent sales tax measure has been challenged by opponents who believe that the measure required a two-thirds supermajority and not the 54 percent vote received. The Sixth District Appellate Court has rendered *Measure A* invalid, and the implementation of the tax is now pending a decision by the California State Supreme Court. The court has agreed to hear oral arguments in June 1995 and a final decision is expected in August 1995. Assuming a favorable decision, it is projected that construction could start by the end of 1995, with revenue service beginning in April 2000. Due to the local and regional consensus that light rail is a key element of the transportation network, funding the TCP remains a high priority. Federal and state funds have been allocated to match the local resources, although the full funding grant agreement will not be able to be executed until the local funding is in place.

The court challenge to *Measure A* is delaying the completion of the Tasman Corridor and the rest of the rail system significantly. Not only has the local funding situation changed significantly, but so has the transportation funding environment. In California, funding priorities now rest with seismic retrofit of existing highway facilities, and in the past several years voters have repeatedly and soundly rejected statewide rail bond, gas tax, and other bond financing measures. As a result, the

California State Transportation Improvement Program, which sets out statewide transportation funding priorities, is now largely unfunded. It is possible then, that the outcome of the *Measure A* legal challenge may severely affect local funding of transportation projects.

Lessons Learned in Silicon Valley

Some of the perspectives discussed earlier in the paper are essentially not new, although some of the specific circumstances are unique. The authors believe that it is valuable to share specific project experiences and lessons learned with others in the industry. In Santa Clara County, it is realized that delays in implementation, increases in costs, and changes in the environment are not unusual for transportation projects and have been handled in various ways in the past. However, the composite effect of a number of issues including a delay in implementation, a court challenge that could lead to a major loss in local funding revenue, changes in the business climate affecting defense industries, and a change in the governing body is of interest.

As discussed before, the delay in the implementation of the overall rail system will probably have the effect of creating a less favorable land use environment for transit, which will lead to lower revenues, bolstering the arguments of those opposing the funding and hampering the early implementation of the overall rail system. Although there may be advantages in the long term in the reconstitution of the governing board, it may be speculated that in the short term the lack of continuity and perhaps loss of political connections may be a disadvantage. The impacts of these compound effects on the long-term feasibility of the LRT system have not been determined.

It can be concluded that changes will occur over the implementation period of a transportation system. Using the Tasman Corridor as an example, it can be seen that many of the external factors changed to the detriment of the future success of the system. What lessons can be learned?

Notwithstanding the fact that all changes cannot be predicted, it appears logical to attempt to predict the changes as far as possible and plan accordingly. Since the changes that occurred are major and happened at different points in time, planning for a changing environment should be continuous and, if planning resources are constrained, then smaller but more frequent planning efforts should be undertaken. Since the coordination between land use and the LRT system is so important to achieve efficiency, it is particularly important to work continuously with all concerned to create a land use and development environment that will be favorable to successful future completion of the LRT system.

The changes in the prediction of the performance of the system must be communicated clearly to the public, since the public ultimately must authorize funds for the system. Despite the changing economic and political environment, the participants in the process of implementing the LRT system have learned lessons and responded to make implementation successful. One important example is the strengthening of the land use/transit symbiosis that should come about through the reconstitution of the governing body. The design of the TCP was essentially completed in May 1995, and there is confidence that the court ruling on the funding measure will be favorable; if not, alternative funding avenues will be sought to secure the local funds to match pledged state and federal funding.

References

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