There are three steps to the planning process described in the Florida Transit Planning Manual. The first step consists of an exchange of information on transit between the state department of transportation and the local community. After this exchange, the local officials—now informed as to the planning programs and projects that are available—can make a request to the department of transportation for a transit study.

The second step consists of the establishment of a study staff and a survey of the available information. Staff, person hours, and cost in time are presented in chart form so that the level of detail desired in the study can be correlated with the requirements for these various commodities. The data needs and results are given to the local community, who are also informed as to the requirements for staff person hours involved, the cost of them, and the amount of time required to pursue such a program. There is usually some discussion of alternatives. Local decision makers are advised as to the different types of transit (including paratransit), the various types of equipment, and the kinds of services provided by each.

If the local officials decide to proceed further, the third step is taken. In this step, system needs are defined, patronage forecasts are made, attitudes are surveyed, and benefits and costs are determined. These are presented to local elected officials and again a decision point is reached.

It is important to note that, after each of these steps, the local elected officials are required to make a decision based on the knowledge that has been presented to them. At each decision point, good two-way communications must exist between the local elected officials and the planners doing the work. After the third step, should the local officials elect to proceed, an actual system analysis that has alternatives must be completed and this information be presented to the local officials for decision. Again, after the presentation of the detailed analysis of the best alternatives, a decision must be made by the local elected officials as to whether to proceed with the program by applying for a federal grant or to terminate the program.

It must always be remembered that information exchange is a problem at the local level. Planners must constantly do all they can to keep smaller communities from making costly and time-consuming mistakes.

Estimating Transit Demand, Fleet Size, and Costs for Small Communities

Wallace Atkinson, N. D. Lea and Associates, Ltd., Vancouver, British Columbia

Forecasting transit demand and estimating costs for transit systems in smaller communities is very difficult. The Ready Reckoner approach developed in 1974 has been used successfully in smaller urban and suburban areas throughout Canada. This approach can be used to estimate potential demand, system size, and cost parameters. It is a shortcut estimating tool intended primarily as assistance to policymakers in deciding whether or not more detailed analyses and feasibility studies are warranted rather than as a substitute for those necessary calculations.

There are approximately 60 Canadian cities that have populations of 50 000 persons or fewer that have operating transit systems, and some 100 or more are reaching the threshold for service at populations ranging from 10 000 to 25 000 persons. However, policymakers in such cities generally have difficulty in estimating the amount of transit service likely to be required and the costs involved, unless they commission a formal transit study.

This problem was addressed in 1974 by the development of a Ready-Reckoner type of approach for Alberta Transportation that can be used to quickly estimate the potential demand, system size, and cost parameters for transit service in small communities. This Ready-Reckoner approach has already been revised several times as a result of about a dozen studies in a variety of small communities throughout Canada.

The Ready Reckoner approach is intended for use in estimating the potential demand for and the cost of providing typical local bus transportation systems in cities or suburban communities having 5000 to 50 000 persons. It is not intended to be a substitute for a careful analysis and feasibility study for a particular city but rather to be a guide to policymakers in determining whether or not such studies should be undertaken at all.

This paper discusses the Ready-Reckoner procedure and explains its application in other North American cities. The methods used to accommodate variations in city size, shape, and population density and for selection of vehicle sizes, operating policies, fares and climatic conditions are described.

The necessary calculations are presented in a step-by-step sequence that includes tables and charts to assist in the analysis. Provision is made for future cost escalation and service variations.

BASIC DATA REQUIRED FOR INTERNAL TRANSIT-DEMAND CALCULATIONS

The basic data required for the calculation of the potential transit ridership, costs, and revenues include the following:

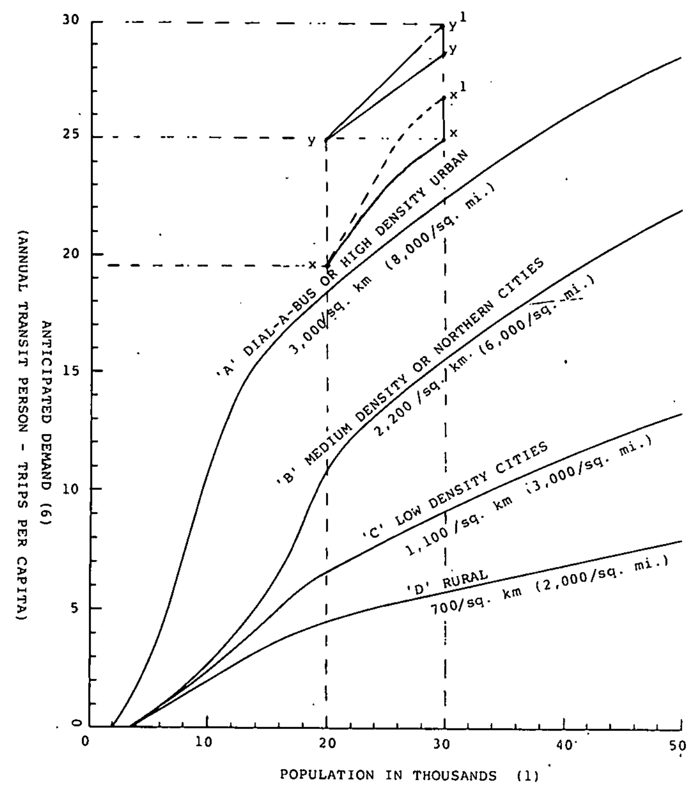
1. The population of the urban area, community, or city;
2. The size of the populated area [in square kilometers (or square miles)]—including neighborhood parks, playgrounds, schoolyards, and cemeteries, but not including undeveloped residential areas or large industrial parks outside the residential areas;
3. The net population density [in persons per square kilometer (or square mile)], which can be calculated from the data determined in steps 1 and 2;
4. The duration of the average work trip by automobile (in minutes) based on the geography of the area and any travel barriers encountered; and
5. The duration of the average trip by bus, which can be calculated by increasing the duration of the average trip by automobile by one-third.

INTERNAL TRANSIT-DEMAND POTENTIAL

The calculation of the internal transit demand is based on Figure 1, which shows a series of curves that represent historic transit-ridership data for approximately 25 small cities (mainly located in western Canada) at varying populations.

The selection of population density as the prime variable was made to encompass the factors of income level, automobile ownership, and city characteristics. For

Figure 1. Relationship between transit demand, population, and population density: U.S. conditions.



example, in cities that have low population densities, those populations tend to be younger and have higher income and automobile-ownership levels. These are communities that have lower transit potentials. The population density is not as critical for taxi-transit or dial-a-bus systems because ridership of these types of systems tends to be higher in low- and medium-density areas.

Some judgment must be used when considering the climatic conditions in a particular city because ridership tends to be higher in colder climates. Similarly, the impact of marketing the system affects the transit demand.

These effects are included by collecting data from existing transit services in cities having socio-climatic-economic characteristics similar to the community under study and creating envelopes of demand. In the example shown in Figure 1, community X, which has a population of 20 000 persons and no existing transit service, is under study by comparison with a similar community (Y), which has a colder climate and experiences 25 person trips per capita on its fixed-route transit service. It can be estimated that the potential demand in community X is 19.5 trips per capita at the current population and will grow to 25 when the community grows to 30 000 persons. However, if community X provides a higher-quality transit service than community Y, the transit use may grow to 30 trips per capita (shown as X') in the future. Similarly, an intensive marketing program in community Y could potentially move the future demand to Y'.

CALCULATION PROCEDURE

Summarize the basic data:

1. Population of area, community, or city;
2. Populated area;
3. Net population density;
4. Duration of average automobile trip; and
5. Duration of average bus trip (increase item 4 by one-third).

The demand can be calculated by the following procedure:

6. Select the annual transit demand per capita from the appropriate curve in Figure 1 by using items 1 and 3 (interpolate for density if necessary).
7. Determine the total annual demand by multiplying the demand per capita (item 6) by the population (item 1).
8. Determine the afternoon peak-hour demand by dividing the annual demand (item 7) by 300 days/year and multiplying by 0.20 for fixed-route systems or by 0.25 for dial-a-bus systems.

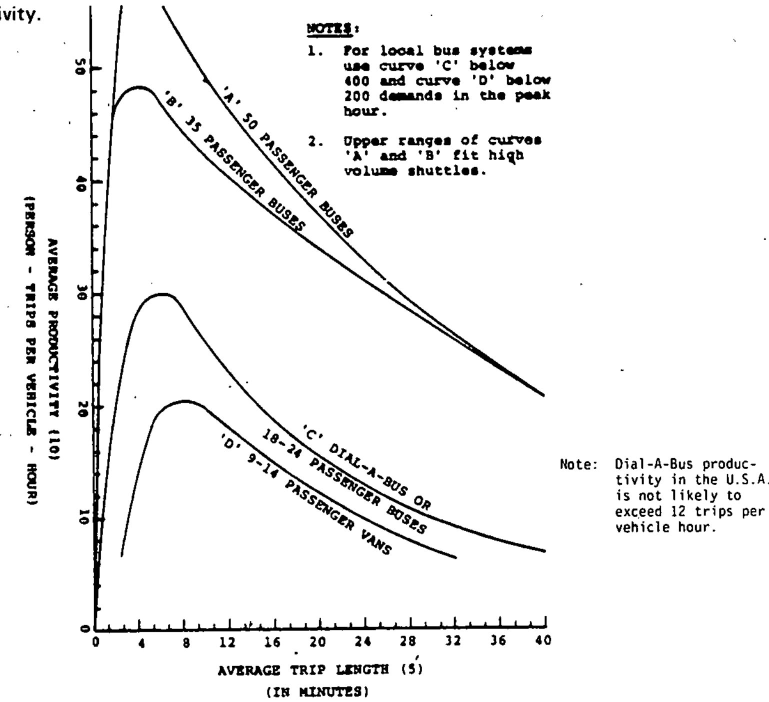
The sizes of the vehicles required will depend partly on the type of transit service to be provided and partly on street patterns and limitations. As a general rule, the sizes of vehicles for local collection-and-distribution services can be selected as follows:

Vehicle Tour (min)	Vehicle
15	9- to 11-passenger van
20	11- to 14-passenger van
30	18- to 24-passenger bus
40	24- to 35-passenger bus
60	35- to 50-passenger bus

9. For communities having fewer than 50 000 persons, vehicle-size selection can also be made on the following basis:

Peak-Hour Demand	Vehicle
<100	9- to 11-passenger van
100-200	11- to 14-passenger van
200-500	18- to 24-passenger bus
500-800	24- to 35-passenger bus
>800	35- to 50-passenger bus

Figure 2. Relationship between average trip length and productivity.



or (1 km^2 = 0.39 $mile^2$)

Peak-Hour Demand per Square Kilometer	Vehicle
<10	9- to 11-passenger van
<20	14- to 24-passenger van or bus
>20	≥35-passenger bus

The calculation of operating hours is based on the curves shown in Figure 2. These curves show the maximum productivity that has been experienced in normal services using different sizes of vehicles and assuming that there is sufficient demand for the service provided.

10. Select the average productivity (person trips per vehicle hour) from Figure 2 based on the average trip length (item 5) and the vehicle size (item 9).

11. Determine the fleet operating hours by dividing the annual demand (item 7) by the productivity factor (item 10).

12. Select the schedule speed as described below (1 km/h = 0.62 mph):

	Speed (km/h)	
Population Density ($persons/km^2$)	Fixed-Route System	Dial-a-Bus System
>2200	18	16
1500-2200	20	18
1100-1500	22	20
700-1100	26	26
<700	32	32

13. Calculate the fleet operating distance (in kilometers) by multiplying the fleet operating hours (item 11) by the schedule speed (item 12).

The size of the bus fleet can be determined by the following procedure.

14. Select the appropriate frequency of service based on bus one-way trip lengths (1 km = 0.6 mile):

Trip Length (km)	Service Frequency (min)
1-2.5	15
2.5-5	20
5-8	30
8-16	60

15. From the vehicle size selected (item 9) and the service frequency chosen (item 14), use the peak-hour demand (item 8) to determine the number of buses required to operate the system by using Figure 3 (round to next higher whole number).

16. Determine the total fleet size by adding for spares (20 percent extra for fixed-route service and 30 percent extra for dial-a-bus services).

The cost components can be determined by the following procedure [the cost components that follow and the financial analysis assume public ownership and operation and were calculated for Canadian dollars ($ Canadian = 0.90 January 1978 $ U.S.) and labor rates].

17. Determine the costs of dispatching and clerical services based on the total fleet size (item 16):

No. of Buses	Annual Cost ($)
1-3	5 000
4-6	16 000
7-9	25 000
10-14	35 000
15-25	50 000

18. Determine the administrative overhead based on the operating fleet size (item 15):

No. of Buses	Annual Cost ($/bus)
1-3	4000
4-14	3000
15-25	2400
>200	1800

Figure 3. Relationship between bus sizes and headways and transit demand.

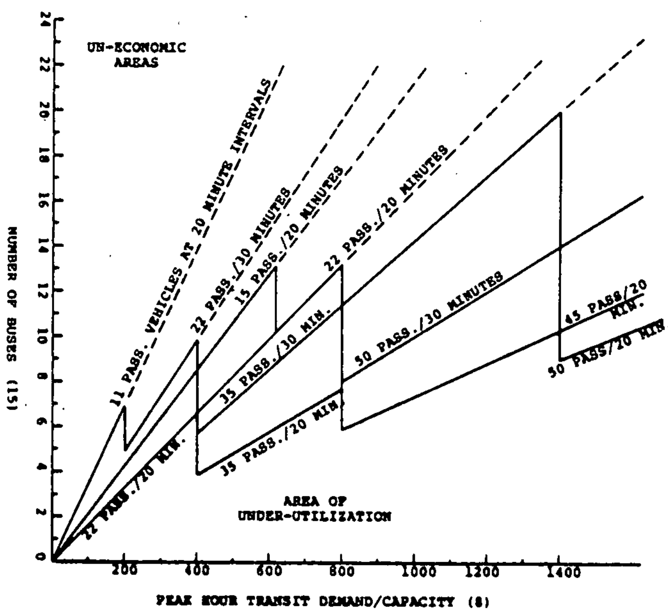
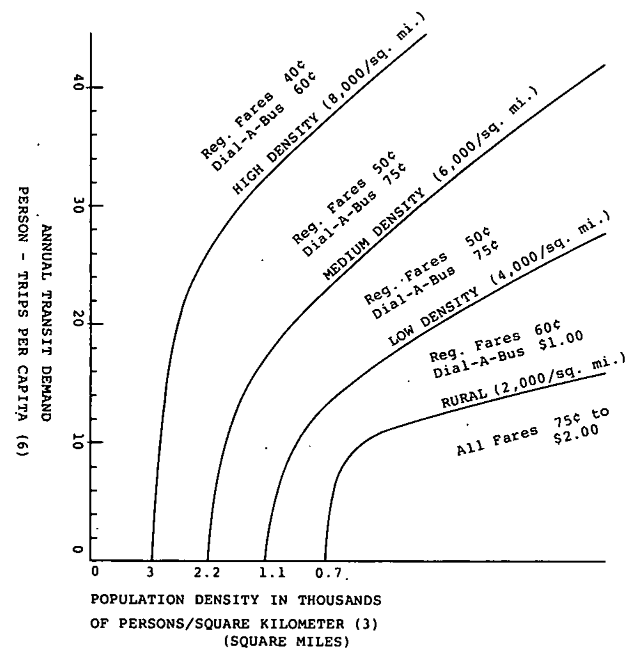


Figure 4. Suggested minimum transit fares by population density and transit demand: U.S. conditions.



19. Determine the capital replacement or depreciation reserve costs:

Vehicle Size	Capital Cost ($)	Service Life (years)	Annual Reserve for Depreciation ($)
9- to 11-passenger van	10 500	3	3500
14-passenger van	14 000	4	3500
18- to 24-passenger bus	24 000	6	4000
35-passenger bus	45 000	10	4500
45-passenger bus	65 000	10	6500
50-passenger bus	68 000	10	6800

20. Select an average adult fare (see Figure 4) by policy decision. Reduce the average fare by the anticipated proportion of children and students as follows:

Children (%)	Fare Reduction (%)
40	20
20	10

The total cost of operators' wages includes bus drivers' wages and fringe benefits plus any overtime allowance.

21. For a municipal system, calculate the cost of operators' wages by multiplying $6.95/h, plus a 27 percent fringe-benefit package plus 5 percent for overtime (i.e., a total of $9.27/h) by the annual vehicle hours of service.

Transportation operating costs include fuel, oil, lubricants, spare parts, maintenance labor, all consumable garage supplies and the cost of maintaining the garage facility and equipment itself and (based on a wage rate for mechanics of $7.60/h) are currently estimated to be $0.22/km ($0.35/mile). Vehicle operating costs include licensing, insurance, driver supplies such as uniforms, tickets, transfers, and schedules and are currently estimated to be $1100/vehicle. Overhead costs are the costs of supervising the service and include a manager, supervisors, dispatchers, and a telephone information clerk and also the maintenance of office space and supplies.

22. Calculate the annual transportation operating costs by multiplying the estimated unit cost ($0.22/km) by the annual vehicle kilometers of service (item 13).

23. Calculate the annual vehicle operating costs by multiplying the estimated unit cost ($1100/vehicle) by the total fleet size (item 16).

24. Calculate the annual overhead costs by multiplying the dispatching and overhead costs (items 17 and 18) by the total fleet size (item 16).

25. Calculate the total operating cost by adding the costs of wages (item 21), transportation operation (item 22), vehicle operation (item 23), and overhead (item 24).

26. Calculate the annual revenue by multiplying the total annual demand (item 7) by the revenue fare (item 20).

27. Calculate the annual operating deficit by subtracting the annual revenue (item 26) from the total operating cost (item 25).

28. Calculate the annual reserve for depreciation by multiplying the total fleet size (item 16) by the capital replacement or depreciation reserve costs (item 19).

29. Calculate the total deficit by adding the annual operating deficit (item 27) and the annual reserve for depreciation (item 28).

The introduction of a new transit service also involves special one-time-only costs. These can be calculated by the following procedures.

30. Calculate the market-introduction costs by estimating losses of 40 and 50 percent, respectively, of the annual revenue (item 26) for fixed-route and dial-a-bus services and savings of 15 percent of the annual operating cost (item 25).

31. Calculate the design costs by adding the estimated costs of a feasibility study ($20 000), a detailed design study ($15 000), implementation ($20 000), and monitoring ($20 000).

32. Calculate the cost of buses on the basis of the bus selected (item 9) by multiplying the total fleet size (item 16) and the current prices (item 19).

33. Estimate the costs of garage facilities and communications equipment.

34. Calculate the total capital required by adding the bus cost (item 32) and the costs of garage facilities and communications equipment (item 33).

For wage rates and cost components other than those used above, the calculations can be adjusted by the following procedures. The cost of operators' wages (item 21) can be calculated by multiplying the annual vehicle hours of service by (9.25/6.95) times the different wage rate. The transportation operating cost (item 22) can be calculated by multiplying the vehicle kilometers of service by ($0.22 \times 0.35/7.60$) times the different mechanics' wage rate and adding this to ($\$0.22 \times 0.25 \times$ the percentage increase in fuel costs) plus ($\$0.22 \times 0.40$).

Other adjustments that can be made to the basic calculation procedure include the following:

Privately owned systems generally have lower fringe costs than do municipally operated systems. For such systems, the basic rates for operators' wages (item 21) and transportation operating cost (item 22) may be reduced to $8.00/h and $0.20/km ($0.32/mile), and the cost of dispatching and clerical services may be reduced by 25 percent.

If the system is operated on Sundays and holidays, the fleet operating hours (item 11) and distance (item 13) can be increased by 12 percent for 8 h of service. If the system is operated for more than 12 h of Monday-Saturday service, the fleet operating hours (item 11) and distance (item 13) can be increased by 7 percent for each hour of service after 7:00 p.m.

Readers of Atkinson's paper should be cautioned that the techniques discussed were not calibrated for U.S. conditions although they may be applicable to small cities in the Pacific Northwest. In general, subsidies per capita are much higher for small Canadian systems than for U.S. systems.

A Vital Phase of Transit Evolution: Management Information Systems

Dennis D. Knautz, McDonald Transit Associates, Inc., Fort Worth, Texas

Passage of the Urban Mass Transportation Act of 1964 signaled a new era for the transit industry by facilitating the public acquisition of private operations as well as capital purchases of equipment. In 1974, operating assistance was provided under the National Mass Transportation Act. The increase in federal funding, however, has resulted in significant increases in federal regulations and reporting requirements. This has caused an intensive effort to provide sound system management and internal controls at the local level. To give transit managers the information essential to fully utilize available funds, management information systems have been developed. Successful management information systems are based on, first, the identification of the particular information needs of a transit system and, second, the development of performance criteria from an in-depth statistical analysis of the management provided. Although the management information systems are continually being updated, the performance criteria are still in the formative stages. Yet it is these performance criteria, based on sound management information, that will help transit to become more cost-effective and to provide better service.

Over the past 15 years, the transit industry has been experiencing a renaissance, an attempt to restore a once vital service back to the level of prominence that it enjoyed during World War II. This revitalization, however, is prompted by more than nostalgia. What is emerging today is a new and dynamic, highly marketable public service that can be geared to every phase of urban life.

This renaissance can be divided into five development phases. The first phase began with the passage of the Housing and Urban Development Act of 1961, which provided grants for demonstrations and loans for projects and made transit planning part of the urban planning process. The Urban Mass Transportation Administration (UMTA) was born in the Department of Housing and Urban Development in recognition of the problems the transit industry was facing and the realization of the role transit could play in the revitalization of the cities. The second phase coincides with the enactment of the Urban Mass Transportation Act of 1964. The third phase was made possible by the National Mass Transportation Assistance Act of 1974, which substantially strengthened the previous financial commitments and initiated the provision of operating assistance for transit. These federal funds began a physical rehabilitation throughout the country. But inherent with the provision of tax dollars, the third phase included the development of federal regulations and accountability. The fourth phase has been the most difficult phase to cope with to date. Once federal funding and federal reporting became routine conditions, it became necessary to develop sound system management and internal control at the local level. Gaining control of systems or depart-