firmed our original study: light rail in the Guadalupe Corridor. But now the project cost was up to $130 million.

Then we had the pleasure of beginning the Guadalupe Corridor Study, our Project Level Alternative Analysis, and Draft Environmental Impact Statement. The cost was another $1.5 million and 2 more years. And we were not surprised to see light rail, with an adjacent expressway in some sectors, again recommended for our Guadalupe Corridor. But now the cost had increased to more than $180 million for the rail portion of the project.

After 4 studies over 9 years, each confirming the prior findings, a cost of almost $4 million, and construction costs that have more than doubled, we are ready to begin preliminary engineering and publication of a final EIS.

This is no marginal project:

- Less than $10 million a mile total project cost.
- More than 42 000 riders per day expected to start.
- More than 5000 riders per hour in peak periods.
- More than 80 percent of the right-of-way in public ownership already.
- A two-directional payload paying 85 percent of the operating cost from the farebox.
- A virtually unanimous local consensus with an 85 percent popular vote in favor of the plan.

And we have just been advised by UMTA that we have been turned down on our request for a $2 million preliminary engineering grant because we are a "new start." So, we are going ahead—with a promised federal letter of no prejudice—on our own, with state aid.

A joint powers agreement signed with the state on March 26 gives the state the expressway portion and our transit agency the light rail portion of the project. We are looking for added help from the California Transportation Commission and also considering various local financing options including assessment districts, revenue bonds, sale and lease-back of vehicles, and bank robbery if needed. Most important, we are going to build a light rail system in Santa Clara County—if we have to drive every spike ourselves.

As in many areas across the nation, we in Santa Clara County are ready to proceed with the interurban transit system of the 21st century—light rail. We have proved, using the federal government's own criteria, that it is cost-effective and it will work. We have tremendous needs that, if left unmet, will jeopardize our economic and environmental viability in the near future. We have no choice. So what do we—what do you—need to do next?

- First, we must systematically and comprehensively spread the message of the virtues of light rail to the public. Let us reestablish the National Transit Advocacy Network that was effective in persuading the early Carter administration that adequate transit capital funding was essential to economic vitality. This group of transit representatives of the National Association of Counties, League of Cities, American Public Transit Association, AMTRAK, and others focused on subject areas of common agreement and was very effective in building the Section 3 capital funding to an acceptable level.
- Second, we must demand that transit, especially cost-effective light rail, be a major priority at the local, state, and especially the federal level.
- Third, we must insist that the federal red-tape studies be reduced to a single, combined alternative analysis, EIS, and preliminary engineering efforts that should lead to a speedy approval or disapproval by UMTA.
- Fourth, we must support the approval of transit capital grants based on cost-effectiveness and proven need, not on whether the system is a "new start."
- Fifth, we must take the risk to advocate for new transit funding sources while attempting to protect traditional allocations.

Most of all, we must retain a consensus and remain focused on the broad objective of promoting cost-effective light rail transit. We must not allow our efforts to be fractured into disastrous competition among transit agencies for inadequate and dwindling dollars. The American transit community must join together because the total system must have priority or our total economic system could fail.

Evolution of Light Rail in Europe Since 1977: Trends, Future Perspectives, and New Approaches

ANTOINE LOMBART, Transurb Consult Brussels

In the first half of this century trams had to carry the main burden of public passenger transport in most European cities and in many cities on other continents. The tram was an important part of urban transport, even in cities with over a million inhabitants where rapid transit systems (metropolitan and suburban railways) already existed.

The middle of the century saw the beginning of a structural transformation in transport characterized by a double shift: from public transport to private cars and within public transport from the tram to the motorbus. This trend first became apparent in the United States, where the number of tram passengers declined rapidly—e.g., from 7.3 to 0.6 billion passengers per year between 1935 and 1958. This process occurred about 20 years later in European cities.

The rapid increase in the number of cars greatly impeded the operation of public transport and deprived the tramway of its most important basis: the provision of a punctual and regular service. The desire to own an automobile increased to the same extent that the attractiveness of the tram diminished. Although understandable at the time, the mood of euphoria that greeted the car, which was believed would solve the transport problem in towns and cities, often affected the decision to the disadvantage of the tram. More and more roads were built to give the car its due place. The old tramways interfered with the cars and were eliminated in many cities, where the infrastructure in the center or at the side of the road hindered parking and loading. The aim was to limit public transport to a few bus routes, and in the cities with over a million inhabitants to a metropolitan railway, for those of modest means.

In some European countries—e.g., England and France—trams were dispensed with almost entirely, whereas in others—e.g., Belgium, Germany, The Netherlands, Italy, Austria, Switzerland, Sweden, and the East European countries—they still remained the main form of public transport in many cities; less frequently patronized tram routes were converted to bus services.

In Europe, the following trends were already evident in the 1950s with regard to the form of public transport:

- Many smaller and medium-sized towns with up to about 200 000 inhabitants dismantled their tramways and switched to buses. In many cases they were old, sometimes historic towns, where trams could operate only on a single track or where the development of efficient sections was not possible for town planning reasons and was also often not financially justifiable.
- Large cities with populations between about 200 000 and 1 million retained the tram as the main form of public transport. However, the motorbus acted as a feeder to rail transport and supplemented it to an increasing extent.
- Cities with over a million inhabitants extended their rapid transit networks (metropolitan and suburban railways) and gradually eliminated their tramways at the same time. Here, too, buses performed feeder and supplementary functions on an increasing scale.

Exceptions to this trend were limited to only a few towns and cities. It is now clear that the trend initiated at that time proved to be correct. Basically, this also applies to comparable cities in other countries, in which the initial situation was similar to that in Germany. However, it was always necessary to continue to develop public transport—i.e., to make it more attractive in order not to fall further behind in the competition with the car. For the tram this meant that it had to extricate itself as far as possible from interference by private transport and provide punctual and fast public transport services with modern vehicles. The outcome of all measures based on this objective is a low-budget, high-quality public transport system—light rail transit.

This policy was pursued in Brussels (1 million inhabitants) from 1964 on. Sound studies and analyses led to the opening of the first light rail section in 1969, initially called semi-metro, later premetro. A comparison of the costs of investment and operation of this 10-year-old experiment with those of a "proper" metropolitan (heavy rail) system clearly indicates the numerous qualities of light rail and the soundness of the efforts undertaken to promote its realization.

This method was evoked by Vukan R. Vuchic in his paper, Current Trends: Problems and Prospects of Light Rail Transit (TRB Special Report 182, 1978).

BACKGROUND

Since 1978 the Commission of UITP has defined light rail as a railbound form of transport that can be developed in stages from a modern tramway to an underground or elevated transport system. Each development stage can be the final stage but should permit further development to the next higher stage.

Light rail systems can either be developed gradually as the main form of transport from an existing tramway or newly built as the only rail transport system in its catchment area or to supplement an existing rapid transit system.

Each of the three possibilities has been translated into practice, the development of light rail systems from existing tramway networks being encountered most frequently.

In 1978, 97 cities were planning, studying, modernizing, or constructing tramway or light rail networks. In 1982, there are 134—an increase of almost 40 percent (Table 1).

During construction of the light rail system, short sections of the network can be put into service immediately after completion and thus be used to improve city transport services without delay.

It is not always necessary to transfer large sections of the rail network to the second level. Construction of special rights-of-way at street level in conjunction with complementary measures, such as the control of signals for general traffic by the light rail vehicles, may also produce the desired effect.

In city centers, where traffic is concentrated in a confined area, it is often impossible to make sufficient space available on roads for separate tracks for light rail systems. In such cases the light rail sections involved are generally constructed underground, thus not only making rail transport totally independent of other traffic and able to operate without interference in its most important and busiest catchment area, the inner city, but also creating the possibility of replanning the city center and adapting it to public needs and requirements. Many cities utilize this opportunity to revitalize their centers. In particular, large continuous pedestrian precincts are created, where—shielded from street noise and away from exhaust fumes—people can again move freely and feel at ease. In addition, it is noticeable that the business communities have also invested large amounts in response to the investments by local authorities in the attractive redesign of their city centers. Revitalization of the city centers has an extraordinarily beneficial effect on urban public transport, whose passengers were already traveling mainly to destinations in the city centers, by increasing the numbers of passengers. Conversely, our city centers are also dependent on attractive public transport. Because they attract large volumes of traffic into an area where there is relatively little space for movement and parking, the city

Table 1. Cities planning, studying, or constructing tram or light rail networks.

Location	Before 1978	Situation in 1982	Increase
America	12	34	22
Africa	4	8	4
Eastern Europe and U.S.S.R.	25	25	-
Western Europe	51	60	9
Asia	3	5	2
Australia	2	2	-
Total	97	134	37

centers can continue to function properly only if they are served by space-saving, high-capacity public transport. Light rail is most suitable for this purpose in medium-sized cities.

The results of traffic surveys and investigations in several cities clearly illustrate the success of light rail. Although conditions in individual cities vary, it is still possible to make some basic statements.

Traveling times have been shortened (sometimes even halved), late running greatly reduced and often totally eliminated, and the number of available seats significantly increased (sometimes doubled) on the light rail lines. The improvements in the services offered have led to greater increases in the number of passengers. In several countries increases between 20 and 60 percent are recorded for light rail compared with the trams previously operating on the same routes. It is significant that car drivers have also been convinced of the improved service and induced to switch to public transport. Some results of a sample survey of households conducted in 1978 in the catchment area of light rail line A in Hanover are of interest in this context:

- 78 percent of all trips to the city center are made by public transport.
- 50 percent of all persons who continuously have a car at their disposal nevertheless use public transport for their journeys to the city center.
- The modal split of about 40:60 (public transport to travel by car) in the entire urban area is reversed in the immediate catchment area of the light rail system—i.e., about 60:40 in favor of public transport.
- Over 90 percent of the persons interviewed thought that light rail satisfied the most important criteria for successful public transport—namely, punctuality, regularity, comfort, and speed.
- 91 percent of the persons interviewed considered that the money spent on light rail was a good investment.

There is every reason to believe that light rail will continue to be successful. Conditions in the energy sector and the far greater public awareness of the environment will also have an effect. With an average number of passengers, modern light rail vehicles consume per passenger only about one quarter of the energy consumed by a car. If it is desired to save energy in the transport sector, this can be achieved most effectively by persuading motorists to make greater use of public transport. However, this is conditional on the provision of attractive services. All components of the urban public transport system must therefore reach the same high standard.

DEFINITION OF LIGHT RAIL

Light rail is a rail-borne form of transport that can be developed in stages from a modern tramway to a form of transport operating underground or on viaducts. Each stage of development can be the final stage but should permit further development to the next higher stage.

Unlike metropolitan railways, light rail is not a self-contained system. Light rail has many features of the tramway and also of the metropolitan railway that are more or less distinct according to the stage of development.

The stages of development differ from each other in the standards of construction of the track and of the stations—including the signal system—and also in the design of the vehicles.

The various stages of development are not necessarily in the order of the following discussion. On the contrary, the development of a light rail system is determined primarily by the objectives and by local conditions.

- Own right-of-way—In one of the first stages, the light rail lines should be separated from other traffic by construction of their own rights-of-way in the roadway. Intersections with car traffic are retained initially. However, intersections with pedestrian traffic should be avoided in city centers, particularly in pedestrian zones (separation, under- or overpasses). At road crossings the light rail system is initially incorporated with equal priority in the phase sequence of the signal system. The trains operate by sight.
- Tunnel sections in city centers—In many cities space is greatly restricted, particularly in the city center; separate tracks cannot be constructed. In this case the rail traffic must be put underground. The light rail tunnels are usually sited immediately below the roads. The tracks are designed to permit high speeds. Train protection in the tunnel sections can be developed in different ways, from operation by sight to a train protection system designed to metropolitan railway standards.
- Tunnels and underground branches in city centers—As tunnel sections advance in the city center, branches are also laid underground. As on a metropolitan railway, the branches are made without crossings. Light rail operation with short intervals between trains calls for train protection systems.
- Short tunnels on outer sections—Light rail tunnels are also constructed on outer sections that cannot be provided with their own right-of-way because of existing development or where a track suitable for light rail vehicles cannot be laid on the road. These tunnel sections should be kept short because of the high construction and operating costs.
- Extensive elimination of grade crossings on the outer sections—At intersections with car traffic, the light rail line passes under the intersection if there is heavy cross traffic. At other crossings, priority is given to the light rail system in the signaling system, the traffic lights being controlled to give priority to light rail movements. Pedestrian crossings are generally replaced by footbridges or underpasses. Extension of train protection equipment from the tunnel to the outer sections is advisable to increase the traveling speed and to shorten the intervals between trains.

This last stage completes the development of light rail systems; except for a few crossings, they operate completely independently of other traffic. In addition to this development, there are also various stages of development of the vehicles used on light rail lines. These stages have a significant effect on the design of the platforms in the tunnel and on the outer sections. In a light rail operation with trams, the modern trams used in the first stages run partly on tracks designed for light rail vehicles but also on conventional tram tracks. The platforms in the tunnel are divided into a tram area (low platforms) and a light rail area (high platforms) and thus permit mixed operation.

EUROPEAN TRENDS IN THE DEVELOPMENT OF LIGHT RAIL TRAFFIC

France

The case of France is typical. Before 1940 many French cities possessed a tramway network. After World War II, however, trams gave way to buses. Saint-Etienne, Marseille, and Roubaix-Tourcoing were the only cities that stayed with tramway operation; Saint-Etienne and Marseille have bought PCC vehicles that were also delivered to the United States. As in music halls, the present trend is retrograde. The most advanced light rail project is planned by the city of Nantes. It is part of the public

transport policy of the new government, and there is hope that its operation can start at the end of 1983 or the beginning of 1984. In Grenoble a basic decision was taken to construct a 10-km light rail line. In Toulouse studies were undertaken on the construction of a 3-km tunnel section in the city center, causing the cost of the light rail project to increase by 40 percent.

Among the various light rail projects, the Strasbourg plan deserves special attention because the last tram line there was only replaced by a bus line in 1960, but the city has the intention of turning back to rail traffic.

Belgium

In Belgium, the cities of Brussels, Antwerp, and Charleroi continue the development of the light rail projects; 6.8 km of light rail tunnel are under construction in Brussels. Moreover, a second tunnel section was opened in Antwerp in March 1980, while an extension of 1.1 km with two stations was put into operation in June of the same year.

At present Brussels has a conventional metropolitan railway, which links the city center with the eastern suburbs. The line is being extended westward. It is envisaged that it will traverse the city from east to west with a length of about 20 km by 1982. Various tunnel sections, each 2 to 3 km long, are currently being used by trams and form the so-called premetro. These tunnels form part of three lines: north-south axis, inner circle, and outer circle. They have metropolitan railway cross sections and are designed for conversion to metropolitan railway operation. These installations are part of the gradual implementation of a general plan to improve the transport network that was drawn up in 1965 and envisages completion of a metropolitan railway network with 5 lines and a total length of about 60 km by 1990. This plan provides for gradual completion and commissioning of the installations, which are to be operated initially as a premetro for a short or longer time—i.e., with trams operating on the surface outside the installations.

The ultimate aim of long-term planning is the metropolitan railway. All installations are designed so that they can be subsequently integrated in the final and relatively close-knit metropolitan railway network originally envisaged. In the short and medium term, however, it is planned to operate the installations with vehicles that are neither metropolitan railway rolling stock nor tramcars but form an intermediate solution—i.e., light rail vehicles that can operate on all roads and even on relatively narrow traffic routes in the city.

This policy of using vehicles that can operate anywhere and embody characteristics between those of conventional metropolitan railway rolling stock and tramcars allows all major effects to be concentrated at points where traffic conditions are particularly difficult. Without calling into question the extension of the conventional metropolitan railway, the policy proposed in Brussels envisages abandonment of the expensive extensions toward the suburbs in the medium term, because public transport vehicles can still operate relatively unhindered there. Hence the funds will be available for the inner city (within the outer circle).

It goes without saying that this policy must include measures that facilitate public transport on the surface in order to prevent the investments in the city center being nullified because the vehicles continue to be impeded on the surface.

Under a law already passed by Parliament, the government is in the process of issuing an order designed to empower the Minister of Transport to take the necessary measures to facilitate operation of public transport on the surface (own lanes, parking bans, one-way streets, remote control of traffic lights, etc.). It should be noted that this new policy in no way reduces the envisaged investments; on the contrary, it concentrates the available funds at the critical points of the network and can at most slightly reduce the kilometers of construction because the work in the city center is more difficult.

The Netherlands

The development in the Dutch cities of Amsterdam and Rotterdam is noteworthy. In Amsterdam it was originally planned to build a metropolitan railway network with a total length of 78 km. About 20 km is currently in service. It is planned to complete a further extension to Gein (about 2 km) by 1982. However, construction of the metropolitan railway will not be continued for cost reasons. Instead, it is intended to develop the existing tramway network into an efficient light rail system.

In Rotterdam a rail line on which mixed operation (metropolitan railway and light rail) is planned is currently under construction. Originally envisaged as a metropolitan railway line, this line was already under construction when a decision was made for cost reasons to develop parts of the line for light rail service with a few grade crossings. The vehicles are designed in such a way that the current can be collected via a contact rail (on the section constructed as an underground railway line) and also via an overhead line and pantograph (on the section constructed as a light rail system).

Germany

In the Federal Republic of Germany light rail systems have been built since the mid-1960s. In every instance they are being developed in stages from an existing tramway network to a light rail system. Individual sections of the network are constructed as reserved tracks on the surface or on the second level, usually underground.

Many cities—e.g., Bonn, Cologne, Frankfurt, Stuttgart, Essen, Düsseldorf, and Hanover—have already constructed large sections of the rail network as light rail systems and put them into service, while others anticipate that large sections of the light rail network will soon be operating. In virtually all cities where rail is the main form of public transport, development of the network is in full swing. Some of these cities (generally those with smaller populations) are restricting themselves to the construction of reserved rights-of-way, whereas others are also transferring long sections of their networks to the second level.

The evolution in Stuttgart is a good illustration. In the late 1950s Stuttgart also found that the old tramway no longer met the changed requirements for a local public transport system. The rapid increase in motor vehicle traffic, particularly in the city center, resulted in greater interference with the trams operating on the roads. There was a noticeable decline in the attractiveness of municipal public transport; abandonment of public transport by the passengers was the logical consequence. The first transport plans, designed to counteract the loss of passengers by improvements to the tramway system, envisaged the construction of an underground tramway. According to these considerations, the tramway with all its branches, intermediate turning loops, and various grade crossings was to be transferred underground in the city center. On the outer sections the tramway would have to operate partially on its own rights-of-way but still with numerous grade crossings and small radii.

Ten years later, however, it was realized that the expensive transfer of a small part of the tramway network to a second level in the city center would not be sufficient to make this form of transport so much more attractive that the drift away from trams by passengers could be prevented or even reversed. In 1969 the political bodies approved an initial light rail concept. It provides for a consolidation of the existing network and the elimination of all trouble spots such as grade crossings, junctions, and branches on the new light rail lines.

In 1973 the wave of enthusiasm for metropolitan railways reached such a high peak, as in other German cities, that Stuttgart also decided to construct a metropolitan railway with 2.90-m wide vehicles. But this enthusiasm quickly died down because the subsidies from public funds were not forthcoming in such large amounts as had been initially assumed.

The final aim of the plan now is to extend the Stuttgart tramway network as a light rail system. The existing tramway is to incorporate three important new features: conversion from meter gauge to standard gauge (1.435 m); replacement of the 2.20-m wide tramcars by 2.65-m wide modern light rail vehicles; and intensified construction of rights-of-way separated from other traffic.

Italy

In Turin, a new 11-km light rail line to Rivoli is planned. A first section will be put in operation with new vehicles in the spring of 1983.

In Milan, the reasons that the city decided to discontinue extension of the metropolitan railway begun only after the Second World War, in favor of light rail lines to supplement the metropolitan railway network, appear interesting. The metropolitan railway has improved transport services only in its immediate catchment area. An attempt was first made to extend the catchment area by fare policy measures. A flat fare for commuters and later (from November 1977) a 1-hour fare for all passengers, both of which are valid for surface transport and the metropolitan railway, were introduced. This, of course, necessitated good connections between the metropolitan railway and surface transport.

However, an effort had to be made to enable the passengers who did not live in the areas served by the metropolitan railway to enjoy its advantages on a wider scale. A way of providing a better and more extensive service in these areas was sought. This transport system had to have a metropolitan railway character and be capable of a similar performance, at least in the overloaded transport directions. This meant conversion of the tramway into a light rail system with its own right-of-way; functional stopping places; traffic control and structural measures for the sections used by trams and light rail; control of traffic lights; use of modern, spacious vehicles with a capacity of 250, including 70 seats; replacement of the pole-type current collectors by pantographs with corresponding conversion of the overhead line; and safe branching points ensured by an absence of crossings or automatic crossing control systems wherever possible.

Four light rail lines with a total length of 43 km resulted. They have their own right-of-way on between 57 and 79 percent of the lines, but achieve a commercial speed of only 11 km/hour and a maximum of 13 km/hour. This modest result is attributable to the fact that it has not yet been possible to introduce adequate traffic control measures in mixed operation.

In addition, the small mean distance of 282 to 322 m between stops does not allow full use of the dynamic running characteristics of the new large-capacity vehicles. However, more regular frequency of trains has been achieved with the larger vehicles by increasing the headway between trains. Labor costs have also been reduced by 30 to 35 percent by introducing the 8-axle vehicles in place of the 4-axle ones. All vehicles operate with one man and without issue of tickets in the vehicle.

Austria

Linz, the capital of Upper Austria, is cited as an example of the Austrian light rail projects. The current population of Linz is just over 200 000.

The 5.5-km new section is designed in accordance with the latest technology. The basic requirements during planning were high commercial speed, minimization of interference by other road users, and traffic installations compatible with the environment. The greater part of the line, 4.6 km, has its own right-of-way at the side or in the center of roads; in the case of sections running in the center of the carriageway, the parallel tracks are separated by continuous white lines. Insofar as road crossings between the stopping places were unavoidable, they are protected by the flashing warning lights used in railway operation, which are operated by overhead line contacts. Whereas the current tramcars are 2.20 m wide, vehicles with a width of 2.40 m can also be used on the new section. This standard profile is now taken as a basis for all new sections.

Sweden

A few years ago, Gothenburg started the construction of a light rail network between the city and the neighboring municipality of Angered, which was incorporated into the city of Gothenburg. The incorporated districts are between 8 and 14 km from the center of Gothenburg. The construction of a fast light rail line played an important part in the first planning phases for Angered-Bergum. The planning department of the transport undertaking and the town planning authorities began to deal with planning questions in conjunction with the construction of public transport systems between Gothenburg and the new areas of the city.

For some time the city had been investigating the possibility of a metropolitan railway network. While the final decision on this question was awaited, several possible solutions for linking the new areas were discussed. The system should have a high capacity and also operate economically. During investigation of these alternatives, the national railway (SJ) announced that a narrow-gauge railway in the vicinity of the incorporated areas was to be closed. It was then proposed that the already existing track bed of this narrow-gauge railway be used to provide a good public transport system. However, it was necessary to modify the gauge for light rail operation.

Line 8 is 11.5 km long, of which 2 km run underground, with a station 24.5 m below the surface. The number of stations has intentionally been kept small to achieve the highest possible speed. This has also contributed to the profitability of the line. All stopping places were built in such a way that they can easily be converted to metropolitan railway standard. The platforms can easily be raised to floor level. Adequate space is available for ticket inspection barriers. With the present system the tickets are cancelled by automatic machines in the vehicles.

Switzerland

In four Swiss cities that operate tramways, great efforts are being made to facilitate tramway operation by construction of further sections with their own right-of-way and by tram-controlled signals at traffic junctions. At present the tramway networks in the four cities have a total line length of about 192 km, about 28 percent in their own right-of-way. Priority is given to the tramway at about one-third of the traffic signals. The aim of all improvement measures is to increase the commercial speed and thus make local public transport considerably more attractive.

In Zurich, a detailed survey of trouble spots (loss of time, accidents, etc.) and the causes of this trouble (parking, traffic control, etc.) revealed that 152 trouble spots and over 200 causes occurred on route 10 alone. About one-third of these trouble spots were eliminated by measures taken before 1975 (adaptation of traffic lights, prohibition of left turns, parking bans, and improved priority measures). Further measures are designed to eliminate another third of the troubles. It was not possible to find a remedy for the rest of the trouble spots. The results achieved on route 10 are very good; it was still possible to increase the commercial speed by 6.4 percent.

The networks of Basle, Berne, and Geneva pursue a policy that tends to give priority to tramcars. Various measures in the field of general traffic were taken and efforts made to ensure that the other users of the public road would respect them. The following measures should be mentioned: no thoroughfare for motor vehicles on certain roads; own lanes for rail transport (particularly

when buses also use the tram lines); continuous marking lines along the tram tracks; and stopping and parking bans in narrow streets.

Portugal

The investment plan for 1982-1986 of the Lisbon network includes the modernization of the group of tram lines running along the Tagus River, the acquisition of articulated tramcars for these lines, line extension, and the construction of new workshops.

Great Britain

The light rail concept is beginning to gain acceptance even in those European countries where surface rail transport was largely abandoned several decades ago. For example, a light rail line about 20 km long was opened in August 1980 in Newcastle, England, a city of about 270 000 inhabitants. Further extensions are currently under construction. It is intended to create a light rail network with a total route length of about 54 km by 1983. A large section of the network consists of lines previously operated by British Rail.

Soviet Union

In Eastern Europe there is a tendency to extend and improve the existing tramway networks and to construct light rail systems as well. In 1976 trams operated in 109 cities in the Soviet Union and carried 8.34 billion passengers with an increasing trend—15 percent of the total number of passengers carried by local public transport. The tramways are being continuously modernized in most cities. As far as is known, however, a new light rail line is under construction only in Kiev. This 9.3-km line links a new housing estate to the city center. The line runs only on its own right-of-way without crossings with other traffic. It achieves a traveling speed of 28.7 km/hour, with a maximum speed of 65 km/hour. The stations are built to metropolitan railway standards. A train safety system permits a train frequency of 110 seconds. The line will initially operate with existing tramcars. It is planned to use Tatra large-capacity vehicles later.

Poland

A metropolitan railway was originally planned in Warsaw. Here, too, a decision is apparently being made in favor of a light rail system for economic reasons. In northwest Warsaw a 3-km light rail line on its own right-of-way went into service in July 1977. A modern, efficient transfer station, at which 6 tram routes and 7 bus routes as well as the new line terminate, was built at its terminus (Huta Warszawa).

In Szczecin the first real light rail section is being planned in the form of a cross-city line. When completed the line will be 30 km long. It will operate on its own right-of-way and on viaducts in the area of the main railway crossings. The aim is a commercial speed of 35 km/hour. Existing tramcars will initially be used on the line. However, the clearances are such that wider light rail vehicles can operate on the line later.

Yugoslavia

In Yugoslavia tramways still operate in Belgrade, Osijek, Sarajevo, and Zagreb. The urban development plans of these cities provide for retention of the tramway or its conversion into a light rail system.

The Belgrade transport authority operates a tramway, trolleybus, and bus network. The tramway accounted for 63.8 million (16 percent) of the 387.5 million passengers carried in 1977. The urban development plan covering the period up to 1985 provides for improvement and modernization of the tramway. The main aims are the extension of the transport network and the purchase of new vehicles and maintenance equipment. It is planned to extend the line network by 20.3 km of double track, so that a network length of 100 km will be available. The 130 tramcars of old design and different types are to be replaced at the same time by 170 modern articulated vehicles. Although a metropolitan railway is envisaged for Belgrade in the long term, it will not slow the modernization of the tramway into a light rail system and the general improvement of urban transport.

German Democratic Republic

Although some cities in the German Democratic Republic are converting certain routes from tramways to buses for economic reasons, some have also extended their tramway networks. Virtually all these new lines have their own right-of-way—i.e., they are built to light rail standards. The vehicle fleet is being renewed. Tatra 4-axle vehicles of type T3D from Czechoslovakia are generally used. In Karl-Marx-Stadt the narrow-gauge lines (925 mm) are being converted to standard gauge. In Magdeburg a new 1.7-km section went into service in 1976. Erfurt likewise opened a 1.7-km section to traffic in April 1978. In Leipzig, too, a tramway route was extended by about 1.6 km into a new residential area in April 1978, even though the tramway network had to be reduced because of the progressive construction of the rapid transit system.

NEW APPROACHES

The house where I spent my youth was part of a tramway depot, and after 27 years of professional life devoted to the management of a public transport company, I can look back on half a century of close contact with public transport.

At the beginning of this century most of the public transport systems were managed by private companies grouped in holdings, and the major goal of these groups was to realize the most favorable financial balance sheet possible. This was perfectly feasible until the years 1960-1965, when the use of private autos began to boom, endangering the financial equilibrium of the companies.

The "golden sixties" are over, and indirect proof is now available that the private car, although it is an outstanding complementary means of transport, was not the miracle-worker some people had believed it to be. The major task of public transport at the moment is to be at the service of the population and to reduce as much as possible operating losses without neglecting indispensable modernizations to make the product attractive. Tomorrow's public transport should more than ever be integrated in the planning and the everyday life of the city in all its aspects. Because private cars permit door-to-door transport most of the time, urban public transport should be able to do the same or offer a valid alternative.

Public transport managers should welcome the passenger at their doorstep—i.e., they should act as a kind of ombudsman and intervene with public authorities in order to place at the disposal of their customers well-maintained sidewalks leading to the stops; shelters protecting them from bad weather and illuminated at night; and reliable information posted at the stops that correctly informs the public.

The network structure must not be fixed forever; on the contrary, it should adapt to the urban activities. Public transport should be ahead of the urban transformations and even lead them in the right direction. The users, in this case the population, should be in continual dialogue with the various authorities, without forgetting the operating personnel who are dealing with the daily problems.

Awareness of the detailed analysis of the numerous aspects of urban transport can prompt the open-minded operator to adapt the operation to the real necessities of the moment.

In the non-OPEC countries, more and more thought is given to electric vehicles, which offer undeniable advantage in areas such as air pollution, noise, capacity, and economy.

Most of the networks in European cities with 1 to 3 million inhabitants that ventured upon a standard metropolitan railway operation can only conclude that the operating costs are very high (vehicles as well as stations); that some platforms at different levels are accessible only with great difficulty (elderly people sometimes panic at the mere sight of an escalator, and, moreover, the maintenance is extremely burdensome); and that insecurity grows with the volume of the stations, and this climate has a restraining influence on the use of public transport.

Once again, light rail traffic can offer a valid alternative, as it is possible to build the required facilities at ground level on very long sections. A tendency exists to construct high platforms at stops to permit easy access to the vehicles. This reduces the stopping times and increases the commercial speed, which contributes to the attractiveness of the system.

The wide range of rail vehicles, each with its own width, length, number of articulations, and couplings, offers the possibility to choose the type of vehicle that seems most appropriate for a particular operation.

I should like to conclude by emphasizing that public transport services can contribute strongly to a city's functioning. Each vehicle is constantly connected with the company's traffic control center, and the vehicles run through a vast network of roads at regular intervals. The drivers can therefore inform the control center about any anomaly met on the way.

On the S.T.I.B. Brussels Passenger Transport System network, for example, the drivers intervened, by transmitting information, on the following occasions: 166 accidents between third parties, 651 calls for an ambulance, 320 cases of traffic lights being out of order, 24 calls for the fire department, 23 cases of lost children, 40 acts of aggression, 44 brawls, 3 cases of leaking petrol and risk of fire, 22 cases of inundation, and 5 uprooted trees fallen on the road.

To strongly motivate the authorities responsible for the organization of all urban transport, it is absolutely necessary to draw their attention to the numerous complementary services public transport in general, and LRT in particular, can offer. With their support, an urban renovation can be brought about that gives the city back to the inhabitants and prepares the shape of the urban region for the coming decades.

LRT Fixed Facilities and Vehicles

THOMAS F. LARWIN, San Diego Metropolitan Transit Development Board

The existing and planned light rail installations in North America serve as testimony to the progress being made to move people more efficiently during this era of tight financial resources. An outstanding feature of LRT is its versatility and its corresponding ability to develop incrementally.

The San Diego project is but an initial increment of a larger LRT plan. We are already in the midst of a construction program to double-track a system that began as a single-track line in San Diego. Ten more vehicles are now on order, and we intend to expand the service to the eastern suburban areas within the next couple of years. Even then we will not be done—there are northward extensions being planned, grade separation projects being designed, and operating enhancements continually being made.

This flexibility and versatility can be translated into low-risk development and low cost. Light rail offers the flexibility and versatility to satisfy transportation needs at low capital and operating costs. Although we hear a lot about the capital cost features of light rail transit, low operating costs are equally important. There needs to be constant vigilance during the planning and the design process to achieve a low-cost operation. A proper balance will continue to pay financial dividends in the future.

VEHICLES

A wide variety of vehicle technology is currently operating. PCC cars are still operating in Cleveland, Pittsburgh, Toronto, San Francisco, Boston, and Newark. These cars average 40 years of age. Table 1 shows recent activities in procurement of newer vehicle technology. In Calgary and San Diego, 3-car train units are in peak-period service. In San Diego, 4-car train units will eventually be operated. While most of the areas are opting for double-ended vehicles, single-ended vehicles are also available if the operations permit their use. These new vehicles have 3 or 4 doors on each side. Seating capacity ranges from 49 for the Tokyu car in Buffalo to 84 for the Breda car being used in Cleveland.

Platform boarding conditions vary. Subway sections of the San Francisco Muni use high-level boarding (platform aligned with the floor level of the car), but the San Francisco Boeing cars can use both high- and low-level off boarding. Low-level boarding is used outside of the subway sections. In San Diego, low-level boarding is used, although Edmonton and Calgary use high-level boarding on the same car.

Special needs of the elderly and handicapped are also a consideration in choice of boarding type. However, it is not necessary to provide handicapped assistance on the vehicle. The intended station design for the at-grade stations in downtown Buffalo has a platform that enables a person in a wheelchair to be lifted to the floor level of the train even though the car will have low-level boarding. Portland is also designing this type of off-vehicle lift. Special car lifts are provided on one end of each San Diego car.

RIGHT-OF-WAY VARIATIONS

LRT operating environments range from on-street, mixed traffic to grade-separated conditions. Mixed-traffic operations are still prevalent in most of the pre-1978 systems. Mixed traffic is the least desirable situation because of automobile traffic interference that causes delay, impaired reliability, and increased safety hazards. However, exclusive and separated rights-of-way are not always possible, especially in today's era of scarce resources.

On-street operations can be improved through various traffic engineering treatments. Such treatments include exclusive transit lanes as in Philadelphia and San Diego, paint striping to keep automobile traffic out, and special