Chapter 14

RURAL PUBLIC TRANSPORTATION

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This chapter traces the history of rural public transportation, presents issues that are critical to the planning and design of rural services, and concludes with models for evaluation of rural public transit. Rural public transit services are those transit services that are provided in rural or small urban areas with under 50,000 population and are open to the public, as opposed to closed-door special client services. Rural public transportation for the purposes of this chapter does not include air, rail, intercity bus, or private auto transportation.

Rural public transportation is characterized less by the scale or magnitude of individual projects than by unique operating strategies in specific geographic planning areas. Rural public transportation in one area of a state may mean a small fixed-route service operating on 20-min headways. Yet, in another area of the same state, rural public transportation may involve the local senior citizens center station wagon, with volunteer drivers, that takes people on trips with headways of days for life-support shopping and medical services. The range of services are illustrated by the following descriptions.

° The Community Action Agency, Mercer County, West Virginia, provided individuals with automobiles and they, in turn, were responsible for transporting others.'
° New Castle, Indiana, (population 20,056), operates seven vehicles in fixed-route service.2
• In 1974 West Virginia initiated a statewide Transportation Remuneration Incentive Program (TRIP) based on a user-side subsidy similar to food stamps.3

While at least one rural public transportation service started about 1860 (the

Kernville Stage and Freightlines, a private operation in California),4 the majority of the current rural public transit systems have been established since about 1960. Many services were funded through the Older Americans Act of 1965 and the Office of Economic Opportunity's Community Action Program. In a 1976 study of *75* projects, it was found that 35 had received subsidies from the Office of Economic Opportunity and 23 had received federal funds for the elderly.5 In a 1989 study, it was found that of 1161 rural transit providers in the United States, *57%* received some social service funding and of that group 41% received funds from programs for the elderly.6 Most of the early rural transportation systems were not-for-profit providers or public agencies, and this arrangement continued through 1990, with approximately 57% of all rural systems operated by a public agency, 41% operated by a not-for-profit agency, and 2% operated by for-profit companies.7

The not-for-profit agencies' interest in transportation traditionally focused on identifying the need for services. These same agencies, however, frequently lacked planning and operation capabilities. In the West Virginia TRIP, this weakness was identified as a major problem.8 Deficient planning and operational expertise caused some defective initial service design and operational errors in early (1960s) projects. Almost all the early projects intended to become self-supporting in some fashion—through fares from riders, through contracts with public or private groups, or through a continuing commitment of operating subsidies from a state or local government.9 One program, for example, established a sequence of five operational goals for each new route as follows:

1. Operating revenue equal to driver wages.
2. Operating revenue equal to driver wages plus variable costs.
3. Operating revenue equal to driver wages plus variable costs plus operation costs minus depreciation.
4. Nonoperating revenue plus operating revenue equal to total costs minus depreciation.
5. Nonoperating revenue plus operating revenue equal to total costs.10

While these goals are admirable and undoubtedly helped guide the program in a sensible fashion, the realities of providing service in an environment characterized as "high need and low demand"11 meant that the ultimate goal, to become self-supporting, was unrealistic. In 1974, assessment of a selected group of systems revealed that few had succeeded in becoming self-supporting.12 Lack of monetary success coupled with the social service advocacy base of the systems started a movement in the early 1970s to secure federal subsidies to offset system deficits. These efforts resulted in Section 147 of the 1973 Federal-Aid Highway Act, enacted to implement rural transportation demonstration projects. In 1978 the United States Congress enacted Section 18 of the Urban Mass Transportation Act. The Section 18 program established a formula grant program for areas other than urbanized areas larger than 50,000 population. Section 18 required a minimum 50% local match for operation subsidies and a minimum 20% match for capital and project administration. (See also Chap. 3.)

The importance of the link between rural public transportation and social services was affirmed in 1985 when an amendment to the Urban Mass Transportation Act allowed contract revenue (monies secured through contracts for services with social services agencies, cities, towns, and others) to be used as local match on Section 18. This meant that federal funds could be utilized in certain contract situations to match Section 18 federal funds. The amendment lessened the burden on local government for match, and it also encouraged additional coordination of services in rural areas. The dependence on federal funds is shown in Table 14-1: 26.5% of nonurban costs are supplied by federal funds as compared with 7.7% of urban costs. Although 49% of the U.S. population resides in rural and small urban areas dependent on federal funding, these areas receive less than 10% of the total available Urban Mass Transportation Act funding. Furthermore, Section 18 assistance has declined since 1980, while rural public transit systems using the programs have greatly expanded.13 Lack of funding and the continuing need for services mean new services must often be planned with less federal funding, and existing services must be made more efficient.

TABLE 14-1
Operating Costs for Public Transportation

Revenue Generato	% Urban Costs	% Nonurban Costs
User	44.3	27.8
Local	30.3	34.7
State	17.6	11.0
Federal	7.7	26.5

Source: Adapted from American Association of State Highway and Transportation Officials, *1985 Survey of State Involvement in Public Transportation,* a report to the Standing Committee on Public Transportation (Washington, D.C.: American Association of State Highway and Transportation Officials, October 1985), p. 21. Survey *of State Involvement in Public Transportation,* Copyright 1985. The American Association of State Highway and Transportation Officials, Washington, D.C. Used by permission.

DEFINING AND ESTIMATING RURAL TRAVEL NEEDS14

THE CONCEPT OF NEED

It is extremely difficult to provide a quantitative response to the problem of defining the magnitude of rural public transportation needs. Nonetheless, it is not difficult to establish conceptually the critical need for adequate transportation services to rural residents. The energy crisis and inflation of the early 1970s focused attention on the singular dependence of the rural population on the automobile. Few economical

alternatives to automobile travel existed. Particularly acute problems faced the transportation-disadvantaged sector of the population, including the elderly, handicapped, youth, and those limited by single-auto ownership. Difficulties were also particularly evident for those elderly and poor who desired to travel to points of human services delivery in nearby town centers.

On a national scale, data from the Nationwide Personal Transportation Study (conducted by the Bureau of the Census for the Federal Highway Administration, 1969- 1970) helped to illustrate the magnitude of rural travel problems and needs.15 The data confirmed that those living in unincorporated areas traveled more frequently and generally made longer trips than average. Public transportation was used for work trips by only 2.6% of the people in unincorporated areas and 3.1% of those in towns with less than 5000 population. In addition, only 12.4% of all households in unincorporated areas did not own cars (mostly the poor and elderly).

While these data were only nationwide averages, they suggest some definite trends in rural travel. First, there is an overwhelming reliance on automobile travel. Second, those rural households in reasonably stable and comfortable financial positions are willing to drive more often and longer. These households may not perceive any pressing travel needs or problems. Third, the small fraction of those rural families who are transportation disadvantaged have urgent travel needs. Thus, in many cases the transportation problem can be summarized as a question of whether or not a privileged majority is willing to subsidize the transportation costs for a dependent minority.

Since rural transportation problems and needs are so closely correlated with auto availability, several analysts have measured needs in terms of automobile accessibility. In a report to the U.S. Senate, Ira Kaye suggested that "transportation-deprived" households were those that did not own an automobile and "transportation-handicapped" households were those that owned no more than one automobile.16 The latter definition recognized the fact that the breadwinner was expected to utilize the only car available for work trips. A survey indicated that in at least 28 states, over two-thirds of the rural population could be classified as transportation handicapped and that in 12 states at least 20% of the households were transportation deprived.

Burkhardt and Eby procured a refined algorithm for assessing rural transportation needs.17 They recognized that need must include both the factors of transportation availability (for example, car, taxi, shared rides, walking, bus service) and the concomitant factors of transportation affordability (for example, level of income per household). A numerical rating scheme was devised to produce composite levels of need based on the degree of modal accessibility plus the level of income. The authors, however, recognized the arbitrary nature of the needs estimation process and suggested a probing of consumer behavior through demand analyses.

Unfortunately, since the concept of need for rural transportation services has not been rigidly defined, this need has been difficult to measure. Various analysts have taken different approaches to evaluate needs, and there is not a clear uniformity of opinion. Basically, three broad approaches are available. Perhaps the most common approach is for experts, such as transportation engineers, planners, sociologists, and/or transit managers, to assess relative needs based on various social indicators combined

with their best judgments. Second, need may be gauged from a survey of potential users, developed through a home-interview questionnaire. Finally, need may be estimated by comparing the travel behavior of a target group against a standard taken from local or national travel surveys.

CONTRASTING DEMAND WITH NEED

The distinction between rural transportation needs and rural travel demands is most crucial to the eventual development and implementation of transit services and should be recognized. Unlike need, demand is based on the economic willingness-to-pay concept and is measured (for example, the price of travel). Demands are registered in a market and are, therefore, related to the user's income level. Those with low incomes, or no automobiles available, are less likely to demand travel.

Travel demand contrasts sharply with the social concept of need. Travel needs are a fixed amount of travel that is deemed necessary to provide an adequate standard of living, a quantity not affected by the price of travel. One may have a need to travel independent of the ability or willingness to pay. In this context, need is an equity criterion, indicating a deviation from an established norm that should be corrected.

TECHNIQUES TO ESTIMATE NEED

Techniques used to estimate the magnitude of rural transportation needs are somewhat arbitrary, and their limitations should be recognized by planning agencies developing a need estimate. For example, the technique of solely *using the judgments of experts is* inadequate because it is completely devoid of community participation in a project that is pertinent to the community's welfare.

A second technique, *using an opinion poll of area residents,* poses severe measurement problems. Home interviews by both Jon Burkhardt and R. N. Robertson failed to identify significant need when respondents were asked what trips they would like to make that they currently were not making.18 In both studies, the "desired" trips were found to be less than 6.0% of the existing ones, although the investigators commented that many of the respondents had difficulty grasping the idea of "desired trips" and thus probably substantially underestimated them. In any case, it is exceedingly difficult to find any major unserved demand in this manner.

A third technique, *comparisons against a standard, is* the most realistic, although it also suffers drawbacks. Comparisons cannot be made with travel in urban areas, for example, since rural households are usually more self-sufficient. In addition, rural travel distances are generally longer. Consequently, rural trip-making needs are different from trip-making needs in an urban area.

Another difficulty in making comparisons is that in most states the rural population tends to be older and poorer.19 These are precisely the types of people that make fewer trips, even in urban areas. Any comparison, therefore, should be with population groups of similar characteristics. Even then we may find that older people in rural areas "need" to make fewer trips because of the locational self-sufficiency and

because of the traditional helpfulness of nearby relatives and neighbors in providing transportation.

A fourth technique, *gap analysis,* has been utilized in several studies.20 This technique is based on the hypothesis that a difference in trip-making rates (for example, the gap) is a direct indicator of transportation need. To apply this procedure, a minimum trip-making rate is set as the standard amount of transportation to be supplied. Usually, an areawide average volume of trips generated per household per day is used for the standard. The choice of an average value is crucial to the magnitude of the needs estimate, and the transportation analyst should clearly state all assumptions. For example, a study of Raleigh County, West Virginia, noted that either a national average, a statewide average, a county average, or averages of rural and poor populations might be used.2i

Trip-making rates may be cross-classified to attain a more realistic estimate of transportation needs. This approach depends only on the detail of the data collected. One strategy is to cross-classify the travel data by target groups (also known as market segments) and by trip purpose. A target group is an identifiable unit of rural trip makers such as the elderly or the handicapped. Trip purposes could include grocery shopping, other shopping, health care, personal business and recreation. Travel rates for the target groups are determined, and needs estimates, specific to the study area, are then developed.

A continuing problem has been the lack of a comprehensive data base. While urban transportation studies have been substantial and voluminous in terms of data collection efforts, rural areas have been almost completely ignored. One reason for this, of course, is the large expanse of rural territory in this country and the resultant prohibitive cost of conducting home-interview origin-destination surveys similar to those done in urban areas. Another reason is the comparative lack of congestion and related problems such as air pollution and accidents, which may inspire local officials to study rural needs. Even census data are less helpful in rural areas, since the smallest geographic unit usually is the enumeration district and much valuable information (for example, income and trip to work) is not collected.

PLANNING RURAL PUBLIC TRANSPORTATION SYSTEMS

In 1977, Tardiff, Lam, and Dana noted in a review of small-city and rural transportation planning that "The state of the art in non-metropolitan transportation planning is one in which there has been considerable disjointed effort in providing services, but little systematic development of policies, planning theories and methods."22 Little refinement of rural planning methods or theories has been conducted since that statement was made. Nonetheless, many rural systems have been planned. Figure 14-1 presents a typical planning sequence for a new transit service. The definition of unmet need and goal setting, combined with community input, are critical steps in planning

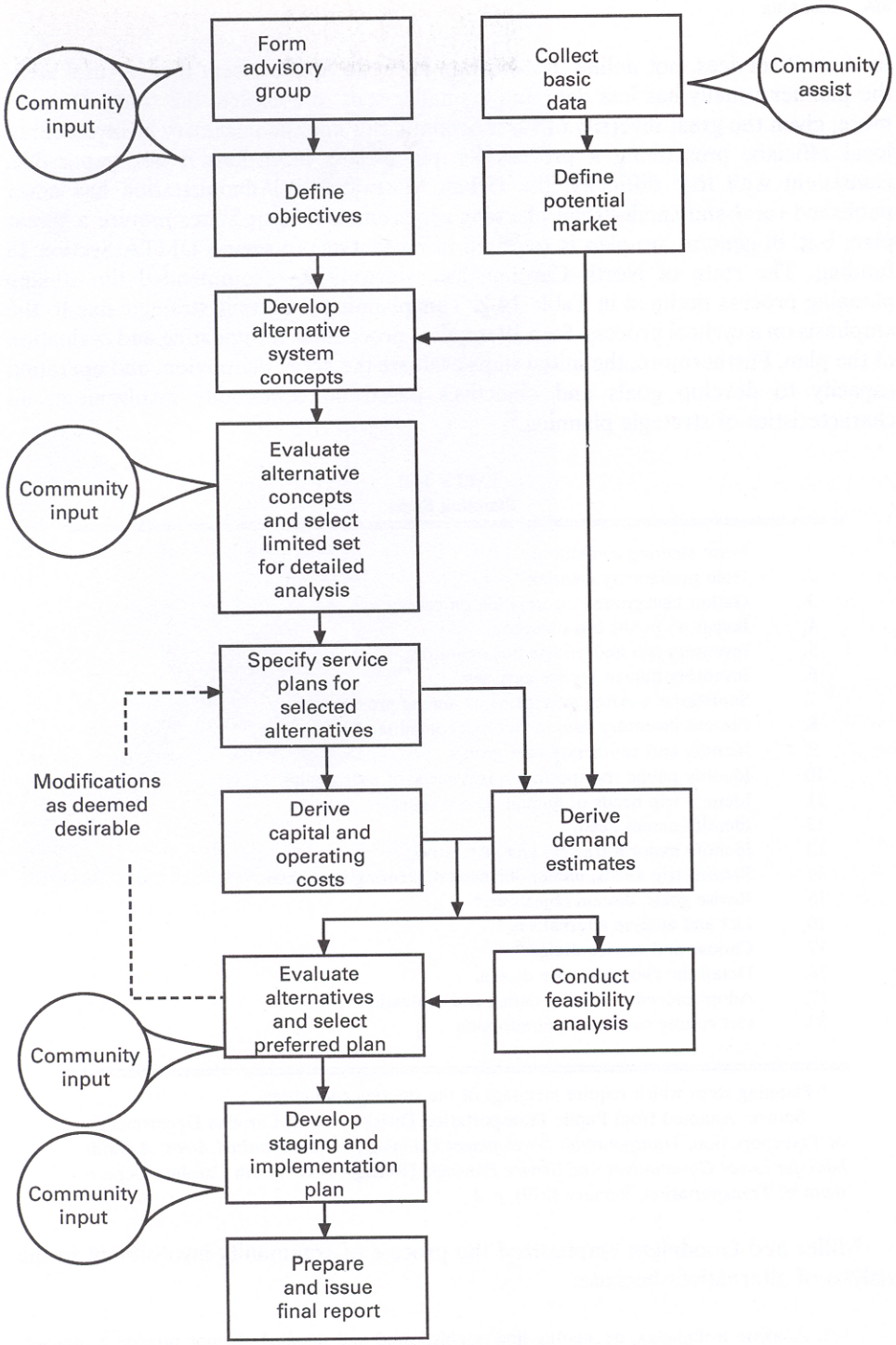


Figure 14-1 *Flow diagram for public transit study.*

for transit services, not unlike the situation in urban areas, except that in rural areas the planner usually has less data and a smaller staff to complete the study. Furthermore, given the great diversity of rural communities and the necessary involvement of local officials, prescribing a process for planning is hazardous if not impossible. Consistent with that difficulty, the Urban Mass Transit Administration has never published rural and small-urban planning requirements. Some states require a 5-year plan, but, in general, no plan is required in most states to secure UMTA Section 18 funding. The state of North Carolina has, since 1979, recommended the 20-step planning process outlined in Table 14-2. This planning process is strategic due to the emphasis on a cyclical process. Step 19 requires procedures for updating and evaluation of the plan. Furthermore, the initial steps evaluate the area environment and operating capacity to develop goals and objectives based on community involvement, all characteristics of strategic planning.23

TABLE 14-2
Planning Steps

1. Form steering committee.
2. Hold preliminary meeting.*
3. Gather background information on county.
4. Inventory public bus operator.
5. Inventory taxi and private bus operators.
6. In ventory human service agencies.
7. Sum7.marize existing arrangements among providers.
8. Presen t inventory data to steering committee.*
9. Identify and enumerate user groups.
10. Identify public transportation trip needs of user groups.
11. Identify trip needs of human service agencies.
12. Identify unmet need.
13. Identify major attracters and generators.
14. Present trip needs, unmet demands to steering committee.*
15. Revise goals, discuss objectives.*
16. List and analyze alternatives.*
17. Choose and service design.*
18. Detail the chosen service design.
19. Adopt procedures for updating and evaluation.*
20. Get county commissioner adoption.

* Planning steps which require meetings of the steering committee.

Source: Adapted from Public Transportation Division, North Carolina Department of Transportation, *Transportation Development Planning for Nonurbanized Areas: A Guidebook for Local Governments and Service Providers* (Raleigh, N.C.: North Carolina Department of Transportation, January 1979), p. 4.

Miller and Goodnight emphasized the process of community involvement in the analysis of alternatives because:

1. Analytic techniques, no matter how sophisticated and detailed, do not provide completely

accurate estimates of transit patronage. This is especially true for small communities that do not have transit services.

2. For many of the smaller communities a set of feasible alternatives is limited and the cost of testing the most promising alternatives by actually implementing the services is not great.
3. For small systems, the cost of error is not great. Change in routes and additions of buses can be achieved at little cost addition.
4. Factors entering into the decisions pertinent to implementation include social, political, economic, and technical considerations. The transportation related estimates should be balanced in accordance with the roles each of these considerations play.24

DEFINING ALTERNATIVES25

A variety of vehicle types and operating strategies has been suggested as applicable to rural public transportation, and rural transportation planners are encouraged to consider many vehicle choice options and operating strategies in developing prospective systems. In addition, they are expected to survey all existing providers and supply options and to consider other usually neglected alternatives for improving rural mobility. These include carpools, community volunteer groups, and mobile delivery of human services. In general, it is expected that alternatives would be selected on a cost effective basis, but this may not always be the case. For example, some agencies may choose to provide fewer vehicles with more expensive equipment (for example, lifts for handicapped), although the actual demand for these facilities may be extremely limited. A representative list of technological alternatives for transit service follows.

1. *Conventional fixed route, fixed schedule system.* A conventional bus system would have vehicles operating on fixed routes and fixed schedules. One variation that seems to be more feasible for low-density rural areas is periodic scheduling, where, instead of daily service, buses serve different areas on different days of the week. Every citizen is offered a dependable means of transportation to the local town or closest urbanized area at least once a week. In this manner, capital and maintenance costs are kept low.

2. *Dial-a-ride (dial-a-bus).* One of the largest components of the total operating costs of either conventional or demand-responsive service is the drivers' wages. Rural transit systems, like their urban counterparts, are highly labor intensive and, no matter how small and economical the bus, the demand in many rural areas is often too small or too scattered to warrant fixed schedules and routes. Some economies may be achieved by providing demand-responsive services that minimize vehicle-miles and vehicle-hours of service, yet still provide a minimum acceptable level of service to the users. Dial-a-ride is one such system, using minibuses or vans and offering door-to-door service on a telephone demand-scheduled basis. In many situations an advance sign-up system for riders, such as those found in many rural systems, is more practical. This option is termed *planned demand* and usually requires 24-h or longer advance notice to a

dispatcher. An extensive planned demand service has been operating in rural Missouri counties since 1971.26 This type of service is particularly attractive to elderly and handicapped segments of the population who would have difficulty obtaining access to fixed-route service.

Little used but possible modifications for demand-responsive systems include *mail-a-bus and porchlight bus.* In the early 1970s in one community in Missouri, the bus would travel a specific route and stop at any residence where the porch light was illuminated. If the rural area is characterized by low telephone ownership, it may be more effective to use the postal system as a means of transmitting information concerning desired rides. Requests put in the mailbox during the day could be collected that night by a dispatcher at the post office, who would then schedule buses for pickups and deliveries the following day. In some situations it may even be possible to have the mail truck itself serve as a passenger conveyance as is done extensively in Switzerland.

3. Jitneys. The jitney is analogous to dial-a-ride in that it is partially demand responsive, but instead of being a bus or van it is usually a private passenger car or station wagon that travels along a semifixed route. These vehicles travel basically one route, but vary somewhat to offer door-to-door service. The jitney driver may offer reserved seating, but more often cruises along until waved down by an individual desiring a ride. In urban areas, no strict schedules are adhered to, but in rural areas a somewhat fixed schedule would be necessary because of the probable few number of jitneys traveling on the back roads. Jitneys have not been extensively used in rural transport systems, but could be applicable to areas with well-defined travel corridors, such as the mountain valleys of Appalachia.

4. School buses. Most rural areas are served by a central school system that usually requires an extensive fleet of school buses. These buses generally are idle most of the day and could be used for other needed transportation functions. However, in many states there are legal restrictions on their use. In addition, certain design characteristics (such as a high first step, stiff ride, and narrow seat width) in most school buses make them unsuitable for adults and particularly unsuitable for the elderly. Another difficulty is that of scheduling, because school buses are available for nonschool purposes only in the late morning and early afternoon, thereby eliminating their use for work trips. Part time drivers for the short nonschool use period would have to be found. Also, use during the off-peak periods might hinder maintenance operations in the bus garages. Despite these problems, some state legislatures have passed laws allowing certain entities to use school buses for purposes other than the transportation of children. Florida has been notable in this regard and has a joint-use program with coordinated transit providers and school districts.27

5. Taxis. This alternative, unlike the jitney, is completely demand responsive. One problem with the taxi is that the usual practice of servicing only one request at a time forces up the cost of using this mode and makes it prohibitive to many rural families. Yet, if subsidized or coordinated with other modes, the taxi could

become more valuable in solving the rural transportation problem. Situations where the taxi might be used include:

a. Where dispatching ensures filling the taxi to capacity, with the cost being split between all the parties (known as shared-ride services).

b. Where, by pooling resources and hiring the taxi by the day, service organizations find they save money in the long run by not having to purchase and maintain their own vehicle. Also, they do not waste valuable employee time by sending them out in departmental cars to pick up patients or other service recipients.

The basic objections to utilizing existing taxi companies for the provision of rural transportation are the regulations eliminating the possibility of shared rides and also the difficulty that aged or handicapped persons have using small vehicles. However, financially sound taxi companies generally have smoothed out the types of operational and administrative start-up problems that may plague some newly formed rural systems (for example, maintenance, dispatching, and management). Such companies would be logical choices to operate rural public transportation systems.

6. *Rural feeder services.* Any operating scheme could be combined to feed intercity buses. Systems would collect passengers on the back roads and drop them off at waiting stations on the main routes where larger buses operate, or the systems would be the final link in the reverse trip. Intercity bus passengers left off in town could rely upon the taxi to complete the journey. The Rural Connector Service initiated by Greyhound Bus in 1987 and even earlier by Vermont Transit and Stage Coach of Randolph, Vermont, are examples of this type of service scheme.28

7. *Innovative services.* An enormous array of innovative services, such as organized hitchhiking, cars supplied to individuals who agree to carry others, and even supplying car loans, have been attempted.29 Some innovations are no longer in existence, but innovative utilization of volunteers as staff and drivers continue in many rural areas. The rural transit planner should be alert to utilizing the unique qualities and resources of an area when designing an alternative.

Although small vehicles are cheaper to run than large ones, the total cost of transportation/seat-mi decreases markedly with increasing vehicle capacity. For most rural systems, however, vehicle load factors are low, so high- capacity vehicles are not needed. Vehicle selection should not be made solely on the basis of capital and operational costs; the degree of capital subsidization, the user level of service provided, and the type of demand to be satisfied should also be considered.

Minibuses, with capacities ranging from 8 to 20 passengers, are the most popular vehicles for meeting the transportation needs of the rural areas where demand does not warrant the use of larger vehicles. Also, they can be more easily maneuvered on the substandard roads often found in rural areas. Due to their low capital and

operating costs, minibuses may be able to run routes that were considered economically infeasible with larger conventional buses.

Most rural transit systems have chosen to purchase either van-type vehicles or small transit buses. In general, they also tend to buy new vehicles rather than used ones. The reasons for new vehicles are twofold. First, the purchase of older vehicles involves a trade-off of depreciation for maintenance costs. Maintenance costs for older vehicles may prove to be unacceptably high, especially when the purchase price of new vehicles is fully or partially subsidized from outside sources. Second, operators are especially cognizant of the impact of a clean and reliable vehicle on ridership. They prefer the positive community impact of shiny new vehicles.

A number of operating strategies are feasible for rural localities. The alternatives may be analyzed by considering different types of routing and headways. Many operating systems provide both fixed-route/fixed-schedule and demand-responsive services or innovative service that features aspects of all the alternatives. The fixed routes generally serve work trips, are used as connectors between town centers, or are closely tied to a human services delivery system (such as a senior-citizen lunch program). Occasionally, the topography of a rural county is ideally suited for fixed routes, such as the Appalachian corridors or the coast of California.

Partially demand-response systems include those using route-deviation or point- deviation systems. These services have been operated in small-town environments and provide more flexibility than the fixed-route/fixed-schedule system. Fully demand-responsive services, operating on real time with dynamic routing, have generally not been applied in rural scenarios, especially if the system is to cover an entire county, since demand densities are too low.

The door-to-door service characteristics of demand-responsive systems are highly desirable. Therefore, some rural counties have provided door-to-door transportation services on a scheduled (for example, planned-demand) basis. Often the same vehicles that carry peak-hour work trips will operate in the planned-demand mode between the peak hours. To increase the economic efficiency of these systems, the county is often divided into sectors, with service in a sector only being offered on specific days of the week.

The most vexing problem facing rural transit planners is how to allocate scarce resources for the most public good. Sooner or later all service providers or planners are forced to make relative value judgments on whether, for example, in a managed demand system, they allocate vehicles to transport one person to regular kidney dialysis or to provide service to seven people who want to go grocery shopping. Although most systems do not formally establish priorities, an informal priority often is adopted whereby the number of people transported is roughly weighed against the trip purpose so that one person requesting service for recreational purposes would receive service after another individual receives service for a medical purpose. While, in general, the rule of first come, first served is observed, trips are judiciously prioritized, and dispatchers often negotiate with potential passengers on the most advantageous time to make their trip.
There are numerous routing and scheduling options for rural transit systems.

However, few guidelines exist to aid in the development of routes or schedules for a new rural service. Operating experience is perhaps the best source for current guidelines. Experience with rural transit systems in North and South Carolina led to the following conclusions about scheduling.29

SCHEDULNG PRACTICES

1. Rural worker schedules should rarely exceed 1.5 h total run time from origin to destination. Workers tend to resist trip time that is more than double car-trip time.
2. Rural social delivery schedules can be somewhat longer in overall duration (about 2 h is maximum). As a rule, trip needs in this category have less urgency, and passenger demands on the schedule are less critical.
3. Rural social delivery schedules should allow 2 h between arrival time and return time for general business and shopping needs.
4. Rural demand-route schedules should have generous time allowances built in for passengers embarking with groceries and for elderly passengers, who are slower to board and discharge. Stop allowances should be roughly estimated at 2 to 3 min apiece. This is more difficult to achieve on fixed-route schedules.
5. Fixed-route schedules should be geared for an average open road speed of 40 to 45 mi/h (64 to 72 km/h), with a time insertion of about 2 to 5 min at each mainline stopping point. Very little allowance is required (at first) for flag-stop possibilities. These will usually be rare during the first year of operation.
6. All schedules should consider allowing at least a 5- to 10-min delay at each end of a long—about 25 mi (40 km)—run. This scheduled slack time permits drivers to catch up on any unplanned delays on the prior leg.
7. Worker buses should always have at least a 10-min prior arrival time at the factory gate to allow time for workers to check in. Less than that will produce a drastic and immediate drop in worker ridership, since they are by far the most critical riders in the system.

ROUTING RULES

Routing rules have been gained as a product of operating experiences. Most are stated as rules of thumb that should not be blindly adhered to in all cases. The following guidelines are often used.

1. Rural passengers are reluctant to walk as much as 0.4 km (0.25 mi) to a fixed-route bus stop.
2. For many-to-one demand-responsive services, loop routes radiating about a central destination are desirable. Passengers are returned home as the vehicle leaves the central destination and picked up on the return to town. This procedure shortens the average passenger's in-vehicle travel time.
3. Routes should not be modified to accommodate only one or two people, although route planners should be alert to all suggestions.

4. Variable and irregular scheduling typical of route-deviation bus systems places severe restrictions on reliability. Riders have more confidence in a fixed-route system or an advance reservation door-to-door service.

In summary, the design of a successful rural transportation system (including vehicle selection, routing, and scheduling) is contingent upon the planners' thorough knowledge of the community, its geography, its road network, and the needs of the potential rider. Guidelines are available, but one cannot assess the exact impact of changing any of the design variables without actually operating a system. The *Florida Management Manual for Small Transit Systems* notes that the transit manager of very small transit systems (no more than five buses) will probably want to simplify the planning and scheduling process by basing service on policy decisions involving what the transit system believes it can afford and general marketing considerations.30 The discovery of what the system believes it can afford and general marketing considerations will be found through the planning process.

Planning for transit in rural areas is a lengthy process. Data from Theodore Wallin and Alice Kidder indicate that it takes approximately 3 years to complete the planning process for an average service from initial problem identification, meetings, writing funding proposals, getting approval for funding, and finally operating the service. Table 14-3 presents the elapsed time to pass selected milestones in the planning process. Planners should be aware that each community has its own peculiarities or strengths, which may lengthen or shorten the planning process.

ESTIMATING DEMAND31

The concepts of need and demand are inescapably intertwined in the planning process for rural public transportation. Typically, planners are aware that transportation in rural areas is characterized as high need and low demand. That is, the social consequences of not providing service to low-income households, elderly, or others with a high need is great, yet the ability of these people with high need to pay for service makes for low demand. The difficulty of establishing demand is acute, and no entirely satisfactory process for establishing need and demand in rural areas has been developed.

Although the estimation of potential ridership is a difficult task, it is an essential component to the planning and design of a rural transportation system. The inefficiencies associated with an underutilized vehicle fleet may eventually result in the premature demise of rural transit services. A demand projection should, therefore, serve as the primary basis for the system's design.

TABLE **14-3**
Elapsed Time Requirements to Pass Selected Milestones

Task	Mean Months Required to Pass Milestone	Lowest Number of Months Reported	Highest Number of Months Reported
Calling initial organized meeting	5.3	1	15
Getting agreement to start a transportation service	5.2	1	15
Meeting with other organizations to consolidate or coordinate service	24.6	2	99 or more
Writing proposal for funding (only during the initial period before vehicles started on the road)	5.8	1	12
Getting needed funds to get started	5.9	1	15
Meeting with key officials to get approvals (leases, donations of space, permits, etc.)	5.4	0	50
Planning the service and program	17.1	2	99 or more
Hiring staff	16.4	1	99 or more
Recruiting volunteers	33.7	2	99 or more
Training volunteers	5.0	0	9
Training other paid drivers	1.7	0	2
Publicizing service	4.9	2	12
Arranging insurance	3.8	0	14
Setting up routes and schedules	19.0	1	99 or more
Making experimental changes in routes and schedules	34.7	2	99 or more
Completing other tasks involved in start-up	3.7	1	8

Source: Adapted from Theodore A. Wallin and Alice Kidder, *Financing and Sustaining Mobility in Rural Areas: A Manual*, Final Report, prepared by The Franklin Program on Transportation and Distribution Management, Syracuse University, for UMTA, Technology Sharing Program, Report no. DOT-I-87-2 (Washington, D.C.: U.S. Department of Transportation, August 1986), pp. 4-9, 4-10.

As previously discussed, a number of techniques have been used to determine demand. Recent experience, however, has shown that the following methods are not reliable.

- A local "would-you-ride" survey.
- Gap analysis.
- Professional opinions.

A common approach to demand estimation has involved door-to-door attitude surveys prior to the development of the transportation service. Such surveys generally include questions about the number and types of transit trips that would be made under various environmental conditions (for example, quality of service, automobile availability, and frequency). There are two serious flaws with this method of demand projection. The first difficulty is that multipurpose journeys are often not measured properly by the questionnaire. Generally, respondents are asked to indicate how many trips they would make on the service, if it existed, for each trip purpose. In doing so, they often neglect to consider multipurpose trips and provide an overestimate of the actual number of person trips. Second, and of critical importance, the demand forecasts on the basis of attitude surveys of this type generally are not verified by actual travel behavior. In a survey of prospective travel frequencies in a small town in New York (Oneonta), public response indicated that a demand-activated bus service would generate 33,700 trips/week when an actual service in a comparable nearby small town (Batavia, New York) only generated 1500 trips/week.32 The discrepancy between the estimate and actual demand illustrates the fact that public opinion surveys cannot be directly translated into actual vehicle trips.

Both gap analysis and the use of professional opinion (such as the Delphi technique) also have shortcomings. Gap analysis is better suited as a needs estimation tool. The use of experts' opinions, as incorporated into a "goals attainment" procedure, has not been sufficiently tested to be recommended for use.

It is evident that demand forecasts for a particular area should be tempered by a knowledge of the existing levels of demand for like transportation services in other similar localities. Table 14-4 presents a summary of some existing rural transportation systems and their service characteristics. Some of these programs include special service to the elderly, while others have a broader ridership base. Trip-generation rates in Table 14-4 are presented in terms of annual transit trips (one-way) per capita. Note that most systems are servicing less than 1.0 transit trip per resident per year. This rate of travel might be used as a liberal rule of thumb for maximum anticipated ridership, in the absence of better data. Many systems will not even produce this level of ridership. In a study for the state of Pennsylvania, a range of travel rates between 0.3 and 2.4 annual trips per capita was used to develop a forecast of statewide potential rural transit demand.33 This is quite a wide range (the highest estimate being 8 times the lowest) and may prove to be of little aid to a planner trying to decide on a realistic demand level to use for a particular county or planning district.

TABLE 14-4
Observed Rates of Transit Use

Trip-Generation Rate (Annual trips per capita)	LOCATION
4.00—10.00	Batavia, N.Y. (dial-a-ride)
3.00—4.00	High estimate, small urban areas (Pa.)
2.00—3.00	High estimate, rural (Pa.)
1.00—2.00	Mid-Delta (Ark.)
0.50—1.00	Raleigh County (W.Va.)
	Low estimate, small urban areas (Pa.)
0.25—0.50	Venango Action Corp. (Pa.)
	Low estimate, rural (Pa.)
0.00—0.25	Kingsport, Tenn.
	Potter County (Pa.)
	McKean County (Pa.)

Three approaches to estimating demand that are considered acceptable are:
.°Trip-generation-rate models.
• Regression models.
• Participation-rate models.

Only trip-generation models have been utilized to any extent and are the obvious choice for preliminary planning, although a functional-demand equation developed by Burkhardt and Lago through statistical analysis of fixed-route and demand-responsive systems may prove quite useful.34 The third technique analyzes the demand for rural transit to social services in terms of the participation rate of those utilizing social services and the likelihood of transit use for travel to the services. This technique may be well suited for those rural transit systems designed to act primarily as a human services delivery system for the elderly.

The trip-generation-rate model is an aggregate approach. That is, trip rates are assumed to hold for an entire population. However, by detailing exact target groups that are expected to utilize the system, a more refined travel estimate is produced.

To compute demand by means of the trip-generation-rate model, the following formula is used:

$$D = \sum_{i=1}^{n} di\,(POPi) \qquad (14\text{-}1)$$

where D = total annual demand for transit trips annual trips per person in the ith target group
d1 = annual trips per person in the ith target group
(POPi) = population of the ith target group
n = number of target groups

In Pennsylvania studies, planners selected two target groups, the elderly and the nonelderly poor, which were expected to comprise 80% of the public transportation system ridership. The demand equation is

$$D = \frac{12(POPelderly) + 19(POPpoor)}{0.80}$$

where the trip-making rates for the two groups were projected to be 12 and 19 trips per year, respectively. Subsequent demand studies using Wisconsin data have shown that use of a "no-auto-available" target group produced more accurate demand projections, and a study in California emphasized the importance of income in demand projections.35 Completely satisfactory demand models have not been developed, and this area has progressed little since the mid-1970s.

Planners developing rural public services typically separate potential ridership to identify high-demand market segments without service, such as an employment center or senior center. Table 14-5 presents a list of potential market segments. The ridership for the high-demand segment is then quantified as trips per day, and other services are incrementally added to the core service. As the planner quantifies other lower-demand market segments, the total estimated demand is then compared to demand estimation models and actual ridership from other similar systems to determine if the estimates by market segment are reasonable. For further discussion of market segmentation, see Chap. 16.

TABLE 14-5

Transit-Dependent Market Segments

1. Frail elderly (those persons no longer able to drive themselves).
2. Children in families with no available transportation.
3. Students who do not have cars of their own, and who need to get to colleges, technical institutes, job training programs, etc.
4. The physically disabled (persons with vision impairment, multiple sclerosis, polio, paralysis, etc.) who have not been able to drive themselves.
5. The mentally disabled (mental retardation, mental illness, brain injury, etc.).
6. The low-income family that does not have one car for each wage earner and for whom at least one adult is transit dependent (for example, welfare mothers without cars).
7. Those who are fearful of driving or who are unwilling to drive to unfamiliar areas such as to hospitals in large cities.
8. Those who have no license to drive.
9. Those who have no transportation to programs designed for special groups, for example, the seniors (e.g., recreations sites and adult day care), the low income (e.g., welfare offices), or the general public (e.g., public hearings).
10. Spouses of wage earners who take the family's only vehicle to work, leaving the spouse with no transportation for part of the day.

Source: Adapted from Theodore A. Wallin and Alice Kidder, *Financing and Sustaining Mobility Programs in Rural Areas: A Manual,* Final Report, prepared by The Franklin Program on Transportation and Distribution Management, Syracuse University, for UMTA, Technology Sharing Program, Report no. DOT-I- 87-2 (Washington, D.C.: U.S. Department of Transportation, August 1986), p. 2-1.

COORDINATION

The concept of market segmentation is particularly important when the issue of coordination of rural passenger transportation is considered. Rural transportation service for some market segments exists in practically every county in the United States. The service may only be for Head-Start children or senior citizens' centers, but the planner for rural transit is encouraged to consider the concept of coordination before initiating a completely new service, because some level of service undoubtedly already exists. The concept of coordination will be initially introduced into the planning effort in an inventory of existing providers. The existing providers may include various social-service providers, public providers, and private for-profit providers. All these groups should be considered in the coordination process. The concept of coordination is not directed specifically at consolidation of services but rather at a family of activities, ranging from communications between operators to the maximum coordination, which is consolidation of services. The benefits of coordination are:

1. Eliminating duplication of transportation services.
2. Making better use of underutilized equipment, expertise, facilities, or other resources.
3. Matching transportation providers with transportation purchasers.
4. Taking advantage of volume purchasing power.36

The coordination benefits realized may be more service for the available funding, more available service, and better availability of transportation to those in need. Large monetary savings through any coordination efforts are unusual. The monetary savings of programs have been unclear, and the actual benefits of coordinated services typically are service quality improvements and more available service.

Coordination to achieve these benefits is complex due to the great number of federal programs that supply or have the potential to supply passenger transportation services. Approximately 114 programs exist that pertain to passenger transportation, and the estimate of expenditures by the U.S. Department of Health and Human Services approaches $1 billion per year.37

The major impediments to the coordination of public and specialized transportation in rural areas arise from the multiplicity of human-service and related transportation programs provided by the federal, state, and local governments. The issues that will necessitate resolution in most coordination efforts include:

1. Inconsistencies in service boundaries or target population groups.
2. Cost allocation methods and cost accounting requirements.
3. Matching rate type, and percentage variances.
4. Data collection requirements.
5. Vehicle operating costs (insurance, maintenance, gas, license, etc.) and pro rata utilization charges for nonprovider agencies.
6. Public service commission (or public utilities commission) regulation and requirements.
7. Funding levels authorized for programs

8. Commingling of funds (administrative mechanisms and budgetary procedures).
9. Auditing standards and requirements.
10. Effective utilization of volunteers (in-kind services and facilities) in program planning, development, and implementation).
11. The relationships between human services, transportation systems, proprietary transportation providers, and public mass transportation systems in both urban and rural areas.38

Saltzman investigated the coordination of transportation by human service agencies and discovered five factors that influence a given social service agency to participate in a coordinated transportation service, as shown in Table 14-6.39 Figure 14-2

TABLE 14-6

Factors Influencing Agency Willingness to Coordinate

Relative Rating	Gamma	r	Rank	Variable Description
Influential	-.40	-.42	1	Perceptions of whether the cost savings were worth the loss of control when coordinating.
	-.32	-.28	2	Amount of time an agency had available to negotiate coordination.
Moderately influential	+.25	+.28	3	Whether an agency thought they would not lose much control if they coordinated.
	-.25	-.19	4	Perceptions of how much cost savings would occur from coordination.
	+.22	+.23	5	Whether transportation was an authorized function of the agency.
Negligible or no influence	+.20	+.20	6	Amount of administrative effort an agency thought it would take to coordinate.
	+.001	+.02	7	Whether an agency thought regulations were a barrier to coordination.
	-.04	-.06	8	Whether an agency was sure it would have operating funds the next year.
	-.OS	-.02	9	Whether an agency expected an increase in next year's budget.
	-.02	-.02	10	Whether an agency received its approved budget before or after it was required to start operating a system.

Source: Adapted from Arthur Saltzman, *Coordination of Transportation by Human Service Agencies: An Interorganizational Perspective*, Ph.D. dissertation for the University of California, Irvine, reprinted in Technology Sharing Program (Washington, D.C.: U.S. Department of Transportation, January 1980), p. 183.

is the path diagram for Saltzman's "willingness to coordinate hypothesis." The diagram shows that, if an agency believes that their savings are worth the loss of control and

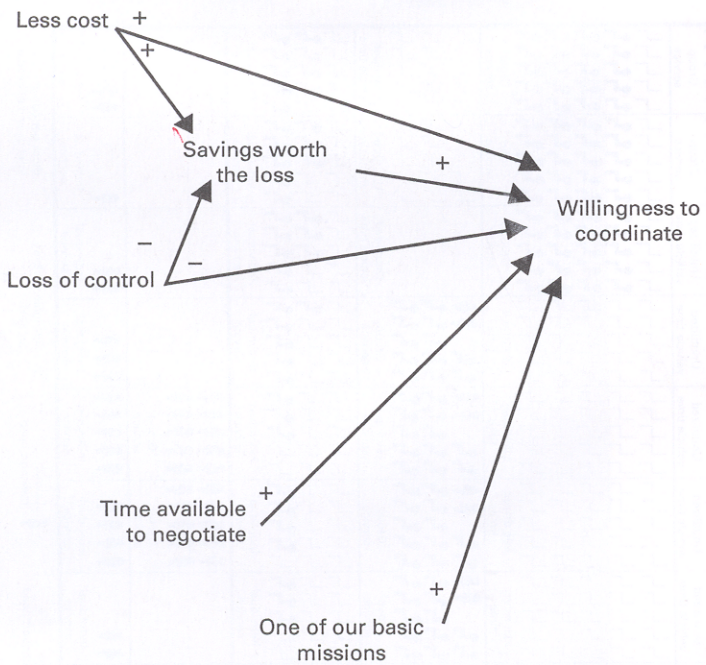


Figure 14-2 *Path diagram for willingness-to-coordinate hypothesis. [Source: Arthur Saltzman*, Coordination of Transportation by Human Service Agencies: An Inter-organizational Perspective, *Ph.D. dissertation for the University of California, Irvine, reprinted in Technology Sharing Program (Washington D.C.: U.S. Department of Transportation, January 1980), p. 185.]*

the lower costs are coupled with time available to negotiate and if the agency has the coordination of services as one of its basic missions, it is likely that the agency will participate in a coordinated service. This macro approach to coordination is then coupled with a micro evaluation of coordination as shown in Fig. 14-3, where a planner must identify underutilized vehicle time or driver time and couple these factors with the unmet transportation needs of various market segments.

Contracting or purchase of services from private for-profit operators has been receiving considerable attention and is a special area of coordination. With private operators, coordination may involve other activities rather than direct service functions. These might include routine maintenance, vehicle cleaning, dispatching services, and other activities. As can be seen from Table 14-7, coordination with private operators goes beyond the mere purchase of transportation services. Practically any activity that is conducted by the transit service is an opportunity to coordinate with the private sector.

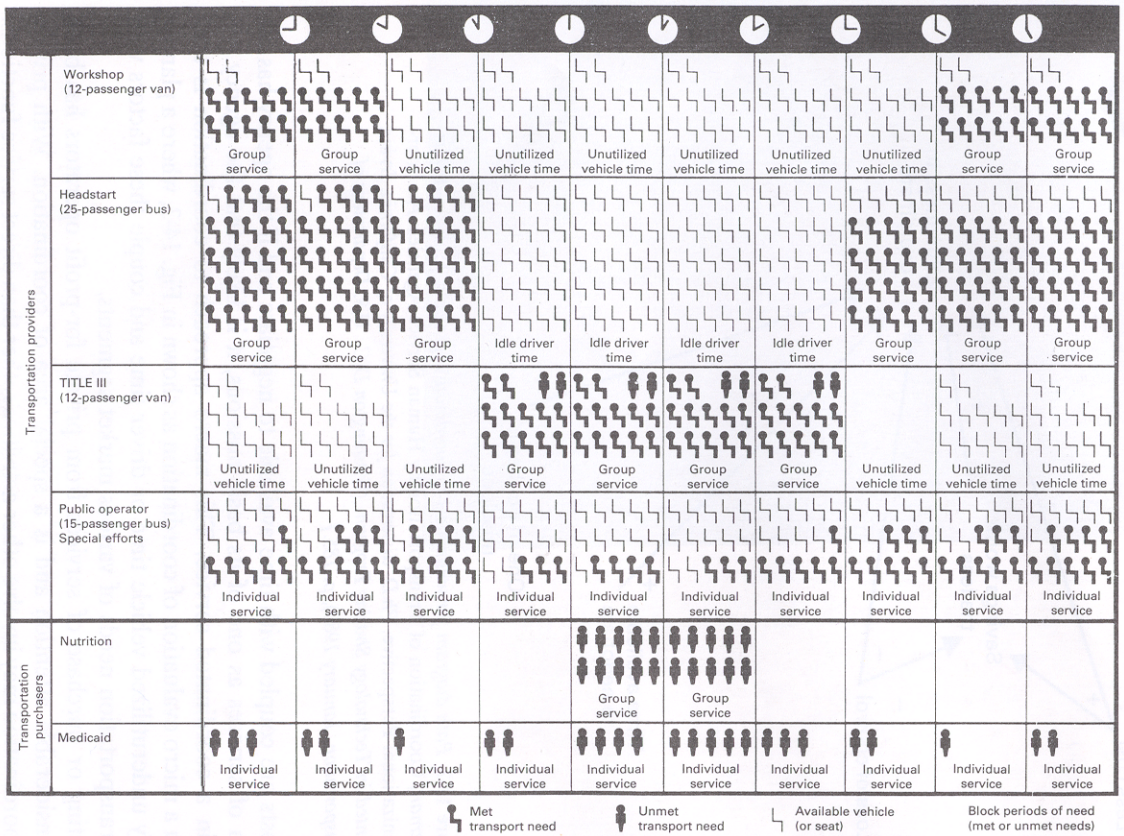


Figure 14-3 *Transportation resources and needs. [Source: Applies Resource Integration, Ltd.,* Planning Guidelines for Coordinated Agency Transportation Services *(reissued version), prepared for U.S. DOT and U.S. Department of Health and Human Services, Report no. DOT-I-87-33 (Washington, D.C.: U.S. Government Printing Office, April 1980), p. 7.]*

TABLE 14-7

Private Sector Coordination. Contracting : Opportunities

Category/Name Administration	Activity	Private Sector Provider
Grant Administration	Grant preparation	Consultant
	Grant management	Service contractor
	- record keeping	Management company
	- financial transportation	
	- regulatory compliance	
Reporting	Procedures/forms development	CPA
	Data collection	
	Data analysis	Data processing company
Computer Processing	Software and hardware needs	Consultant
	System installation	
	System maintenance	Service contractor
	System evaluation and updating	
	Turn-key service	Management company
Procurement	Specifications development	Consultant
	Production inspection	Service contractor
	Inspection and acceptance	Management company
Audit/Accounting	Independent year-end audit	CPA
	Overhead audits	CPA
	Monthly accounting	CPA
Planning	Transportation Development Plan	Consultant
	Management audits	Consultant/Management co.
	Special studies	Consultant/Management co.
	Route and schedule evaluation	Consultant/Management co./service contractor
Marketing	Marketing analysis	Research firms
	Campaigns and promotions	Marketing/PR firms
	Vehicle advertising space	Marketing/PR firms
Maintenance	Vehicle cleaning	Local garages
		Specialty service corp
	Vehicle body/paint work	Body/paint shops
	Major vehicle repairs/overhauls	Engine/transmission shops
	Routine vehicle maintenance	Local garages
		Auto/truck dealerships
	Office equipment	Business machine repair
Operations	Employee recruitment	Personnel agency
	Employee (contract) management	Personnel agcy-/Management.co.
	Employee training	Personnel consult./Mngementt.co.
	Vehicle operations	Taxi/limousine
		Tour companies
		Para transit companies
		Emergency service providers
		School bus companies
	Safety training	Consultant / Management co.

Source: Adapted from Carter-Goble Associates, Inc., *Private Sector Contracting for Rural and Small Urban Public Transportation Providers: Workshop Manual,* Technology Sharing Program (Washington, D.C.: U.S. Department of Transportation, 1990), p. iii-8.

Forty-one states have some type of coordination mechanism, and these efforts can be categorized into one of three methods for coordination of the administration of transit programs: (1) task forces, (2) committees, or (3) mandatory programs.40 The transit planner should consult with the state agency responsible for public transit to determine the level of coordination necessary as plans are developed.

IMPLEMENTATION

The key element in the implementation process is the coordination of the planning effort with the day-to-day requirements of an implementation program. The initial implementation considerations are many in number, but the following list represents those that are essential to the development of a successful system (they are discussed in this section and the next):

1. Institutional arrangements.
2. Policy making and staffing.
3. Insurance.
4. Finance and funding.
5. Cost and evaluation.

The principal institutional arrangements that are considered in the planning process are:

1. The nonprofit organization, organized according to the laws of individual states.
2. Private for-profit corporations.
3. Regional transit authorities.
4. Transportation districts.
5. Service provision under a governmental agency, typically a city or county government.

No single model has been uniformly successful. Cooperatives at one time were considered promising, but given public funding requirements and tax advantages of other forms of operations, the cooperative mode of organization has been largely avoided as of the mid-1970s. The most notable of the early cooperatives was the OATS (Older Adults Transportation Service) program in Missouri. This program established itself initially as an agricultural cooperative but found that it could not receive tax advantages or certain essential government grants, which it needed to succeed and, therefore, reorganized as a not-for-profit corporation. This illustrates a critical problem for planners in the initial stages: to choose the correct form of institutional arrangement that allows the program to adapt to the operating environment.

The policy board that is established to operate the service will have numerous areas in which to establish policy. A list of areas for developing initial goals and policies is contained in Table 14-8. The most critical decision that a board will effect is the development of an organization chart and the corresponding selection of a chief executive officer. Figure 14-4 presents a generic functional organization chart. The relationship between the functional organization chart and the personnel organization chart for a small service is presented in Fig. 14-5. As an organization grows, the service may have staff members who conduct planning, marketing, and other activities shown consolidated under the manager's office. The board should be alert and monitor the service through a comprehensive taxonomy of goals, objectives, and targets for each of the functional areas of the service.

TABLE 14-8
Governing Body Policy Decision Areas

°°Farebox recovery.
• Special fares.
• Geographic area of service (demand-responsive).
• Designation of priority patron (demand-responsive).
• Designation of priority trip purpose (demand-responsive).
° Client eligibility requirements (if applicable).
• Client billing rates, form, and amount (if applicable).
• Fleet deployment and garaging.
• Vehicle maintenance scheduling. Capital replacement. Hours of service.
• Length and location of routes (fixed-route).
° Days of service.
• Level of service (for example, fixed-route headways).
• Vehicle capacity and vehicle type.
Ultimate fleet-size.
• Vehicle backup.
Accessibility features.

Source: Adapted from National Association of County Engineers, *Rural Public Transportation*, NACE Action Guide Series Vol. II (Washington, D.C.: Federal Highway Administration, 1986), p. 3-2.

The most critical area of initial development in the implementation process is securing insurance, which has proved to be a difficult necessity both in terms of costs and availability. An agency's attractiveness for insurance coverage can be enhanced not only by a good loss ratio but also through the development of a strong risk-management program. The principal areas to develop loss control measures are organizational, vehicle, employee, and passenger safety programs; service factor considerations; physical property protection; and professional liability.41

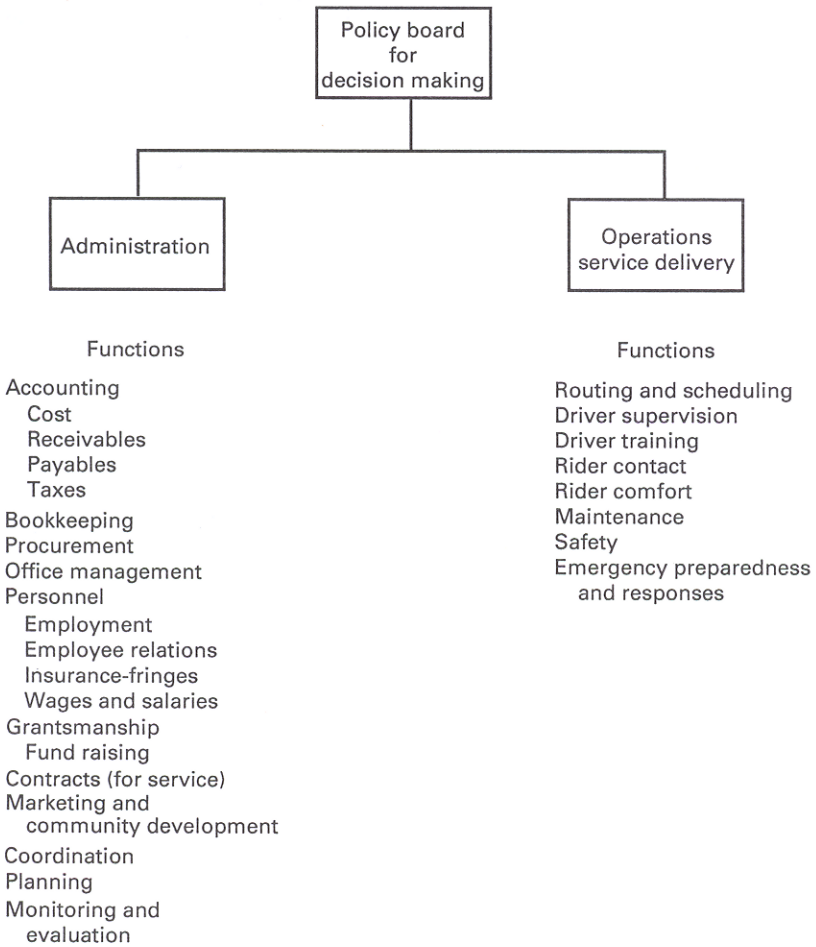
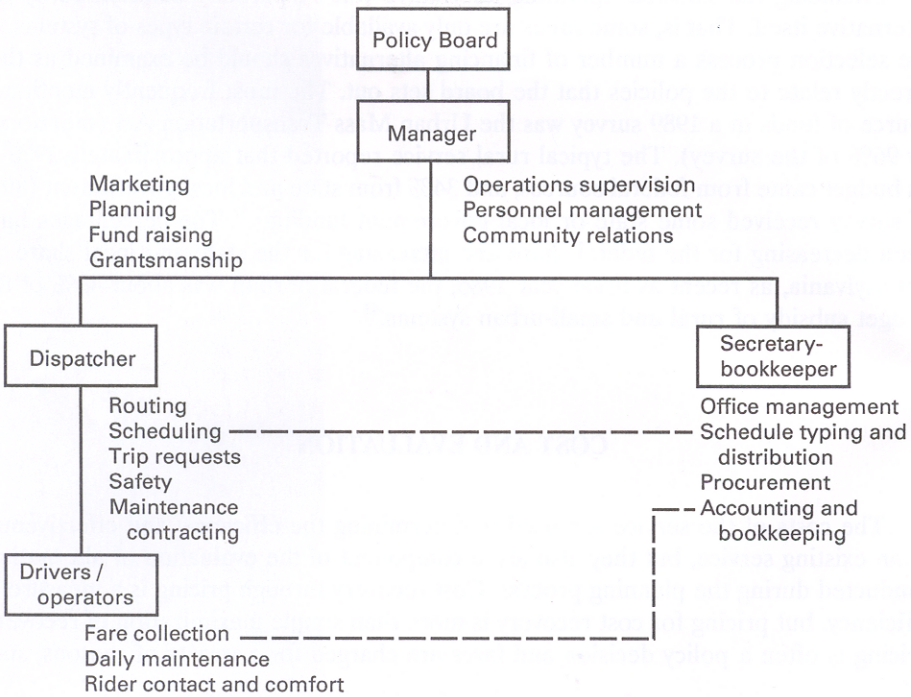
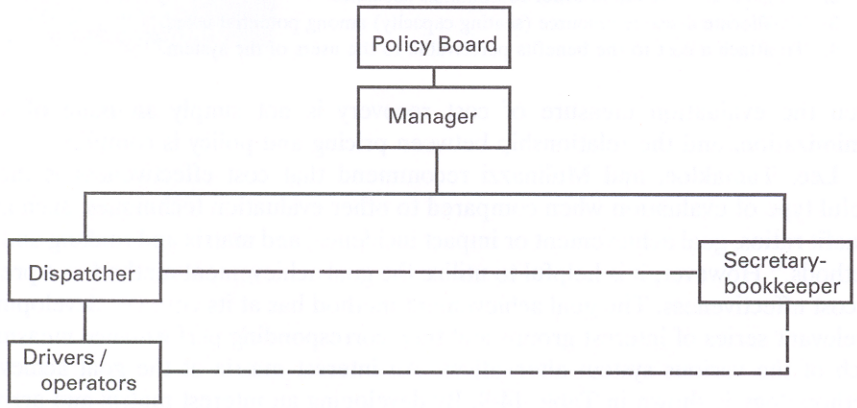


Figure 14-4 *Functional organization chart.*



Functional Organization Chart

From the above the personnel chart is developed



Personnel Organizational Chart

Note: Solid lines indicate direct line authority and supervision. Dashed lines indicate coordination between positions.

Figure 14-5 *Development of organization chart from functional organization chart.*

Financing the selected operating alternative will be partially determined by the alternative itself. That is, some funds are only available for certain types of systems. In the selection process a number of financing alternatives should be examined as they directly relate to the policies that the board sets out. The most frequently mentioned source of funds in a 1989 survey was the Urban Mass Transportation Act (mentioned by 96% of the survey). The typical rural service reported that approximately 29% of its budget came from federal sources, and 34% from state and local government (80% of survey received some state or local government funding).42 The percentages have been decreasing for the federal share and increasing for the state and local share. In Pennsylvania, as recent as fiscal year 1986, the federal portion was about 48% of the budget subsidy of rural and small-urban systems.43

COST AND EVALUATION

The costs of the service are used in determining the efficiency and effectiveness of an existing service, but they also are a component of the evaluation of alternatives conducted during the planning process. Cost recovery through pricing is a measure of efficiency, but pricing for cost recovery is more than simple maximization of recovery. Pricing is often a policy decision and fares are charged for a variety of reasons, such as:

1. To avoid the stigma attached to free-fare systems as poor people or "welfare buses."
2. To generate revenue in order to minimize subsidies.
3. To allocate a scarce resource (seating capacity) among potential users.
4. To attach a cost to the benefits perceivable to the users of the system.44

Even the evaluation measure of cost recovery is not simply an issue of subsidy minimization, and the relationship between pricing and policy is complex.

Lee, Tamakloe, and Mulinazzi recommend that cost effectiveness is the most useful type of evaluation when compared to other evaluation techniques, such as cost-benefit ratios, goal achievement or impact incidence, and matrix and ranking and rating methods.45 However, it is helpful to utilize the goal achievement method as a precursor to cost effectiveness. The goal achievement method has at its core the development of a relevant series of interest groups and then corresponding performance measures for each of the various system alternatives. An interest matrix of the goal achievement methodology is shown in Table 14-9. By developing an interest matrix and arriving at various measures, corresponding to the various groups, a cost effectiveness evaluation can be applied. If measures of convenience, such as frequency of service, are important to one of the interest groups, a measure of frequency (number of vehicles serving a given destination per hour) can be evaluated and referenced back to the interest group.

ABLE 14-9
Impact-Interest Matrix

Impact or Condition Set	Interest Group: Passenger	Operator	Community
Availability	X		
Area coverage		X	
Speed	X	X	
Cost	X	X	
Punctuality/reliability	X	X	
Comfort	X		
Convenience	X		
Security/safety	X	X	
Frequency	X	X	
Capacity		X	
Side effects		X	
Passenger attraction		X	X
Long-range impact			X
Environment/energy impact			X
Economic efficiency			X
Social objectives			X

Source: Joe Lee, E. K. A. Tamakloe, and Tom Mulinazzi, A *Public Transportation Needs Study for the Low Density Areas in a Five-State Region in the Midwest (Iowa, Kansas, Missouri, Nebraska, and Oklahoma),* Final Report (Washington, D.C.: U.S. Department of Transportation, April 1981), p. 91.

For example, in a simulation study of demand-responsive transportation in rural Virginia, alternatives were defined by service-area size (called the sector) and the number of vehicles assigned to a sector.46 Sector size was defined as either the entire county or one of five wedged-shaped factions of the county. Level-of-service (LOS) factors and system resource utilization and cost factors were then determined for each combination of service area and number of vehicles. From these data, an analyst was able to evaluate three possible demand-responsive service options.

° *Option A:* Purchase enough vehicles (5) to meet the target demand and run them over the entire county (761 rte.-mi).
° *Option B:* Purchase enough vehicles (4) to meet the target demand and run the entire fleet within a sector (571 rte.-mi). Alternate sectors according to the day of the week.
• *Option C:* Confine service to sectors but operate vehicles simultaneously in all sectors (673 rte.-mi). Purchase enough vehicles (5) to meet demand or provide at least daily service in each sector.

Differences in the options lead to some interesting cost base comparisons for the particular area. By restricting service to one sector per day, the fleet size could be reduced by one vehicle and the route mileage by 25% on a countywide service. Also,

daily operating costs (including fuel, insurance, license, maintenance, repair, labor, and vehicle depreciation, but not administrative cost) could be reduced by approximately 20%. If through an interest matrix it was revealed that the passengers found a once-a- week service frequency unacceptable, then by purchasing a fifth vehicle, service could be improved. A vehicle could be assigned to each of five sectors, with all vehicles operating simultaneously. This might be an acceptable alternative, although daily operating costs would increase to a level comparable to the cost of option A. If, according to the interest matrix, it was revealed that cost per mile was acceptable with option A to an appropriate interest group, then option C with simultaneous service to all sectors would be slightly preferable to the unrestricted countywide service from an operation standpoint.

Data to evaluate alternatives before operations begin are difficult but not impossible to develop. By developing a sample budget and then comparing the system cost to similar systems, costs can be compared. Evaluation after operations have been initiated is more straightforward, and data are available from most state departments of transportation on operating costs. Table 14-10 presents a cost element structure to

TABLE 14-10

Cost Element Structure for Rural Transportation Systems

Overall Cost Category	Cost Elements
Operating costs	
Per vehicle-mile	Fuel
	Oil
	Tires and tubes
	Vehicle repairs and maintenance—parts
	Vehicle repairs and maintenance—nonvolunteer labor
	Vehicle repairs and maintenance—volunteer labor
Per vehicle-hour	Driver wages—nonvolunteer labor
	Driver wages—volunteer labor
	Dispatcher wages—nonvolunteer labor
	Dispatcher wages—volunteer labor
Per vehicle	Insurance
	Maintenance of dispatching equipment (base and mobile)
	Driver examinations and training, license, and tags
	Vehic1e storage (including covered storage)
All other operating costs	General and administrative overhead
Capital costs	Vehicle capital
(including depreciation	Dispatching equipment capital (including
and interest charges)	dispatching base, repeaters and mobile equipment)

Source: Adapted from Joe Lee, E. K A. Tamakloe, and Tom Mulinazzi, A *Public Transportation Needs Study for t*e Low Density Areas in a Five-State Region in the Midwest (Iowa, Kansas, Missouri, Nebraska, and Oklahoma),* Final Report (Washington, D.C.: U.S. Department of Transportation, April 1981), p. 49.

aid in evaluating costs before operations begin. Table 14-11 represents typical operating costs for various-size systems to aid in evaluating operating systems.

Regardless of whether the evaluation is before or after services have begun, the relationship between goals and costs cannot be ignored. Furthermore, even if a system is meeting goals at a satisfactory cost, monitoring still must take place. The evaluation process and relationship of goals is shown in Fig. 14-6 and reinforces the concept that costs and evaluation are always examined in some interest matrix context.

TABLE 14-11
Operating Costs per Trip and per Vehicle-Mile, by Size of System

	All Trips by All Providers	Fixed-Route Service Only	Demand-Responsive Only
All providers			
Operating cost per trip			
Arithmetic mean	$2.98	$2.53	$3.55
Median	$3.81	$5.30	$3.64
Rang *	$1.40—$13.74	$1.43-$12.62	$1.34-$15.84
Operating cost per vehicle-mile			
Arithmetic mean	$1.29	$1.94	$1.09
Median	$1.19	$1.77	$1.39
Rang *	$0.59-$13.74	$0.91-$3.67	$0.55-$2.21
Small providers (1-5 vehicles)			
Operating cost per trip			
Arithmetic mean	$3.25	$3.03	$3.28
Midian	$3.62	$5.54	$3.17
Rang *	$1.69-$16.69	$1.84-$12.62	$1.69-$17.25
Operating cost per vehicle-mile			
Arithmetic mean	$1.41	$1.63	$1.31
Median	$1.42	$1.65	$1.42
Rang *	$0.61-$2.40	$0.96-$2.62	$0.74-$2.21
Large providers (6 + vehicles)			
Operating cost per trip			
Arithmetic mean	$2.92	$2.40	$3.61
Median	$3.87	$3.01	$4.42
Rang *	$1.30-$12.51	$1.43-$6.81	$1.01-$12.51
Operating cost per trip			
Arithmetic mean	$1.28	$2.08	$1.01
Media	$1.21	$1.78	$1.13
Rang *	$0.61-$2.52	$1.16-$3.67	$0.51-$2.09

*Range excludes 10% of cases at each end of array.
Source: Adapted from Community Transportation Association of America, "Profile of Section 18 Programs" (draft 1990).

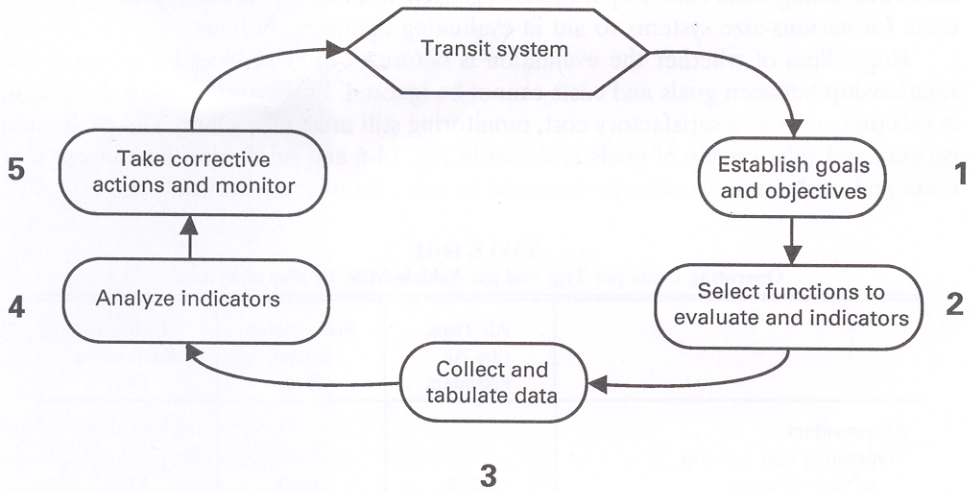


Figure 14-6 *Performance evaluation steps. [Source: Carter-Goble Associates,* Rural Public Transportation Performance Evaluation Guide, *Final Report, prepared for Pennsylvania DOT, reprinted by Technology Sharing Program, Report no. DOT-I-83-31 (Washington, D.C.: U.S. Department of Transportation, November 1982), p. 4.]*

SUMMARY

Identifying the need and demand for rural transit services is an abstract and difficult process. However, the planning process whereby market-segment analysis and involvement of the community are coupled to select a feasible alternative can be systematic and reliable. This planning process that evaluates market segments for their needs and demand is based on the heritage of rural transit, serving those in greatest need.

When evaluating alternatives, there are many different types of strategies that all relate conceptually to cost evaluation. One alternative that should always be evaluated is coordination. While coordination evaluation is a critical planning step, it must be remembered that the American public demonstrates a willingness to support an isolated and fragmented rural transportation service (the school bus system). Consequently, the rural transit planner should not be hesitant to design a service that is somewhat narrow but has wide support on an interest matrix. When evaluating the selected alternatives, at least six principal institutional arrangements may be used; however, the determining factor for the selection of an institutional arrangement should be based on the potential for a strong financial plan that will allow a rural public transportation system to thrive and serve those in need.

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EXERCISES

14-1 It has been said that passenger transportation is perhaps the most critical element in the delivery of social services. How can public transportation planners use this to their advantage?

14-2 Develop a matrix rating five agencies and their willingness to coordinate. Scale the matrix so that one agency clearly wishes to coordinate and one clearly does not want to coordinate. Use a semantic differential with 5 a high score and 1 a low score on each of the principal coordination factors.

14-3 Community involvement in the planning process is critical to the success of any planning effort. Who should be on the planning committee and what special issues should the creator of the committee be alert to as the committee is developed?

14-4 Examine the elapsed time for selected planning milestones in Table 14-3 and the planning model in Fig 14-1 and note that it takes approximately 17 months to complete the planning process. If, as shown in Table 14-3, calling the initial organizing meeting takes 5.3 months, what could the planner for a new service do if she or he must complete the process in 12 months to meet the terms of a planning grant?

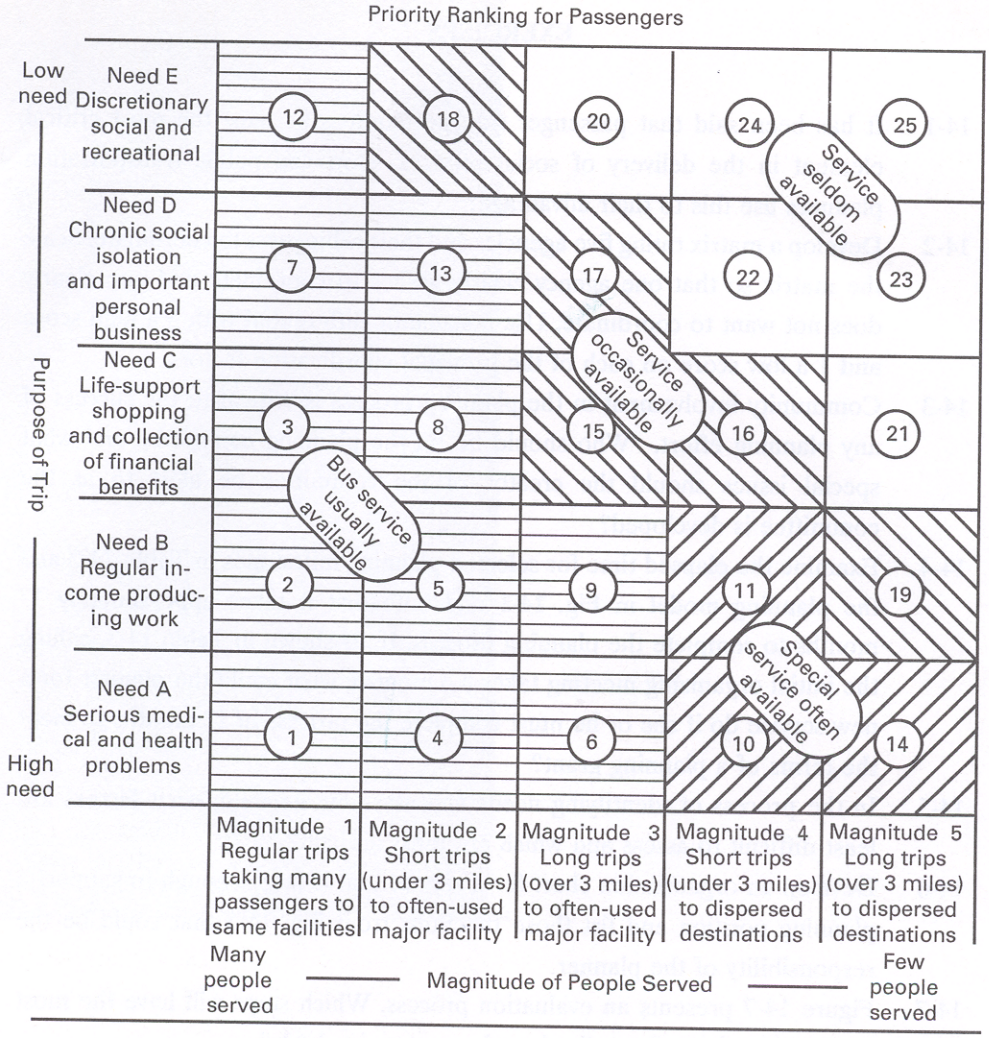
14-5 In the process of identifying needs and assessing demand, what factors are least difficult to assess and which are most difficult?

14-6 Develop an organization chart for a service that is large enough to support a planning position and list those functions from Fig. 14-5 that could be the responsibility of the planner.

14-7 Figure 14-7 presents an evaluation process. Which steps will have the most involvement from the policy board or governing body?

14-8 List three performance indicators for monitoring ridership and then list the corresponding data required to evaluate the indicators. Finally, list the possible corrective actions for improving the performance indicators.

14-9 Using the following matrix, which areas of the matrix would be best served by fixed-route, fixed-schedule conventional transit? demand-responsive transit? a volunteer automobile-based transit program? a taxi user side subsidy?



Notes:

1. The numbers in the circles indicate the priority that will be assigned to that trip.
2. The lower the priority number, the greater the chance that the system will be able to provide service.
3. Passengers with high numbers may be able to get service later when the demand is less or may not be able to get service at all.
4. This figure is intended for management use. It is not designed to be understood by laypersons or passengers.

Source: Dave Systems, Inc., Anaheim, Calif., no date.