OPERATING AND MAINTENANCE COSTS OF LIGHT RAIL TRANSIT

Ronald DeGraw, Southeastern Pennsylvania Transportation Authority

This paper explains the costs of operating light rail lines, and it explains how light rail can be more economical than other modes under certain conditions. Using 3 recent studies of proposed light rail lines as examples, the paper shows that new lines can be economically constructed and operated with a potential ridership of as little as 20,000 daily passengers. The self-service fare system used on European light rail lines is explained, and an opinion is given recommending that such a system could be implemented on new light rail lines built in the United States. Relatively fixed maintenance costs, high passenger-to-operator ratios, and multiple-unit capabilities make traffic increases on light rail lines much more economical to accommodate than on bus lines. The paper details how light rail lines have high passenger carrying capabilities (as much as 20,000 passengers/h) yet need relatively low passenger loads (only 20,000 passengers/day) to economically justify implementation and still have sufficient revenue to cover all operating costs. Also discussed are the ease of implementation, the versatility of the mode, and passenger acceptance and preference.

Many cities now are considering the construction of new light rail lines. Some cities, such as Dayton, Ohio, already have undertaken feasibility studies. The Dayton study is interesting. It concludes that a 12-mile (19-km) light rail line constructed partly on an existing railroad freight right-of-way and partly on downtown streets would produce an initial daily ridership of 20,000 passengers. The rail line would be supplemented by a 10-bus feeder system at outlying stations. A flat fare of 40 cents would be charged, and transfers would be free. There would be no complicated zone fares, nor would passengers have to pay extra to transfer to the buses.

It is estimated that the annual operating costs for a fleet of 48 rail cars and 10 feeder buses would be 2.3 million dollars, all of which would be offset by revenues.

By the year 2000, daily ridership would have risen to 48,000 passengers, which would require 99 rail cars and 17 buses. Annual revenue would then amount to 5.4 million dollars; total operating expenses would be only 3.7 million dollars. This would produce a surplus of 1.7 million dollars. This means that, although the number of passengers would more than double, operating expenses would increase by only about 60 percent.

This interesting situation is due to 2 principal factors. Two of the largest expenses in operating a rail line are maintenance of the right-of-way and personnel required to run the service. A doubling of passengers does not require a doubling of maintenance-of-way expenses. Right-of-way expenses are relatively fixed costs, and, although it is true that more traffic results in more wear and tear to the roadbed and stations, the increase is not proportional.

An increase of passengers on a bus line results in a directly proportional increase in the number of people required to operate the buses. But this is not necessarily true with a light rail line. Just as subway and rapid transit lines can operate up to 10-car trains with only 1 or 2 in a crew, so, too, can light rail lines take advantage of longer trains.

It has long been an established practice in some European cities to operate light rail trains of 2 or 3 cars that accommodate as many as 350 passengers with only 1 operator. Five buses would be required to carry the same number of passengers. This is accomplished by use of a self-service system. Persons paying cash fares board the first car where the motorman is stationed. But passengers with tickets may board the following cars by pushing a button on the exterior of the cars that causes the doors to open. Once they are inside, passengers have their tickets validated by a small machine similar to the machines used until recently by the Chicago Transit Authority to validate transfers. A passenger must keep the ticket for the duration of the trip and must show it to roving inspectors. A stiff fine is imposed on any passenger who does not have a validated ticket. This system works well in Germany, and German authorities are convinced that there is little cheating.

Such a system has never been attempted in the United States, and there is certainly some doubt about how well a self-service system would work in large Eastern cities where it is already great sport to try to "beat the system." But it probably would work in many other areas of the country. The Dayton study is predicated on the use of this type of system.

Such a system has a very obvious effect on operating costs. A newly constructed light rail line may operate on a 20-min headway for the midday base period. As the line becomes more popular and attracts more riders, it might be necessary under customary operating conditions to increase the headway to every 10 min and double the number of operators. But, if an automatic fare validating system is used, 2-car trains could be run every 20 min with only 1 operator on board, which would cut personnel costs in half.

The operation of 3-car trains with a single motorman would result in even greater savings per passenger.

Advocates of light rail lines frequently say that a double-track line can carry up to 20,000 passengers/h in 1 direction. These are staggering figures, and they tend to scare smaller cities into thinking that they may not have enough riders to justify constucting light rail lines. The Dayton study, however, predicts initial ridership of only 20,000 per day and claims that construction of a new line for even this small a number of passengers can be economically justified.

It further claims that a new system unfettered with expensive and intricately sophisticated gadgetry can meet all of its operating expenses.

The Media and Sharon Hill lines of the Southeastern Pennsylvania Transportation Authority (SEPTA) carry 15,000 daily passengers. The Norristown High-Speed Line carries about 9,500. The 2 Shaker Heights Rapid Transit lines have a daily volume of 13,500. The line in Newark carries 14,000 daily passengers.

No formula exists that requires a certain number of passengers per hour or per day to justify construction of a light rail line. There are no guidebooks to use to find out whether an area has the potential to build a line. And, unfortunately, there has been no new line constructed in the United States in the last 20 years that could be observed as a model light rail operation. One has to go to Europe for that.

The feasibility of a light rail line depends largely on local conditions. A system that already has light rail lines might encounter union problems if it wished to operate a new line with only a single motorman for a 3-car train. A city in which light rail transit would be new probably would not have that problem.

Operating and maintenance costs on most existing light rail lines in the United States do not tell the whole story. They are higher than those that a new line would incur for a variety of reasons. In many cases, rights-of-way have been permitted to deteriorate, and a transit authority would have an accelerated and costly catch-up program. Cars are old; therefore, their maintenance costs are very high. And, because the cars are old, they are not adaptable to 1-person operation. They are also less reliable and less attractive because of their age.

Most existing light rail lines do not have adequate grade-crossing protection. They lack the crossing gates that would permit faster and, therefore, less expensive operation.

One of the major attractions of light rail transit is its flexibility. It can run in high-speed subways (such as in Philadelphia, Boston, and soon in San Francisco), in the streets, on elevated structures (as in Boston), and on private rights-of-way with no grade crossings (such as Boston's Riverside Line). Its private way can be crossed by many highways (as in Shaker Heights and the SEPTA Red Arrow Division); it can run in the medians of highways (as in Shaker Heights and Boston); it can use abandoned railroad rights-of-way (as in Boston); and it even can run in the bed of an abandoned canal (as in Newark).

The facilities supporting a light rail system can be extremely simple and, therefore, are economical to build and maintain. Stations can be simple blacktop platforms with small 3-sided shelters. Expensive high-level platforms are not necessary, nor are large station buildings, intricate fare collection devices, or cashiers. Routine maintenance costs for such stations are low, particularly in areas where vandalism is not a major problem. Areas that involve street running may simply use curbside loading with no station facilities or special platforms. If operating speeds are not high, wayside signals may be omitted except on curves and at junctions or single-track areas, thereby reducing maintenance costs.

Using single track on lightly trafficked portions of a route can help reduce maintenance costs. However, it also can produce some expensive head-on collisions.

Elaborate terminal facilities are often not necessary. Pittsburgh, for example, has no off-street facilities in its downtown area. Neither do many Philadelphia lines. They simply operate on downtown streets. This can result in a considerable saving in the personnel and maintenance costs required to operate a terminal facility.

Unlike railroads and heavy rapid transit lines, there are usually no yard crews or control tower operators employed on light rail lines. Train operators throw their own switches, manually or automatically, even at major junction points. And they take their own cars to and from storage areas. This creates a large saving in personnel costs.

Existing railroad rights-of-way are the real hope for building new light rail lines in the United States. A recent study for Bergen County, New Jersey, considered the feasibility of converting a Penn Central freight line into light rail service. Passenger service on the 14.5-mile (23.3-km) West Shore Line was abandoned in 1959; now the communities along the line are seeking to reinstitute commuter service into New York City.

The study found that light rail transit, although more expensive to build than conventional railroad commuter service, would have lower operating and maintenance costs. Light rail transit also would operate at higher speeds and offer more frequent headways, thereby providing a more marketable service.

The medium level of ridership contained in the report would result in an operating deficit of about 500,000 dollars/year with conventional rail service and an operating surplus of about 750,000 dollars/year with light rail transit.

A 1971 study of the feasibility of light rail transit for Rochester, New York, concluded that operating costs for light rail transit would be 24 percent lower than bus costs chiefly because the use of light rail transit would require 43 percent fewer operators.

The most expensive item in most transit systems is operators' wages. Light rail transit technology offers the advantage of operating 2-, 3-, or even 4-car trains with a single operator. It now costs approximately 17,000 dollars/year for each operator. Therefore, substantial savings can result from 1-person operation of a train.

There are many costs associated with rail transit that are not necessary in a bus operation, including the maintenance of track, signals, bridges, substations, fencing, and stations. All of these expenses accumulate, and, in many cases, they create a situation in which it is more expensive to operate light rail transit than it is to operate buses.

I am not trying to imply that all buses should be replaced by light rail lines. That would be foolish. There is no question that the bus is an extremely important public transportation vehicle and will remain so. There are many situations in which a bus is the cheaper vehicle and is the most practical mode of transportation. But there are many other situations in which rail lines will perform better and more economically than bus lines, particularly on heavy corridors into a city.

An example of a more economical operation would be where numerous bus routes come from a city in the same general direction on a major highway corridor, then fan out to serve various suburban areas. A light rail line might replace the bus lines on the trunk corridor. The bus lines would then be relegated to short suburban routes feeding into the nearest light rail station. Such a situation probably would reduce the number of operators needed to maintain the total transit service and would provide a speedier, more comfortable, and more economical ride for passengers.

There is considerable evidence that passengers prefer light rail lines to bus routes. According to the American Public Transit Association, passengers per route mile (kilometer) on surface rail lines dropped 11 percent in the 16 years between 1955 and 1971. Passengers per route mile (kilometer) on bus lines throughout the nation dropped 52.5 percent during the same period. Many passengers seem to feel that rail lines are easier to use because there is no question of where they are and where they will stop. Bus routes tend to wander, and there is no visible evidence of where the bus runs. Operators of transit buses tend to create various spurs, alternates, and extensions to their bus routes, many of which confuse passengers. Light rail cars have more comfortable seating and aisle space and a smoother ride than buses.

Perhaps the most important attribute of light rail transit is that its flexibility permits it to grow with the needs of a region. An initial line can be constructed inexpensively, and then can be upgraded gradually to permit higher speeds and greater frequency as money becomes available and as patronage increases.

This flexibility is not inherent in most other forms of transportation. Its presence in light rail transit permits maximum economies in both construction and operation.

REFERENCES

1. Comparison of Bus and Rail Modes: Line Haul Service Henrietta-Charlotte, Rochester, New York. Corddry, Carpenter, Deitz and Zack, Engineers, 1971.
2. Feasibility Study of Light-Rail Transit Service in the Southeast Corridor, Dayton, Ohio. Louis T. Klauder and Associates, 1973.
3. Preliminary Analysis of Rail Passenger Service in the West Shore Corridor. Louis T. Klauder and Associates, 1974.
4. S. F. Taylor. Urban Transportation—Another Alternative: A World-Wide Survey of Light-Rail Technology. Heritage Foundation, Inc., Washington, D. C., 1974.