a forum to discuss the best methods of providing assistance to operators. Five methods were considered.

First, on-site methods were discussed, as was assistance provided to individual operators on location by one or more persons who have specialized expertise. Then area workshops, or groups of operators brought together to share knowledge on topics of mutual interest, were suggested. The need for information pertinent to the operation of transit properties that is distributed on a regular (newsletter) or intermittent (special reports) basis was expressed. Audiovisual presentations can also present information on specific topics in a structured manner. And there is a need for university and college or night school courses.

It is not surprising that the consensus at each workshop was that the on-site method is the most preferred method for providing assistance. The other four methods did have appeal for specific problems or situations. In most cases, formal instruction programs at the university and college level were judged to be too broad in scope for transit operator's purposes.

The inventory process also elicited a surprising number of potential assistance sources. Several large operators, consultants, colleges, taxicab operators, and the Institute of Transportation Studies at the University of California at Irvine all indicated a willingness to be considered as possible assistance resources.

CALIFORNIA'S TRANSIT MANAGEMENT ASSISTANCE IMPLEMENTATION PROGRAM

California's first-year transit management assistance program will consist of six elements that fall into two general categories. These six elements are in addition to existing Caltrans transit planning assistance, information sharing, research, and training programs. The first category, statewide management assistance, revolves around the dissemination of information. The three specific elements of this category are

1. Central transit information center: A central transit information center will be established by Caltrans, Division of Mass Transportation (DMT), to serve as an information resource for small operators in urban and rural areas;
2. Newsletter: A newsletter will be published by Caltrans-DMT on a bimonthly basis and will be directed to small operators with emphasis on state and federal legislation, innovative activities and programs of small operators in California and elsewhere, scheduled workshops and seminars, APTA-CAPOTS activities, technical developments, etc.;
3. Workshops: Twice yearly in two locations in the state, two three-day workshops will be conducted on subjects such as grantsmanship, regulations, FARE, insurance, legal issues, joint purchasing arrangements, transit goals, financial management, productivity techniques, scheduling, marketing, maintenance, etc.

The second category, local management assistance, is directed toward providing assistance to individual operators and toward developing programs on specific topics. There are three specific elements in the first-year program for this category:

1. On-site assistance: An exchange program between transit operators and Caltrans will be initiated (travel expenses subsidized) to provide on-site assistance in areas such as diesel mechanics, preventive maintenance, scheduling, and run cutting. The function of the exchange will be to encourage Caltrans or large-operator employees to travel to small operations and provide direct on-site assistance.
2. Marketing presentation: A slide and tape presentation will be developed on marketing small transit systems. This presentation will include an educational element as well as a basic promotional package.
3. Driver training program: A basic driver training program will be prepared for transit operators to use and supplement with material they prepare to suit their particular needs or situations.

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Abridgment

Light Rail Transit and Bus Integration in Edmonton

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Edmonton's light rail transit (LRT) started operation on April 23, 1978, to serve the northeast sector of the city. This sector of Edmonton, the area east of 97 Street and north of the North Saskatchewan River, has several major traffic barriers. The population in 1977 of 120 280 was expected to increase to 175 000 by 1985, according to the city's general plan. The transportation options considered were the following:

1. A northeast freeway option: The transit component would require 70 buses in the peaks, including express services for the corridor;
2. An all-bus option: This would require use of 150 buses in the peaks, including express services through the central area of Edmonton; and
3. An integrated bus-LRT option: This would call for 75 buses in the peaks to serve mainly as feeders and cross-city services, together with 14 LRT cars on the northeast line.

The revised 1974 estimates, allowing for capital and operating subsidies from the provincial government and for a constant deficit, showed the following annual costs to the city in 1978: $9.7 million for the freeway option,

$1.1 million for the all-bus system, and $0.2 million (gain) for the integrated bus-LRT. Every year at budget time these estimates were updated. Inflation and an increased deficit notwithstanding, the relative attractiveness of the integrated bus-LRT option remained the same.

An integrated bus-LRT option means that the LRT line is part of the transit network but uses a different technology.

THE BASIC BUS SYSTEM

The bus system developed in Edmonton is based on the timed-transfer concept developed over a number of years. Regular transfer locations are created in the city, and buses meet at the same minutes past the hour to provide regular and reliable connections between routes.

Bus services from these transit centers are generally feeder bus routes serving residential areas, radial routes to the city center, crosstown routes to other centers, and express routes to major destinations such as the city center, university, or government center. The express routes may operate during daytime (6:00 a.m. to 7:00 p.m.) or in the peak hours only and may be an extension of a feeder route.

Bus route changes that are proposed for any sector of the city therefore do have constraints placed on them. The midday schedule module in Edmonton is a bus every 30 min, which means that the travel time of a feeder route must fit within that 28-min period and that the travel time between transfer locations should not exceed 13 min (allowing 2 min for transfer and recovery time).

The midday frequency of LRT service is a train every 10 min. Maintaining the 30-min module along the LRT would mean an imbalanced loading pattern. The midday module along the LRT was therefore changed to 20 min with a pairing of routes.

PUBLIC INPUT

The marketing and development section of Edmonton Transit takes a two-stage approach to public input. In the first stage, the deficiencies, determined from a census, are noted, and the timed-transfer concept is explained. The public is then asked for input on deficiencies as they see them, on routes they desire, and also on roads on which bus routes can or cannot be located.

By breaking up the meeting into smaller groups, each with a resource person and a recording secretary, all input is available in detailed minutes. The staff can then sit down and work out two alternative networks for the sector, and try to cater to the existing patronage as well as to attract additional riders. These two plans are then taken to a second public meeting, and one plan (sometimes with modifications) is recommended to the city council for approval. Citizens who disagree can still go to council and protest (1).

1972 ROUTE CHANGES

In 1972 the public input pointed up a need for connecting the various neighborhoods with the regional shopping centers. In addition, it was found that the university and the government center were destinations that were inadequately served.

By establishing one timed-transfer location next to one regional shopping center (Northgate), the times past the hour could be fixed for the various routes that parallel the railway tracks in an east-west direction before they turn to go north-south through one of the track crossings.

1978 CHANGES

The introduction of LRT meant that bus routes in the residential areas could stay where they were but that the express portions could be eliminated along the Fort Road and the routes diverted to the nearest LRT station. The downtown express routes along 97 Street, from west and northwest of 97 Street were maintained.

The university bus, via downtown on 82 Street, was also maintained but with a reduced peak-hour frequency. A feeder bus to the Coliseum station was also added. All other routes that operated as loops were broken into routes terminating at the Belvedere or the Coliseum station.

Local service between LRT stations was introduced by extending a crosstown route (no. 11). The LRT services give a midday frequency of a two-car train every 10 min, a peak-hour frequency of a two-car train every 5 min, and a late evening and Sunday service of a train every 15 min. During special events a 7.5-min frequency is run, using three-car trains.

In the peak hours the number of buses passing 97 Street at the Canadian National (CN) tracks was reduced from 34 to 22, while at 82 Street at 112 Avenue the number was reduced from 48 to 22. The seating capacity of the LRT that replaced the bus service is 1536 seats/h (12 × 128 seats). The LRT does, however, produce time savings and gives more generous standing room of 3888 spaces. The before-and-after comparison is therefore (a) a reduction in buses of 1824 seated transit capacity and 2736 full transit capacity and (b) an increase in LRT of 1536 seated transit capacity and 5424 full transit capacity.

The local bus routings were given a 50 percent increase in service. Midday the service was changed from 30 to 20 min and in the peak hours from 15 to 10 min.

The actual total bus requirements were reduced from 91 to 78 buses in the peak hours and from 49 to 44 at midday. The original estimated bus requirement of 75 buses (bus-LRT proposal) was based on maintaining the same level of service with growth. With the 50 percent increase in level of service, the ultimate bus requirement of the integrated bus-LRT option will now exceed 75. It is also expected that LRT will be extended to Clareview, which will reduce bus requirements between 137 Avenue and Belvedere. However, this extension will also require additional LRT units.

DESIGN OF BUS-LRT STATIONS

Edmonton's northeast LRT line is 7.2 km long, of which 1.6 km is in a subway in downtown Edmonton. There are two downtown subway stations in use, while a shell for a third station is being built just east of 97 Street. The two stations, Central and Churchill, are of standard design with a central platform, a full mezzanine floor, and several exits from the mezzanine to the street system above. Bus-LRT transfers involve walking to the nearest bus stop.

The surface portion has three stations, two of which are important timed-transfer stations, Belvedere and Coliseum. The design of these two stations differs in that Belvedere is a temporary terminal of the line. There are proposals to extend the line to Clareview. Passengers have to cross the LRT and CN tracks at grade and then walk to the bus station, which is laid out in the form of a U with a central island; this minimizes bus-pedestrian conflicts.

Belvedere station also has a park-and-ride lot for 320 cars. After one month this lot filled daily and is also popular for shoppers on Saturday and patrons going to football games at the Stadium.

Figure 1. Average 1978 weekday patronage.

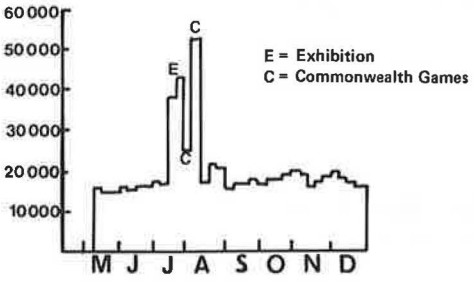
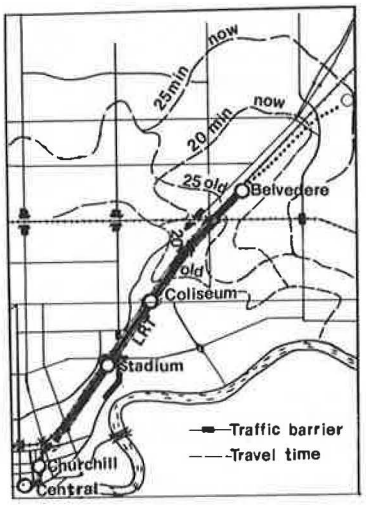


Figure 2. Traffic barriers and travel time savings.



The Stadium station has only one crosstown route that connects at the present time.

PATRONAGE CHANGES

The introduction of LRT changed the travel pattern of many transit passengers. The patronage along 97 Street was reduced by 4000 passengers/day; the bus patronage along 82 Street was reduced by 9900/day. After one month LRT was carrying about 17 000 passengers/day.

Figure 1 gives some figures regarding LRT patronage between May and December (months indicated by letters). However, since the opening there have been several occasions when LRT patronage increased. The annual Klondike Days and Exhibition increased patronage between July 19 and July 29, 1978. From August 4 to 13 the Commonwealth Games were being held in Edmonton and again normal patronage patterns were distorted. In reality it is too early to draw conclusions because of a number of other factors such as the fare increase on April 1, 1978 (from 35 to 40 cents), and the reduction in gasoline tax of 10 cents per imperial gallon on April 1, 1978, in Alberta.

Notwithstanding these systemwide deterrents to transit, an average month, June 1978, showed that overall patronage had increased by 1 percent compared to June 1977. Only time will tell the real impact of Edmonton's LRT line. In July 1978 patronage was 9 percent more than that of July 1977. Patronage on the LRT increased to about 46 000 per day during Klondike Days; the Exhibition grounds are of course directly accessible from the Coliseum station. The maximum load was an estimated 61 400 on parade day.

On an average day the daily patronage on LRT is about 17 000, of which about 2350 travel in the peak hour in the peak direction. With 1536 seats available in the peak hour on the LRT, a third of the patrons have to stand. Before LRT the daily patronage on 97 Street and 82 Street together was 25 000. On an average day in June it was 17 000 on LRT and 11 100 on the remaining bus system. The maximum daily load during the Commonwealth Games was 69 000.

TRAVEL TIME

As can be expected, LRT will reduce travel time the most for the outlying areas that are reasonably close to a station. The travel contour map in Figure 2 was prepared from midday schedule times. The travel times with LRT make an allowance of 4 min for transfer time. The equal travel time via LRT-bus and bus via 97 Street is just west of 82 Street.

The northeast areas of Clareview had a travel time saving of about 8 min as a result of LRT. The area of Abbottsfield had no time savings at all. It is not surprising, therefore, that the latter has generated the most complaints, since they now must travel via Coliseum station. This is particularly true for trips that go beyond downtown and involve a second transfer.

The immediate area of the Coliseum had a time saving of 9 min and Belvedere of 11 min. The public is likely to respond to these time savings, but the experience in Edmonton is that it usually takes time before significant mode shifts occur.

CONCLUSIONS

The integrated LRT-bus system has proved able to handle the existing transit patronage and has attracted additional riders, notwithstanding the introduction of transfers. The conversion from express buses to feeder buses-LRT has been accepted as an attractive alternative.

The LRT-bus system has also shown its worth during special events at the Coliseum, Exhibition grounds, and Stadium. However, a system capable of carrying 5400 people an hour in one direction cannot be expected to fill a stadium of 46 000 people.

The disadvantage of the LRT system is that it does not serve two major trip destinations, namely the government center and the university. Passengers to these destinations are required to make a second transfer. A complete valid solution probably requires a more complete system.

ACKNOWLEDGMENT

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