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Estimating Operating Costs of Fixed Guideway System Proposals

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Introduction

Research on operating costs of new fixed guideway transit systems in contrast with their capital costs, has received little attention. Recent cost escalations of the Bay Area Rapid Transit District (BART) and the Morgantown, West Virginia people mover illustrate the inability of analysis to accurately forecast capital costs or estimate annual system operating costs.

Urban Mass Transportation Administration (UMTA) officials are concerned about the operating costs of proposed fixed guideway projects because of the large amount of Federal funds which might be required to continue operations. All applicants who seek to build and operate fixed guideway projects must now prepare an analysis of alternatives. An evaluation of system operating costs should be included in the analysis.

Scenario writing is presented in this paper as a technique which can assist in the evaluation of proposed system operating costs.* This technique makes it possible to examine the impacts of alternative trends on operating cost escalation. Two projects proposed for Los Angeles, the Wilshire subway and the Downtown People Mover are used as case studies. The analysis of the data generated from the scenarios illustrates that the problems of operating cost escalation will continue despite incorporation of advances in transit technology.

The discussion is presented as follows: First, the application of advanced technology to two recently constructed rail transit systems is reviewed. This subject is presented to demonstrate that large-scale automation does not

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*For a more detailed discussion of scenario writing see the authors dissertation: Escalation of Urban Transportation Operating Cost: Implications for the Future.

prevent operating deficits. Second, the three major categories of people mover systems are described. Based on the experience of automated rail transit systems and people mover systems, UMTA has chosen to use the simplest people mover technology for testing in downtown environments. Third, the issue of whether planners can forecast operating cost of high capital cost transit system proposals is analyzed. The two case studies with the scenarios are then presented.

Fixed Guideway Systems - Rail Transit

Prior to the 1960's, rail transit was characterized by minimal automation. An engineer controlled the train, a conductor controlled the doors, a dispatcher controlled operations, a switchman controlled major junctions, and a station attendant collected fares. The growing sophistication of computer technology in the early 1960's was viewed by transportation planners as an opportunity to reduce the labor input in rail transit operations and thereby slow the escalation of operating costs. It was anticipated that large initial investments in fixed costs (computerized control systems) would yield savings in the long run.

Two strategies were adopted employing computer technology. The first strategy, exemplified by the Port Authority of Pennsylvania and New Jersey (PATCO), was to adapt the new technology to the existing state of the art in transit operations. The second strategy, exemplified by the Bay Area Rapid Transit District (BART), was to adapt the existing state of the art to the new computer technology.

Port Authority Corporation of Pennsylvania and New Jersey (PATCO)

The first American fixed guideway transit system to employ Automatic Train Operations (ATO) was PATCO, a fourteen mile rail line connecting center city Philadelphia with southeastern New Jersey (See Figure 1).[1] With the ATO system, train speed and stopping can be automatically or manually controlled. The train operator controls the doors and also activates the ATO system when the train is ready to leave a station. Train supervision is manually controlled by a central dispatcher. Train protection, the function necessary to prevent collisions, is automated with a combination of wayside and track equipment, and cab signals. PATCO trains can achieve speeds with ATO or manual operations of up to 75 mph on standard gauge (4'8") track.

System stoppages attributable to malfunctions of the automated systems have been minimal. Full automated operations were begun after system construction was completed in 1969. Overcapacity during peak periods rather than technical problems has slowed growth in PATCO's ridership. To remedy this problem, the State of New Jersey is providing the local share required for an UMTA capital grant to purchase forty-six additional rail cars and expand station parking lots. Also, a new station at Woodcrest, located between the Haddonfield and the Ashland stations, is being constructed.

San Francisco Bay Area Rapid Transit District (BART)

Although the seventy-one mile BART system connecting East Bay suburbs and Oakland with San Francisco (See Figure 2) was planned at the same time as PATCO, an entirely different approach was taken. Hamer comments:

> Instead of proposing detailed hardware specifications, which would be based largely on existing tehcnology, transit planners merely set general performance standards for a fully automated system and invited builders to design the cheapest way of meeting them. (Hamer, 1976: 83)

[1]PATCO planners, according to Engineering News Record (November 3, 1977), are preparing to submit a proposal to UMTA for a 14.2 mile extension connecting the existing line in Camden with northeastern suburbs. The cost of the extension is $750 million.

The final product was the first fully automated American rail transit system. Speed regulation, station stopping, and door operation are all conducted by an ATO system. Train supervision and train protection are also computer controlled.[2] On PATCO trains, the operator is an integrated element, but on BART trains, as Hamer notes: "the operator is a redundant element meant to provide passengers with psychic assurance in a 'no-hands' environment." (Hamer, 1976: 83)

Technical problems continue to plague BART operations five years after the first segment was opened. The Sequential Occupancy Release (SOR) system, the train protection system, has not been fully certified by the California Public Utilities Commission. As a result, only one train can travel through the Transbay Tunnel every six minutes. Through service between Richmond and San Francisco and extra peak period service on the heavily patronized Concord line cannot be implemented until shorter headways are possible.

Strategy One (PATCO) Versus Strategy Two (BART)

Automated technology permits an improvement in operating efficiency by reducing the number of employees required. Both BART and PATCO have been able to minimize employment in direct train operations. However, because of numerous technical problems BART has a maintenance staff of over one thousand.

In fiscal year 1976, PATCO carried 145.6 revenue passengers per employee per day compared to BART's figure of 66.8 (California State Legislature, 1975:179). PATCO personnel cost per revenue passenger was \$0.32 compared to \$1.09 for BART. PATCO personnel cost per vehicle mile was \$0.82 compared to \$1.42 for BART.

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[2] Hamer (1976) and U.S. Congress (1976) offer detailed discussions on BART technology.

Until PATCO adds more peak period patronage capacity, its revenue passenger per employee figure is likely to remain constant. Once BART implements additional service, now delayed for technical reasons, its number of revenue passengers per employee should show a marked increase.

The new rail transit systems in Washington, D.C. and Atlanta have profited from BART's experience with respect to maintenance and technological problems. Yet, the success of PATCO operations in minimizing operating deficits indicates that the planners of these other rail transit systems now under construction have spent large sums of capital to achieve labor savings which could have been possible with a smaller investment in automation.

The automated rail systems just described were designed to transport suburban commuters to central city business districts. Research and development have also been conducted on automated transport of people within a short central city corridor. These people movers are discussed in the following section.

Automated Guideway Transit - People Movers

In their attempt to offer the comfort and convenience of automobile transportation to transit riders, planners have developed Automated Guideway Transit (AGT):

> ....a class of transportation systems in which unmanned vehicles are operated on fixed guideways along an exclusive right of way. The capacity of the vehicles ranges from one or two up to 100 passengers. Single units or trains may be operated. Speeds are from 10 to 40 miles per hour. Headway [the time interval between vehicles moving along a main route] varies from one or two seconds to a minute. There may be a single route or branching and interconnecting lines. (U.S. Congress, 1975: 1)

There are currently three major categories of Automated Guideway systems:

- Shuttle Loop Transit (SLT)

- Group Rapid Transit (GRT)

- Personal Rapid Transit (PRT)

UMTA has been directly involved with the implementation of SLT systems and GRT systems. PRT systems are only in the research stage.

Shuttle Loop Transit

A Shuttle Loop Transit (SLT) system is somewhat similar to a horizontal elevator. Automated vehicles follow a continuous loop. Minimal use is made of operational switching in passenger carrying operations. Stations are on-line. Minimum headways must be at least one minute, and vehicle size is set by anticipated peak demand. A Congressional report comments:

> The potential in comparison with buses for improved service at lower operating cost and life cycle cost recommends these systems to other transportation modes. The advantage must, of course, be balanced against the need for exclusive rights-of-way. (U.S. Congress, 1975: 375)

Until recently, SLT systems were limited to primarily airport operations. UMTA established the Downtown People Mover Program to determine if the technology used in airport SLT systems could be transferred into an urban environment.

U.S. Secretary of Transportation Coleman in December 1976 approved a commitment to the City of Los Angeles for $125 million to fund a people mover system in downtown Los Angeles. The people mover project is one part of a regional transportation improvement program which also includes a rail transit line within the Wilshire Corridor, and an expanded bus system.

Three other cities were selected by UMTA officials to participate in the downtown people mover program. Cleveland will receive $41 million for a 2.1 mile loop, St. Paul will receive $45 million for a 2.6 mile double lane loop, and Houston will receive $24 million as a grant and a $10 million loan.[3] The dollar commitment to Los Angeles for its 2.69 mile double lane people mover is higher than the combination $120 million in grants and loans awarded to the other three cities.

Group Rapid Transit

The Group Rapid Transit (GRT) systems can be either classified as moderate headway or short headway types (U.S. Congress, 1975: 376). GRT systems are technologically more complex than SLT systems. Their large capacity and intermediate stops distinguish them from PRT systems.

Moderate headway GRT systems represent only a slight departure from rail transit systems. They are in a network configuration involving switching for multiple routing. Either a single vehicle or vehicles in trains can be operated. Stations however, are located off the main line allowing trains to pass a station while other trains are stopped. Also, the GRT vehicles are generally smaller (50-100 passenger) than those used by conventional rail transit systems.

GRT systems with moderate headways are now operating at Dallas/Fort Worth Airport and on the Morgantown, West Virginia campus of the University of West Virginia. The Dallas/Fort Worth system has been operating since 1976 with minimal stoppages because of technical problems. The Morgantown system, in operation since 1975, is now being expanded. Completion of the expansion according to the Transportation Research Board (1977a), is expected in 1980.[4] These GRT systems:

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[3]Newly elected Cleveland Mayor Dennis Kucinich, according to Passenger Transport (December 9, 1977, p. 1), recently sent UMTA officials a letter saying he wanted the city's application for a $41 million federal grant to be withdrwan and the $55 million people mover project terminated. Planning for the people mover systems in Los Angeles, St. Paul, and Houston is continuing.

[4]See Hilton (1974) for a history of the Morgantown GRT system development.

> ....are capable of operation as intermediate capacity line haul systems and as regional networks. In addition, they have the potential to circulate people in major activity centers and to connect major activity centers. ....these systems represent a much needed mode, which, if satisfactorily developed will assume a major role in urban transportation between rail rapid transit and the bus, and the deployment of these systems should be encouraged. (U.S. Congress, 1975: 376).

More details on operating cost experience of these systems are discussed later in this report. The short headway GRT systems are proposed to operate at headways between three and fifteen seconds and carry eight to twenty passengers at a rate of 3,000 to 15,000 passengers per lane hour.[5] The applications of these systems are based on an unproven premise that:

> ....the smaller vehicles and implicitly smaller guideways would reduce the cost and the intrusive nature of the guideway and increase their acceptability to the community. In addition, the operation of shorter headways would permit line capacity growth; and more frequent service to the diverse destinations typical of urban travel and would result in increased system patronage. ....However, the economic feasibility, the increased service potential, and the greater acceptability of the potentially lighter guideways have not been established and a considerable body of opinion exists that feels that the short headway group system will not be acceptable. (U.S. Congress, 1975: 377).

Personal Rapid Transit

Personal Rapid Transit (PRT) systems are proposed to provide non-stop service from an origin to a destination for an individual or related groups of passengers. Small (4-6 passenger) demand actuated vehicles are used with headways of one to two seconds. PRT networks such as one designed by the Aerospace Corporation (1976) for Los Angeles are intended to provide area-wide coverage with a network of fixed guideways and stations. PRT supportors believe that this mode is:

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[5] Automobile capacity and speed are optimized on a freeway lane at about 2,000 automobiles per hour at a speed of 40-45 miles per hour per automobile.

....the only means by which a significant fraction of urban trips may be attracted from the automobile to provide a service comparable to that of the automobile, that is a personal vehicle with accessibility to a major portion of urban areas with trip times, cost and direct service competitive with that of the auto. (U.S. Congress, 1975: 378).

The opposing viewpoint, stated in the same study:

....questions whether the PRT even with its claimed service could attract a significant fraction of the urban automobile trips unless severe restrictions are placed upon the use of the auto. (U.S. Congress, 1975: 378).

Because PRT is now only in the conceptual stage, the following discussion on operating costs is limited to SLT and GRT systems.

Operating Costs of Automated Guideway Transit

Data on automated guideway transit operating costs have yet to be analyzed in depth. Table 1 is a cost comparison between Shuttle Loop Transit operations at Tampa Airport and Seattle-Tacoma Airport. Both installations utilize the Westinghouse people mover system.

SLT cost per passenger and cost per vehicle mile shown in Table 1 are low when compared, for example, to the operations of the Southern California Rapid Transit District which in fiscal year 1976 had an operating cost per passenger of $0.77 and an operating cost per vehicle mile of $1.65, or to the operations of the Alameda-Contra Costa Transit District which in 1977 had an operating cost per passenger of $0.84 and an operating cost per vehicle mile of $1.72.[6] Analysis presented later in this paper shows a people mover operating in a downtown environment has a unit cost per output figure higher than in an airport environment. Yet, these figures remain below conventional transit system costs.

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[6]Output data come from transit agency annual reports. Total operating cost does not include depreciation.

Table 1

SLT OPERATING COST DATA

Category	Tampa Airport	Seattle-Tacoma Airport
Length of single lane guideway (feet)	7,100	9,050
Number of stations	8	
Number of vehicles*	8	9
Capital cost (millions)	$8.25	$14.0
Year completed	1971	1973
Annual operating and maintenance cost (thousands)	$275	$540
Passengers per year (millions)	12.5	5.7
Vehicle miles per year (thousands)	380	430
Operating and maintenance cost per passenger	$0.02	$0.09
Operating and maintenance cost per vehicle mile	$0.72	$1.26

Source: U.S. Congress, 1975: 52.
*Each vehicle carries 90 to 100 persons.

Limited Group Rapid Transit operating cost data were available for the AIRTRANS operation at Dallas/Fort Worth Airport. Between the months of April and October 1976, operating and maintenance cost per vehicle mile ranged from $0.63 to $0.88. Cost per passenger ranged from $0.40 to $0.83 which is higher than comparative SLT figures in Table 1. More detail on AIRTRANS is illustrated in Tables 2 and 3.

Table 2

AIRTRANS OPERATING COSTS
April-October 1976

Month	Direct Operations	Power	Labor Maintenance	Maintenance Materials	Total
April	$24,494	13,999	119,844	46,423	$204,161
May	$25,609	17,893	112,923	65,797	$222,222
June	$21,314	19,211	98,091	45,092	$183,698
July	$24,698	22,090	123,046	44,545	$214,379
August	$24,648	22,798	98,755	52,125	$198,326
September	$26,294	18,728	113,441	85,125	$245,398
October	$27,278	19,039	130,096	50,767	$227,169

Source: LTV Corporation in "New Concepts in Urban Transportation," (Transportation Research Board, 1977b: 2).

Table 3

AIRTRANS PERFORMANCE MEASURES
April-October 1976

Month	Passengers	Cost Per Passengers	Vehicle Miles	Cost Per Vehicle Mile
April	510,403	$0.40	322,360	$0.63
May	493,827	$0.45	310,077	$0.72
June	556,661	$0.33	324,173	$0.57
July	564,155	$0.38	306,256	$0.70
August	521,911	$0.38	330,544	$0.60
September	613,495	$0.40	327,197	$0.75
October*	473,269	$0.48	257,172	$0.88

Source: LTV Corporation in "New Concepts in Urban Transportation," (Transportation Research Board, 1977b: 2).

*In October 1976, the system was shutdown for maintenance.

A comparison between AIRTRANS and the Tampa and Seattle-Tacoma Airport systems is difficult. They were designed for different purposes. AIRTRANS was designed to ferry passengers and freight between airline terminals. The SLT systems were designed to transport departing and arriving passengers between the main airport terminal and the gates. Almost all passengers using the Tampa and Seattle-Tacoma Airports ride the people mover; however, at the Dallas/Fort Worth Airport only those passengers transferring between airlines use AIRTRANS.

Based on the available data, AIRTRANS is operating approximately 300,000 vehicle miles per month while the Tampa Airport SLT is operating 380,000 vehicle miles per year, and the Seattle-Tacoma Airport SLT is operating 430,000 vehicle miles per year. AIRTRANS vehicles travel over a nine mile guideway compared with the approximate one mile guideways at Tampa and Seattle-Tacoma Airports. AIRTRANS operates fifty-one vehicles compared to eight on the Tampa SLT system. AIRTRANS and Seattle-Tacoma SLT each carry 500,000 riders per month while the Tampa SLT monthly patronage is one million. Comparisons on a cost per passenger basis are misleading because of the different functions of the people movers.

The use of expensive automated guideway technology appears well suited for the airport environments in which they have been placed. The SLT systems with their minimal technological problems are operating at a low cost per passenger. Although the Morgantown and AIRTRANS GRT systems have had costly technological problems, they are now operating with minimal shutdowns.

A major policy issue raised by UMTA officials is whether automated guideway technology can be taken from an airport environment and placed in densely populated central business districts. UMTA officials have learned from experience that technological simplicity is to be preferred. The Morgantown people mover system, which employed GRT technology, had many problems. Thus, SLT technology has been chosen for the downtown people mover program.

While local officials are willing to match UMTA people mover grants with local funds on the assumption that the downtown people mover (DPM) program will be beneficial, issues related to DPM operating costs have not been clarified. For example, will DPM employees belong to the same union as conventional transit employees and demand similar wage and benefit packages? The inclusion of such factors in operating forecasts is not well developed. In the next section, this issue is discussed in more detail.

Forecasting Costs of Proposed Transit Projects

With new transit proposals comes a necessity to forecast both capital and operating costs. In the 1960's elected officials showed more interest in capital costs than operating costs. Emphasis was on getting construction started. Planners therefore spent much time developing estimates of capital cost. The lack of attention given to project operating cost estimates was noted by Kulash and colleagues in their report on the Washington, D.C. METRO:

> For public works projects of this magnitude, the attention tends to focus almost solely on the capital costs and thus to ignore the expenses of operating and maintaining the facilities once they are in place, not to mention those for replacing rail cars, buses, or other items. Further, as the system ages, the unit operating and maintenance expenses will increase. (Kulash, et. al., 1976: 61).

The available literature on cost overrun of urban transit projects has reflected the emphasis on capital costs. Merewitz (1973), for example, compared the capital cost overrun experiences of urban transit projects with other types of public works projects including water resource, highway, building, and ad hoc projects. He concluded that:

> Cost overruns are significantly smaller in water and highway projects executed by established government agencies. Such bodies have accumulated experience doing such projects and must maintain credibility with legislators to obtain resources to do future projects. Cost overruns are greater in ad hoc projects as well. Ad hoc projects are typically done once for all with neither learning nor a need to establish credibility. The experience on urban rapid transit projects is worse than average, but this difference is not significant in a statistical sense. Urban rapid transit projects have often been constructed by inexperienced bodies which become operating transportation properties after passing an initial construction phase. (Merewitz, 1973: 484).

Experience seems to be a key factor in holding down the gap between estimated and actual costs. While inflation and unforeseen changes in the project itself cannot be controlled, poor administration of projects can. Merewitz states:

> Controllable overruns are due to poor administration of projects, starting with incomplete surveys of engineering, financial and legal problems which might have been anticipated ahead of time. Poor administration may also include overly complex organizational structures for planning and constructing projects, poor contracting practices, unnecessary scope changes, and simple inexperience of personnel for the type of project of the area in which the project is undertaken. (Merewitz, 1972: 4).

An agency staff such as a highway department is better prepared to forecast new highway construction costs because of repeated highway building experience. Their experience also makes them less dependent on consultants. An agency such as a transit district which has never built an automated rail transit system is likely to underestimate both the cost and the complexity of their proposal. The transit district staff will probably then turn to consultants for assistance.

A similar concept can be extended to forecasting costs of new automated transit systems. Since a transit agency will usually build a completely new system only once, its initial operating cost estimates are not likely to be based on operating experience. Cost estimates can be taken from examples of other new systems or additions to existing systems located elsewhere. However, without the operating experience these operating costs estimates should be carefully examined.

The experiences of BART and Morgantown staffs are useful lessons. The inexperience of the staffs necessitated the use of consultants. BART's operating costs have been far above the forecasts given to management by consultants. For fiscal year 1977, operating costs were projected in the Composite Report (San Francisco Bay Area Rapid Transit District, 1962: 34) to be $13.62 million ($1962). The actual figure was $70.2 million. Adjusting the 1977 figure to 1962 dollars, the forecast is off by a factor of 1.6. The level of inflation and the effect of legislation such as Section 13 (c) of the Urban Mass Transportation Act of 1964 were unforeseen. Other factors could have been controlled. The use of automated technology was viewed by BART proponents as a means of controlling cost increases by reducing the required labor inputs. Planners assumed that the technology would work. There was no questioning of what cost could be incurred if the technology would not work.

While the Morgantown people mover has not incurred similar labor cost increases, tehnical problems have caused operating costs to increase. Again, planners assumed that the technology would work without problems. The cost of these mistakes has caused the user fee paid by University of West Virginia students to be increased from $10 per semester to $15 per semester, effective September 1, 1977 (Transportation Research Board, 1977a).

An instructional lesson for Los Angeles planners now contemplating a new rail transit system is to examine what the level of operating costs would have been had the 1968 SCRTD rail transit proposal been implemented. According to SCRTD consultants Coverdale and Colpitts (Southern California Rapid Transit District, 1968: VI-3), the operating costs of the completed 1968 plan in 1980 would be $30 million ($1968). Assuming that constant dollar transit costs continue to escalate at four to five percent per year, the 1980 operating costs of the 1968 SCRTD rail transit plan would likely be $52 million ($1968), or 80 percent higher than forecast.

One can imagine what SCRTD's current financial problems would be if the rail transit system had been built. Some cutbacks in the bus system are now taking place because of inadequate revenues and escalating costs. Certainly it is realistic to believe that the bus network would have been different had a rail transit system been built. However, the financial problems would still be serious.

Elected officials today, given their awareness of operating deficits of bus and rail transit systems, should be wary of new transit proposals whose operations are forecast to incur low or no deficits. Trend extrapolation used in the proposals does not really contribute to a deep understanding of possible future operating costs. Historical evidence can be helpful, but it cannot be the sole basis on which we act. Vanston, Jr. and colleagues comment:

> In order to minimize the risk inherent in planning against a single, unforeseeable future and to be in a position to profit from different possible trends and events, many governmental agencies and private companies are finding it desirable to plan against not one but rather a range of possible futures. (Vanston, Jr., et. al, 1977: 159).

Scenario writing is a technique which can help with this task. How do scenarios work? The are:

> ....a description of the conditions under which a policy that is to be analyzed, designed or evaluated is assumed

> to perform. It consists of an outline of a sequence of hypothetical events usually including a forecast of what will happen to the environment during some period of time....Scenarios, provided they are well executed, can be extremely useful. By providing an insight into possible futures, they can make us aware of the potential consequences of particular policies. (Quade, 1975: 188)

The Urban Mass Transportation Administration requires an alternative analyses when funds are requested for a major mass transportation investment (Federal Register, 1976 p. 41513). An assessment of each alternative's operating costs should be included in the analysis. Scenario writing can be a useful technique to generate operating cost implications of alternative trends to those that appear in the project proposal.

To examine the feasibility of using this technique, scenario writing is applied to the operating cost data of two projects proposed for Southern California: the Los Angeles Downtown People Mover and the North Hollywood-Wilshire Rail Transit line. In the proposals of both projects, the assumption is made that constant dollar operating expenditures will change only as a result of an increase in vehicle mileage. The implications of increases in constant dollar expenditures because of other factors is examined in the scenarios. This analysis demonstrates how planners can assist officials by making them aware of potential operating cost increases attributable to unanticipated events.

Los Angeles Downtown People Mover

The Los Angeles DPM as shown in Figure 3 is proposed to connect Union Station to the northeast of the central business district with the Convention Center to the southwest. This 2.69 mile, double tracked line has a total of eleven stations. In addition to serving a large concentration of Federal, state, county, and city employees, the DPM guideway will be located within the

Bunker Hill Redevelopment area and the growing financial and hotel centers. The employment served by the DPM is primarily a skilled, high income labor force.

Almost the entire work force in the DPM corridor commutes to work from outside downtown Los Angeles. The Los Angeles Community Redevelopment Agency (CRA) staff have proposed that large parking structures and bus stations be constructed at the Convention Center and Union Station. Both of these DPM terminals are located at or near major freeway junctions. Commuters will transfer from cars or buses onto the people mover which will transport them to their workplace, thus reducing the number of vehicles entering the CBD.

A key factor in the demand forecast developed by the CRA staff and consultants is the willingness of commuters to transfer from buses or cars onto the DPM. Demand for the initial operating year is 58,100 trips per day, and 81,000 trips per day by 1990 (Los Angeles Community Redevelopment Agency, 1976). These figures translate into annual figures of 18 million and 25 million, or an average annual growth of 3.35 percent.

The proposed operating costs for the initial operating year and 1990 are shown in Table 4. The CRA (1976) cost items have been combined into six categories.

The direct labor component shown in Table 4 assumes no vehicle operators are required. As a result, direct labor comprises only 31 percent of the initial year operating budget. Fringe benefit expenses comprise 9 percent of both the initial year and 1990 operating budgets. For other transit modes such as bus and rail, the share of the total budget for fringe benefit expenses has steadily increased since 1960.

Table 4

LOS ANGELES DPM OPERATING COSTS

Item	Initial Year	(Percent of Total Budget)	1990	(Percent of Total Budget)
Direct Labor	$813,016	(31)	$813,016	(29)
Fringe Benefits	245,905	(09)	245,905	(09)
Power	648,208	(25)	728,000	(26)
General and Administrative	339,260	(13)	366,730	(13)
Liability Insurance	216,000	(08)	302,800	(11)
Other	331,890	(13)	355,239	(12)
Total	$2,600,980	(100)[a]	$2,811,690	(100)

Source: Los Angeles Community Redevelopment Agency, 1976.

[a]Total does not equal 100 percent due to rounding.

The assumptions on which the CRA data were developed were:

a) Costs are in 1976 dollars

b) Operated by City of Los Angeles and maintained by City employees

c) Labor rates are based on current agreement between SCRTD and Amalgamated Transit Workers Union with an assumed 7 percent increase to the July 15, 1975 wages

d) Power cost is $0.03 kwh, which is the same rate being used for SCRTD alternative analysis

e) Fringe benefits are calculated as 30 percent of base salary

f) City administrative overhead is 15 percent of all costs

g) Escalator and elevator maintenance is done under a contract to either supplier to outside maintenance contractor

h) DPM maintenance facility is guarded by security guard on a full time basis

i) System operates twenty hours per day Monday through Saturday, and sixteen hours per day on Sunday and holidays

None of the input categories in the CRA proposal change in constant dollar value. The only operating cost increases are attributable to an increase in vehicle miles. Between the initial operating year, 1981 and 1989, annual vehicle miles are 1.979 million. From 1990 onward, annual vehicle miles increase to 2.308 million because of the addition of more revenue vehicles.

Three Scenarios

The implications of constant dollar change in the DPM input categories are examined in this section. Tables 5 to 7 show the operating cost of each scenario in five year intervals. For 1990, CRA forecast total operating cost to be $2.81 million. Scenario One is 19 percent higher at $3.35 million, Scenario Two is 11 percent higher at $3.12 million, and Scenario Three is 2 percent higher at $2.87 million.

Table 5

SCENARIO ONE-HIGH CONSTANT DOLLAR INCREASES
LOS ANGELES DPM, 1981-2000

Category	1981	1985	1990	1995	2000
Direct Labor	$819,685	$887,253	$979,599	$1,081,577	$1,194,126
Fringe Benefits	245,905	292,793	323,268	389,361	429,885
Power	648,240	729,600	845,806	980,521	1,136,693
Liability Ins.	216,000	216,000	302,800	302,800	302,800
Other	331,890	359,248	396,639	437,922	483,501
Subtotal	$2,261,720	$2,484,894	$2,848,112	$3,192,161	$3,547,005
General-Admin.	339,260	434,856	498,420	638,432	709,401
Total	$2,600,980	$2,919,750	$3,346,531	$3,830,593	$4,256,406

Assumptions:

a) Labor negotiators are able to secure an average annual increase in the total wage bill of 2 percent above the general inflation rate between 1981 and 2000.

b) Fringe benefit expenses between 1981 and 1990 are 33 percent of the total annual wage bill. Between 1991 and 2000, annual fringe benefit expenses increase to 36 percent of the total wage bill.

c) Power costs between 1981 and 2000 increase annually at 3 percent above the general inflation rate.

d) Liability insurance costs remain at the levels specified in the DPW proposal.

e) The "other" expense category between 1981 and 1990 increases annually at 2 percent above the general inflation rate. Technological problems with the DPM system cause this increase. Between 1991 and 2000, this cost category continues to escalate at 2 percent annually above the general inflation rate because of repairs from the deterioration of the DPM system.

f) The rate at which the general and administrative category is calculated increases to 17.5 percent of annual operating costs between 1981 and 1990, and 20 percent of annual operating costs between 1991 and 2000.

Table 6

SCENARIO TWO-MODERATE CONSTANT DOLLAR INCREASES
LOS ANGELES DPM, 1981-2000

Category	1981	1985	1990	1995	2000
Direct Labor	$819,685	$861,498	$905,443	$951,630	$1,000,172
Fringe Benefits	245,905	275,679	289,742	323,554	340,058
Power	648,240	715,709	790,201	830,509	872,873
Liability Ins.	216,000	216,000	302,800	302,800	302,800
Other	331,890	366,433	366,433	373,762	412,663
Subtotal	$2,261,720	$2,435,319	$2,654,619	$2,782,255	$2,928,566
General-Admin.	339,260	426,181	464,558	556,451	585,713
Total	$2,600,890	$2,861,500	$3,119,177	$3,338,706	$3,514,279

Assumptions:

a) Labor negotiators are able to secure an average annual increase in the total wage bill of 1 percent above the general inflation rate between 1981 and 2000.

b) Fringe benefit expense between 1981 and 1990 is 32 percent of the total annual wage bill. Between 1991 and 2000, annual fringe benefit expenses increase to 34 percent of the total annual wage bill.

c) Power costs between 1981 and 1990 increase annually at 2 percent above the the general inflation rate. Between 1991 and 2000, use of newer energy sources reduces the increase to 1 percent above the general inflation rate.

d) Liability insurance costs remain stable as shown in the CRA proposal.

e) The DPM system has technological problems from 1981 to 1985 causing a 2 percent average annual increase above the general inflation rate for the "other" expense category. From 1986 to 1994, this category remains at the 1985 level. From 1995 to 2000, a percent average annual increase above the general inflation rate is caused by deterioration of elements of the DPW system.

f) The rate at which the general and administrative category is calculated increases to 17.5 percent of total operating cost from 1985 to 1994, and to 20 percent from 1995 to 2000.

Table 7

SCENAIRO THREE-LOW CONSTANT DOLLAR INCREASES
LOS ANGELES DPM, 1981-2000

Category	1981	1985	1990	1995	2000
Direct Labor	$819,685	$840,383	$861,604	$883,360	$905,665
Fringe Benefits	245,905	260,519	267,097	282,675	289,613
Power	648,240	681,306	716,060	734,142	752,680
Liability Ins.	216,000	216,000	216,000	302,800	302,800
Other	331,890	348,820	348,820	352,308	370,279
Subtotal	$2,261,720	$2,347,028	$2,496,381	$2,555,285	$2,621,237
General-Admin.	339,260	352,054	374,457	447,175	458,716
Total	$2,600,890	$2,699,082	$2,870,838	$3,002,460	$3,079,953

Assumptions:

a) Labor negotiators are able to secure an average annual increase in the total wage bill of 0.5 percent above the general inflation rate between 1981 and 2000.

b) Fringe benefit expenses between 1981 and 1990 are 31 percent of the total annual wage bill. Between 1991 and 2000, annual fringe benefit expenses increase to 32 percent of the total annual wage bill.

c) Power costs between 1981 and 1990 increase annually at 1 percent above the general inflation rate. Between 1991 and 2000, use of newer energy sources reduces the average annual increase to 0.5 percent above the general inflation rate.

d) Liability insurance costs remain stable as shown in the CRA proposal.

e) The DPM has technological problems from 1981 to 1985 causing a 1 percent average annual increase above the general inflation rate for the "other" expense category. From 1986 to 1994, this category remains at the 1985 level. From 1995 to 2000, a 1 percent average annual increase above the general inflation rate is caused by deterioration of elements of the DPM system.

f) The rate at which the general and administrative category is calculated increases to 17.5 percent from 1991 to 2000.

Cost Per Vehicle Mile

Tables 8 to 10 illustrate the cost per vehicle mile for each of the scenarios by five year intervals. The CRA forecast for 1990 cost per vehicle mile is $1.22, a reduction from the 1981 figure of $1.31. For 1990, the Scenario One forecast is $1.45, the Scenario Two Forecast is $1.35 and the Scenario Three forecast is $1.24.

By the year 2000, the Scenario One forecast is $1.85, 52 percent higher than the 1990 CRA forecast. The Scenario Two forecast is $1.52, 25 percent above the 1990 CRA forecast. The Scenario Three forecast is $1.34, 10 percent above the 1990 CRA forecast. Based on CRA assumptions, the year 2000 costs should not exceed the 1990 costs.

Comparisons with existing systems of similar technology are difficult due to the paucity of data. For the Tampa SLT system, the 1975 cost per vehicle mile was $0.78 ($1976) and for the Seattle-Tacoma SLT system, the 1975 cost per vehicle mile was $1.34 ($1976).

Cost Per Passenger

The CRA forecast for 1990 cost per passenger is $0.112, a reduction from the 1980 forecast of $0.144. This decrease from 1981 to 1990 is attributable to a forecast increase in patronage. For 1981, CRA forecast annual patronage to be 18 million and for 1990 to be 25 million. This rate of growth is equal to approximately a 3.35 percent average annual increase. Such a high increase would run counter to experiences of large central city transit systems. Based on this optimistic 3.35 percent average annual rate, cost per passenger figures for the three scenarios are shown in Table 11.

Table 8

SCENARIO ONE-COST PER VEHICLE MILE
LOS ANGELES DPM, 1981-2000

Category	1981	1985	1990	1995	2000
Direct Labor	$0.41	$0.45	$0.42	$0.47	$0.52
Fringe Benefits	0.12	0.15	0.14	0.17	0.19
Power	0.33	0.37	0.37	0.42	0.49
Liability Ins	0.11	0.11	0.13	0.13	0.13
Other	0.17	0.18	0.17	0.19	0.21
Subtotal	$1.14	$1.26	$1.23	$1.38	$1.54
General-Admin.	0.17	0.22	0.22	0.28	0.31
Total	$1.31	$1.46	$1.45	$1.66	$1.85

Table 9

SCENARIO TWO-COST PER VEHICLE MILE
LOS ANGELES DPM, 1981-2000

Category	1981	1985	1990	1995	2000
Direct Labor	$0.41	$0.44	$0.39	$0.41	$0.43
Fringe Benefits	0.12	0.14	0.13	0.14	0.15
Power	0.33	0.36	0.34	0.36	0.38
Liability Ins.	0.11	0.11	0.13	0.13	0.13
Other	0.17	0.18	0.16	0.16	0.18
Subtotal	$1.14	$1.23	$1.15	$1.20	$1.27
General-Admin.	0.17	0.18	0.20	0.24	0.25
Total	$1.31	$1.41	$1.35	$1.44	$1.52

Table 10

SCENARIO THREE-COST PER VEHICLE MILE
LOS ANGELES DPM, 1981-2000

Category	1981	1985	1990	1995	2000
Direct Labor	$0.41	$0.42	$0.37	$0.38	$0.39
Fringe Benefits	0.12	0.13	0.12	0.12	0.13
Power	0.33	0.34	0.31	0.32	0.33
Liability Ins.	0.11	0.11	0.13	0.13	0.13
Other	0.17	0.18	0.15	0.15	0.16
Subtotal	$1.14	$1.18	$1.08	$1.10	$1.14
General-Admin.	0.17	0.18	0.16	0.19	0.20
Total	$1.31	$1.36	$1.24	$1.29	$1.34

Table 11

COST PER PASSENGER
LOS ANGELES DPM, 1981-2000

Year	CRA Forecast	Scenario One Forecast	Scenario Two Forecast	Scenario Three Forecast
1981	$0.144	$0.144	$0.144	$0.144
1985	-	0.139	0.136	0.129
1990	0.112	0.134	0.125	0.115
1995	-	0.128	0.111	0.100
2000	-	0.122	0.100	0.088

The 1990 CRA forecast of $0.112 is 20 percent below the Scenario One forecast, 12 percent below the Scenario Two forecast, and 3 percent below the Scenario Three forecast. Available data shows the 1975 Seattle-Tacoma SLT cost per passenger was $0.09. It must be repeated once again that cost figures for a system that has a captive ridership such as an airport SLT system are difficult to compare to a system in a downtown environment.

CRA forecast 1990 fare revenue to be $2 million. At a $0.10 fare forecast by CRA, this equates to 20 million revenue passengers or 80 percent of total forecast patronage. CRA also forecast that fares alone will not completely finance operating costs; a deficit of $800,000 will develop.

Using similar 1990 patronage figures, the Scenario One deficit is $1,346,531; the Scenario Two deficit is $1,119,117; and the Scenario Three deficit is $870,838. To cover the expected deficit, CRA forecast that an additional $1.5 million in miscellaneous revenues and other assistance will have been made available.

Conclusions on the Los Angeles Downtown People Mover

The ease of obtaining capital could blind planners to the price of financing operations.

a) There is a strong possibility of a wide gap between forecast cost and revenue and actual cost and revenue. This is likely to occur because, as stated earlier in this paper, agencies constructing and operating transit projects for the first time do not forecast capital or operating cost accurately; the experience factor is critical.

b) The Los Angeles downtown minibus routes operated by Southern California Rapid Transit District and which parallel the DPM route alignment have attracted a recent maximum ridership (June 1977) of only 11,000 riders per day at a $0.25 fare. The current minibus riders primarily use the system during the lunch hour. To obtain the required ridership forecast by CRA, the City of Los Angeles will have to restrict automobile and bus movement into the central business district. A related factor is the willingness of commuters to transfer to another mode to complete their journey to work, especially if there continues to be abundant, inexpensive parking spaces available within the downtown Los Angeles area.

c) The scenarios illustrate that the availability of subsidies is critical. SCRTD, the minibus operator, is having difficulty obtaining subsidies for operations. One must assume that subsidies for DPM operations will also not be easily obtained.

These statements illustrate that many decision points are involved in the process of making the DPM project a feasible operation. On a positive note, the scenarios show that the constant dollar increase in cost per vehicle mile for 1990 above the CRA forecast is not too severe. The key issue is maintaining a low labor input. The PATCO rail transit operation indicates that such a policy is feasible if the adopted technology is well developed. The SLT systems now operating demonstrate that a low cost per vehicle mile compared to conventional transit operations is possible.

Wilshire-North Hollywood Rail Transit Line

The proposal developed by Southern California Rapid Transit District (SCRTD) suggests that a rail transit line be built to connect Union Station,

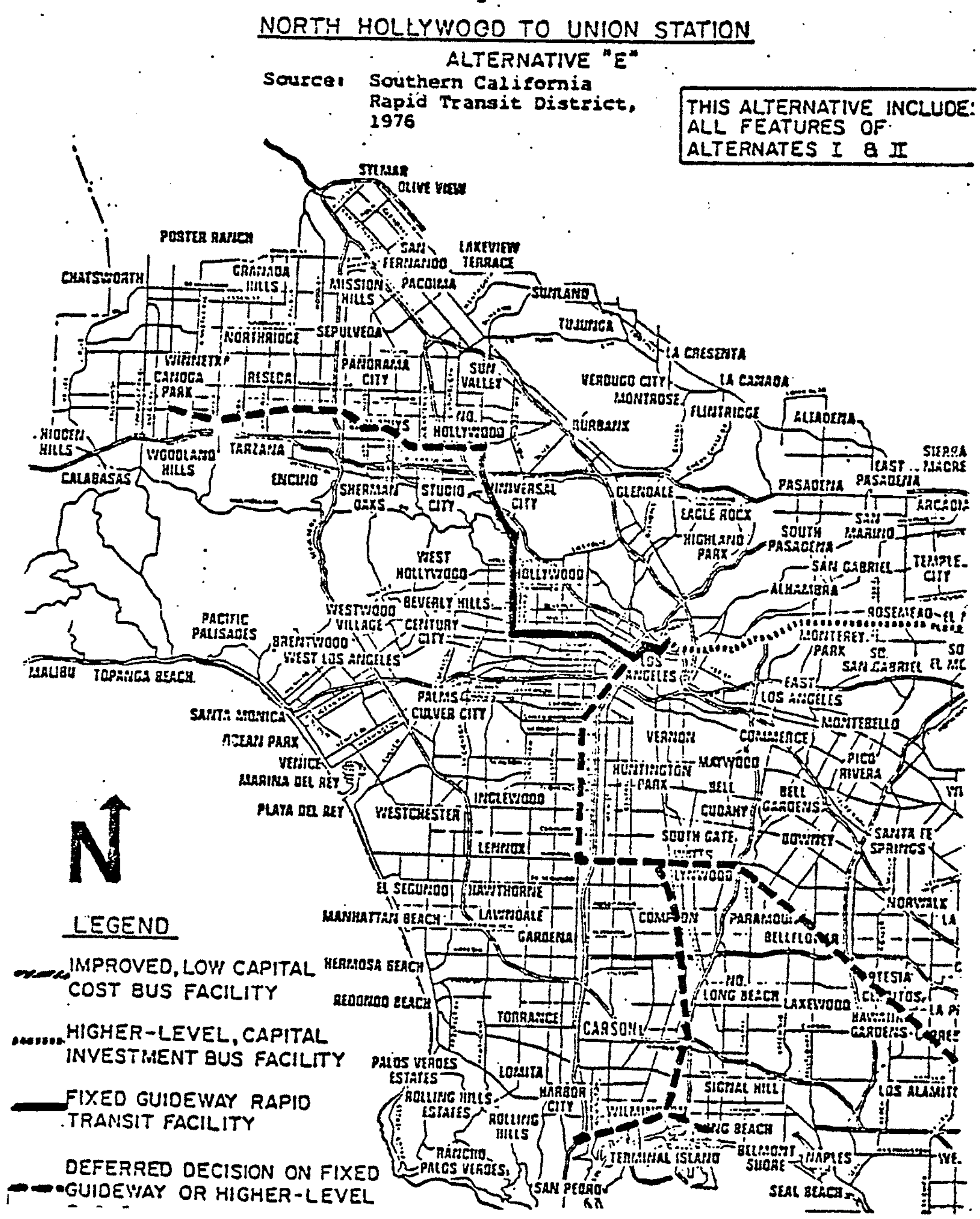

FIGURE 4

Wilshire - North Hollywood Rail Corridor located northeast of the Los Angeles CBD, with North Hollywood in the San Bernardino Valley via Wilshire Boulevard and either La Brea, Highland, or Fairfax Avenues. The fifteen mile transit proposal represents the latest attempt by transit planners and local officials to implement an expensive rail transit system ($1.02 billion 1976 dollars). The current proposal is distinguished from earlier plans in that one route rather than an entire network has been proposed. Federal transit funds and highway funds, state excise gasoline taxes, and state sales taxes can be made available to finance construction.

While the transit technology has not been selected, previous proposals have favored extensive use of automated technology to minimize labor input. The 1976 SCRTD proposal presented only limited operating cost data which appear in Table 12. The operating cost figures are generated from assumptions on the length of the system, the number of vehicles, and amount of required power. The assumptions in the initial SCRTD (1976) proposal were not discussed in depth.

The 1990 estimated annual vehicle mileage is 9.2 million miles. The 1990 estimated annual revenue patronage was not indicated. Estimates of weekday patronage (July 1977) range from 160,000 to 200,000. Based on weekday patronage of 200,000, annual revenue patronage for the fifteen mile SCRTD system should roughly be 52 million. By comparison, in fiscal year 1977, the seventy-one mile BART system carried only 24.6 million revenue passengers.

Table 12

WILSHIRE - NORTH HOLLYWOOD RAIL CORRIDOR OPERATING COSTS - 1990
(1976 Dollars)

Category	Cost (Millions)	(Percent of Total Budget)
Maintenance of Way and Structure	$3.0	(19)
Maintenance of Revenue Vehicles	3.4	(22)
Operating Supplies and Power	2.4	(16)
Transportation	3.8	(25)
General and Administrative	2.8	(18)
Total	$15.4	(100)

Source: Southern California Rapid Transit District, 1976.

Table 13

PATCO OPERATING COSTS - 1975 CALENDER YEAR

Category	Cost* (Millions)	(Percent of Total Budget)
Maintenance of Way and Structure	$1.145	(08)
Maintenance of Revenue Equipment	1.139	(08)
Power	1.511	(11)
Transportation - Direct Expenses	2.136	(15)
General Expenses	8.330	(58)
Total	$14.261	(100)

Source: American Public Transit Association, 1977.
*Cost data are shown in 1976 dollars.

How realistic are the figures shown in Table 12? One method of analyzing their accuracy is to compare them with other rail systems. The PATCO rail transit line discussed in Section 2.1 is approximately the same length as the proposed Wilshire Corridor rail transit line. In 1975, PATCO operated 4.2 million vehicle miles and carried 11.1 million revenue passengers. In Table 13 are 1975 PATCO operating costs taken from American Public Transit Association (APTA) Operating Reports. The format used in that source resulted in a large percentage of PATCO operating expenses being listed in the General Expense Category.

PATCO is cited in the transportation literature as, "well operated and managed" (Vuchic and Stanger, 1973: 13). In 1975, PATCO operated its system, according to APTA (1977) at $3.40 per vehicle mile ($1976). SCRTD proposed in 1976 that it could operate the Wilshire Corridor rail line at $1.67 per vehicle mile. The lower SCRTD estimate and the favorable attention given to PATCO operations makes one question the reliability of the SCRTD estimates. Either the number of annual vehicle miles has been overestimated by SCRTD staff, or the operating costs have been underestimated, or both.

Three Scenarios

The implications of constant dollar change in the rail transit lines are examined in this section. Tables 14 to 16 show the operating cost of each scenario in five year intervals. The initial year of operation is assumed to be 1990. Data are shown in 1976 dollars.

Table 14

SCENARIO ONE - HIGH COST INCREASE, WILSHIRE-NORTH HOLLYWOOD RAIL TRANSIT LINE, 1990-2000
(Millions)

Category	1990	1995	2000
Maintenance of Way and Structure	$3.00	$3.65	$4.44
Maintenance of Revenue Vehicles	3.40	4.14	5.03
Operating Supplies and Power	2.40	2.78	3.23
Transportation - Direct Operations	3.80	4.62	5.62
General and Administrative	2.80	3.41	4.14
Total	$15.40	$18.60	$22.46

Assumptions:

a) Higher labor costs cause each expense category except power to escalate at an average of 4 percent annually above the general inflation rate from 1991 to 2000.

b) Higher energy costs cause power expenses to escalate at an average of 3 percent annually above the general inflation rate from 1991 to 2000.

Table 15

SCENARIO TWO - MODERATE COST INCREASE, WILSHIRE-NORTH HOLLYWOOD RAIL TRANSIT LINE, 1990-2000
(Millions)

Category	1990	1995	2000
Maintenance of Way and Structure	$3.00	$3.31	$3.66
Maintenance of Equipment	3.40	3.75	4.14
Operating Supplies and Power	2.40	2.65	2.93
Transportation - Direct Operations	3.80	4.20	4.63
General and Administrative	3.80	3.09	3.41
Total	$15.40	$17.00	$18.77

Assumptions:

a) Higher labor costs cause each expense category except power to escalate at an average of 2 percent annually above the general inflation rate from 1991 to 2000.

b) Higher energy costs cause power expenses to escalate at an average of 2 percent annually above the general inflation rate from 1991 to 2000.

Table 16

SCENARIO THREE - LOW COST INCREASE, WILSHIRE-NORTH HOLLYWOOD RAIL TRANSIT LINE, 1990-2000
(Millions)

Category	1990	1995	2000
Maintenance of Way and Structure	$3.00	$3.15	$3.31
Maintenance of Equipment	3.40	3.57	3.76
Operating Supplies and Power	2.40	2.46	2.52
Transportation - Direct Operations	3.80	3.99	4.20
General and Administrative	2.80	2.94	3.09
Total	$15.40	$16.11	$16.88

Assumptions:

a) Higher labor costs cause each expense category except power to escalate at an average of 1 percent annually above the general inflation rate from 1991 to 2000.

b) Higher energy costs cause power expenses to escalate at an average of 0.5 percent annually above the general inflation rate from 1991 to 2000.

Cost Per Vehicle Mile

SCRTD staff in 1976 forecast annual vehicle mileage of 9.2 million for 1990. Assuming that output remains constant from 1990 to 2000, then the year

2000 operating cost per vehicle mile for Scenario One is $2.44, a 45 percent increase from 1990. For Scenario Two the operating cost is $2.04, a 22 percent increase; and for Scenario Three it is $1.84, a 10 percent increase. Even with these increases, the 1975 PATCO operating cost per vehicle mile of $3.40 ($1976) is greater than the operating cost per vehicle mile of the three scenarios.

Cost Per Passenger

Comparisons of annual unit costs per passenger among the scenarios and the SCRTD proposal are difficult to make. No information was available at the time of this analysis on the number of passengers transferring to or from the bus system or using only the rail system. If a gross estimate of 52 million annual passenger trips is assumed (based on 200,000 trips per day as shown in the SCRTD proposal), then year 2000 unit cost per passenger ranges from a high of $0.43 for Scenario One to a low of $0.32 for Scenario Three. These $1976 figures are below the $1977 BART unit cost per passenger ($2.02) and the $1976 Chicago Transit Authority subway system unit cost per passenger ($0.81).

Scenario Conclusions

The scenarios illustrate that the SCRTD estimates of input costs and service and performance data yield unit costs per output which are below currently operating rail transit systems. SCRTD staff and consultants should recalculate the data in more detail, item by item, as was done by the Los Angeles Community Redevelopment Agency for the people mover project. As now presented, funding agency officials would have difficulty evaluating proposed operating cost data.

The technology to be used in the system should be clearly identified. Is it currently operating with minimal problems? How much reliance is placed on computers? What would be the unit operating cost per vehicle hour during peak periods versus off-peak periods and the unit operating cost per passenger during peak periods and off-peak periods?

Based on the experience of PATCO, the most efficiently operated rail transit system, some operating subsidies are necessary. From what source will SCRTD subsidies be generated? What is the relationship between projected operating costs and benefits and what taxpayers are to finance? Does the financing of the rail transit system jeopardize existing bus service; will bus fares rise because of problems with the rail transit system? Development of several scenarios could help SCRTD planners analyze implications of different trends.

Summary of Findings and Policy Implications

Recent fixed guideway project proposals have emphasized the use of advanced technology. The operating experience of PATCO reveals that automated technology can improve the operating efficiency of rail transit if it is kept simple and adapted to the existing state of the art. Attempts at adapting the existing state of the art to new computer technology have not prevented rail systems such as BART from incurring very large operating deficits. UMTA officials, having learned from these new rail transit systems, are taking a more conservative approach to testing whether people movers can replace existing downtown circulation systems. Already proven in airport environments, SLT technology was selected for testing in downtown environments rather than a more complex alternative.

In the past, there has been little emphasis given in the preparation of new fixed guideway proposals to implications of constant dollar increases in operating inputs. Officials are interested in understanding the implications of escalating operating costs on availability of revenues and subsidies and how operating cost estimates are related to funing, but too often fixed guideway operating costs have been estimated with considerable unreliability. As a result, it is extremely difficult to know if the data presented have any validity. Transit operators who originate and advocate fixed guideway transit proposals know that high operating cost estimates will decrease support for the proposal. Therefore, they have a strong incentive for publicizing the lowest cost estimates.

The expense of new people mover and rail transit projects has prompted UMTA to issue policies requiring analysis of alternatives. Scenarios can easily be included in the analysis. They are shown in this paper to be a useful planning technique to evaluate proposed operating costs over a specified time period, and they can offer transportation policymakers and professionals a linkage between knowledge of existing trends and impacts of alternative futures.

Scenarios are used to examine the implications of cost increases above the general inflation rate for the proposed Los Angeles Downtown People Mover and Wilshire-North Hollywood Rail Transit Line. According to 1976 data, the Los Angeles Downtown People Mover can experience higher operating costs if the optimistic annual ridership increase of 3.35 percent is not achieved. The scenarios also illustrate that financial problems may occur if assumptions about labor costs and the ability to solve technological problems are inaccurate. However, when compared to existing systems the estimates are prudent.

For the Wilshire-North Hollywood Rail Transit Corridor the scenarios show that the SCRTD estimates of input costs and service and performance data yield unit costs which are below currently operating rail transit systems. In addition, analysis of the Wilshire Corridor rail line proposal reveals a paucity of detailed operating cost data. Since SCRTD is basing operating cost estimates on other systems, the validity of their estimates should be evaluated. At this time (July 1977), it would be impossible for the appropriate officials to determine project worthiness based on project operating costs. Suggestions are made as to the variety of data needed by the transit agency staff. An appropriate agency for evaluating the SCRTD project data is the Los Angeles Transportation Commission since it is close enough to the location of the project and the agencies involved. The Commission, created by state legislation in 1976, has authority to approve or reject regional transportation proposals.[7] The project data should also be released for study by local officials and the public.

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[7] AB 1246

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APPENDIX A

SELECTED COST FIGURES

Table A1

PROPOSED LOS ANGELES DOWNTOWN PEOPLE MOVER
OPERATING COSTS

LENGTH	2.69 Miles - Double Guideway		
STATIONS	11		
		INITIAL	1990
VEHICLES		46 operating 1,979,000 mi/yr	50 operating 2,308,200 mi/yr
OPERATIONS	Two men on duty at all times, 1 supervisor + 1 dispatcher 14,136 manhours/year	$ 90,950	$ 90,950
MAINTENANCE			
Supervision	1 supervisor + 1 clerk on a shift, 1 clerk on second shift, 6240 manhours/year	47,840	47,840
Vehicles Labor-Repair	Major shift - foreman 2 mechanics, 2 electricians, 2 laborors. Other shifts - 1 mechanic 1 electrician. Total of 24,616 manhours	196,470	196,470
Inspector & Hostlers	1 inspector, 1 hostler all shifts 14,136 manhours	110,215	110,215
Cleaning	1 washer/1 cleaner on 2 shifts, 8,320 manhours	58,530	58,530
Materials	20% of vehicle labor		
Spare parts	$365,215	73,040	73,040
Contract	$0.02/veh mile	39,580	46,160
Work	$1000/veh/yr	46,000	56,000
Way & Structures Labor	Major shift - foreman mechanic, electrician, laborer, orther shifts - mechanic & electrician 20,416 manhours/yr	166,180	166,180
Materials	40% of Way & Structure Labor	66,470	66,470

Stations Labor	1 foreman, 3 cleaners - 1 shift 8,320 manhours	$ 58,675	$ 58,675
Materials	Cleaning/Refurbish/Miscellaneous $800/Sta/Yr x 11	8,800	8,800
Contract Work	Escalators - $2400/yr x 30	72,000	72,000
	Elevators - $2000/yr x 13	26,000	26,000
FARE COLLECTION	2 money collectors, 1 shift - 4,160 manhours	32,860	32,860
SECURITY	1 guard full time at Yard & Shop - 8,760 manhours	57,965	57,965
LIABILITY COVERAGE	Self-insured, claim settlement fund based on $0.012/pass	216,000	302,800
POWER	Propulsion - vehicle miles x 6.8 Kwh per vehicle mi + 8 % line losses 11 stations -	1,979,000 veh/mi	2,308,000 veh/mi
	11 stations - 3,358,000 Kwh/yr.	21,608,000 Kwh	24,268,000 Kwh
	Maintenance 1,752,000 Kwh/yr + 10% Contingency @ 0.03 Kwh	648,240	728,000
SUBTOTAL DIRECT COST		$2,015,815	$2,198,955
LABOR FRINGES	30% of Direct Labor ($819,685)	$ 245,905	$ 245,905
SUBTOTAL		2,261,720	2,444,860
GENERAL & ADMINISTRATION	Cost of General & Administrative support of operating division @ 15%	$ 339,260	$ 366,730
TOTAL O & M COST	Cost per passenger - $0.144 (initial), $0.122 (1990) Cost per vehicle mile - $1.31 (initial, $1,222 (1990)	2,600,980	2,811,690

SOURCE: Los Angeles Community Redevelopment Agency, 1976

Table A2

OPERATING FINANCIAL PLAN

LOS ANGELES CENTRAL BUSINESS DISTRICT
CIRCULATION/DISTRIBUTION SYSTEM

(1976 dollars)

	Initial (18 million annual trips)	1990 (25 million annual trips)
-OPERATING COSTS-		
Operating	$2,600,000	$2,800,000
-REVENUES-		
System Revenue		
Fares	1,360,000	2,000,000
Misc.	200,000	300,000
Special Revenue Sources	430,000	1,200,000
	1,990,000	3,500,000
SURPLUS (Deficit)- (not including Mini Bus saving)		
	$ (610,000) excluding Mini Bus savings	$ 700,000 excluding Mini Bus savings
	$ 140,000 including Mini Bus savings	$1,750,000 including Mini Bus savings

Table A3

PROPOSED SCRTD
RAIL TRANSIT OPERATING AND MAINTENANCE UNIT COST
(Jan. 1976 Cost Basis)

Item	Unit Measure	Light Rail	Conventional Rail
Maintenance of Way			
Track	VMT	$0.135	$0.135
Yards & Shops	Vehicle	$3,500	$3,500
Electrification	VMT	$0.045	$0.045
Station	Station	$25,000	$25,000
Parking	Space	35	35
Control & Communication	Track mi.	$5,500	$5,500
Maintenance of Vehicle	VMT	$0.24	$0.31
Power			
Vehicle	VMT	$0.20	$0.20
Stations	Station	$12,000	$12,000
Yards and Shops	Lump Sum	$20,000	$20,000
Transportation			
Vehicle Operators	VMT	$0.135	$0.135
Stations (minor)		$72,000	$72,000
Stations (major)		$112,000	$112,000
Security	Lump Sum	$530,000	$530,000
Control	Lump Sum	$630,000	$630,000
General & Administration	Percent	0.221	0.221
Contingency	Percent	0.20	0.20
Nominal Unit Cost	Vehicle-mile	$1.51	$1.63

SOURCE: Southern California Rapid Transit District, 1976: Part C, p. 20.