SUMMARY OF ORGANIZATIONAL AND ENVIRONMENTAL REVIEW OF 2 PRIVATELY OWNED, SHARED-RIDE TAXICAB SYSTEMS

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Steadily decreasing ridership on traditional urban transportation modes has prompted concern about urban transportation systems. This paper deals with 1 level of such a system—privately owned, shared-ride, demand-responsive services. The intention of this paper is to provide an introduction to some of the basic characteristics and concepts of taxicab service in urban areas. It has been written primarily for the use of those who are generally uninitiated in the subject area but who are nevertheless interested in alternative methods of providing urban public transportation service. The paper serves as a starting point for more detailed study of taxicab systems and services, and it serves to develop an awareness of the operating environments and functional structure that have proved fundamental to the success of any organization. Thus it follows that the way in which a privately owned, demand-reponsive taxicab system organizes itself, provides itself with the necessary personnel, equipment, facilities, and services, and formulates and follows an operating strategy will be the fundamental factor in making the system a workable enterprise. This paper, then, examines the functional structures of taxicab systems, the requirements and characteristics of the people who operate them, the regulatory environments in which the systems operate, and the various pricing strategies that the systems may follow.

INCREASING interest in urban public transportation systems has been generated as the result of increasing ownership and usage of private automobiles and the accompanying steady decline in the ridership and profitability of traditional urban public transportation systems. To satisfy the public's total transportation needs, urban public transportation should include a combination of services, modes, and organizations that yield the optimal trade-off between social benefit and social cost. One service level that may play a key role in the optimal transportation structure is demand-responsive service. This report is part of a research project sponsored by the Urban Mass Transportation Administration, U.S. Department of Transportation, which has examined 2 innovative and profitable demand-responsive shared-ride taxicab companies operating in 2 diverse urban areas—Hicksville, New York, and Davenport, Iowa—and the roles that they play in meeting the public transportation needs of their communities.

TAXICAB SERVICE

Taxicab service is the for-hire public transportation service by which persons may obtain conveyance by road between specifically desired locations by paying fares that are based generally on the trip distances involved. Shared-ride service is that by

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which unaffiliated but currently riding passengers with different origins and destinations are accommodated simultaneously by the same vehicle by means of route deviations. Taxicab companies generally operate in 1 of 3 modes of operation or in combinations of the 3. The first mode uses stands (areas where taxicabs wait for passenger selection); the second mode involves cruising (passengers hail the moving cab); and the third mode involves radio-dispatched fleets.

LEVELS OF SERVICE

A second dimension that may be used in comparing different taxicab systems is the level of service that they provide. There are basically 3 service levels: premium service (1 passenger has exclusive use of the cab), group ride service (more than 1 passenger occupies the cab at the same time for a common purpose destination), and shared-ride service (more than 1 passenger occupies the cab at the same time and has no acknowledged affinity).

ORGANIZATIONAL ASPECTS

Successful demand-responsive transportation systems depend on the effective coordination of several functional areas. The organizational structure of a demand-responsive transportation system should reflect the relative importance of these functions so that the end result is the highest attainable level of operational efficiency and effectiveness.

Functional Structure

The total structure contains both primary and secondary functions. The primary functions, which are especially important, include driving, dispatching, and managing.

The most visible activity associated with the taxicab company is that of driving. The drivers perform the fundamental purpose of taxicab service, which is the transporting of people and goods within a city. Taxicab systems typically attract and provide drivers in 1 of 2 ways, both of which are output related. The most common arrangement is that in which the drivers are employed by the company and are paid on a commission basis (1). Another method is the lease system. Under lease systems, self-employed drivers lease or rent vehicles from the taxicab company's fleet and then retain all of the receipts taken in. Lease drivers are responsible for charging the rates of fare set forth by the laws, ordinances, or regulations of the cities in which they operate and may or may not be responsible for reporting their receipts to the lessors (2).

The dispatching system is the nerve center of a demand-responsive transportation system. The dispatcher is responsible for the day-to-day coordination of vehicle and driver operations through vehicle trip assignments and routing. The dispatcher usually uses some sort of visual display, such as a dispatch board, chart, or grid map that shows origins and destinations demanded, to help keep track of the status of the taxicab fleet and pending service requests. The dispatching situation is more complicated when shared riding occurs. The dispatcher should consider not only the near future availability of now loaded taxicabs and the current availability of empty taxicabs but also the availability of taxicabs already carrying passengers that can deviate from current routes without unduly delaying passengers already in the taxicab or those waiting to be picked up. To be effective in shared-ride dispatching, the dispatcher should visualize not only the origins and destinations of trips but also the exact routes being followed and the exact locations of all vehicles at all times. Every dispatcher has a limit to the number of trips he or she can handle at any one time and is subject to error. (Some shared-ride personnel feel that the most trips a dispatcher can effectively handle in 1 h of a multiple-hour shift is about 100 in shared-ride operations

compared with about 300 in non-shared-ride operations.)

The dispatcher also plays an important role in the initial and continuing training of drivers and in developing high employee morale. The manner in which the dispatcher communicates with drivers in making trip assignments is a key factor in determining the degree of rapport between drivers and dispatchers.

Working closely with the dispatcher is the telephone answerer. The telephone answerer provides the dispatcher with the information he or she needs to assign a vehicle. Therefore, the telephone answerer should get all of this information from the caller and pass it on accurately and quickly. An additional responsibility of the telephone answerer is to detect and verify invalid requests for service. In light of the nature and importance of the dispatching function and its inherent faults, more and more demand-responsive transportation systems are looking toward computerized dispatching systems. Such automated systems would receive requests for service, check the status of the vehicles in operation, and dispatch the appropriate driver after taking into consideration the number and types of vehicles in operation, travel times, return trips, and other operating variables and profitability criteria. The computerized dispatching system also would make possible the use of a more efficient and equitable fare structure based not on the traditional zone and distance systems but on a distance-related sliding scale. The system could tell the passenger how much the trip would cost when he or she telephones in the request for service.

The ultimate responsibility for the successful operation of a demand-responsive taxicab system lies with its management and supervising personnel. Basically, the taxicab system manager's goal is to gauge the demand for taxicab service at different places and different times, to determine and specify the system's market strategy, and then to see that the most efficient use of available vehicles is attained in following this strategy.

The manager's first function is that of planning short- and long-term goals, such as expansion of services, growth in business volume, and maximization of profits.

Pricing decisions involve determining first the basis of the fare structure [typically distance (meter) or zone], the price differentials and exact fares for the various services (products) provided, and the extent of discounts to regular customers. In organizing current and planned operations into an integrated system, the manager should look for the organizational structure that will provide the optimal trade-off between high levels of service and low cost consistent with the market strategy of the system. As directors of private demand-responsive taxicab operations, taxicab managers and supervisors should be both firm and flexible with their workers (3). Managerial personnel must be aware of all the problems that may arise and must be ready to deal with them quickly and fairly. In controlling taxicab operations, system managers should be concerned with maintaining desirable levels of service quality and quantity, revenues, and costs. The key concepts in this area are the precise evaluation of the demand for various elements of urban public transportation service (as is the case in planning) and the most efficient use of all available resources in providing the desired services. In the first case, the taxicab manager can measure demand by becoming active in the community in which he or she operates and being sensitive to the attitudes and problems to which he or she is exposed. The owner-manager of Royal Cab Company of Davenport, Iowa, for instance, regularly goes out into the business community to see whether his services (especially urban goods movement) are of benefit. In the second case, the manager should be constantly evaluating himself or herself, the workers, and the methods that they use, looking for new and more efficient programs.

The secondary operational functions responsible for the success of the entire private demand-responsive system include maintenance of vehicles, vehicle insurance, and advertising and promotion.

Maintenance of vehicles represents approximately 7.5 percent of the cost of operating a demand-responsive transportation system according to statistics of the International Taxicab Association. Vehicles that are idle because of mechanical failures or damage reduce the available capacity of the system and are costly drains on profitability. Two broad areas of vehicle maintenance should be considered: preventive maintenance and repair work. The demand-responsive company should set up a

program of preventive maintenance. This program would involve both the mechanics who perform vehicle inspections and tune-ups at regular intervals and the drivers, who should be conscious of vehicle care in their operations.

As common carriers of passengers in cities, demand-responsive taxicab systems are responsible for the safe conduct of their passengers as well as for the safety of citizens and property in their areas of operation. The factors that determine the insurance rating of a taxicab system include the number, types, and sizes of vehicles making up the fleet, the past insurance record and safety performance of the system, the level of driving experience of the drivers, and the economics of the area involved. Insurers frequently include deductible provisions to eliminate small "nuisance claims." This may actually help the taxicab system because deductibles contribute to lower insurance rates and act as strong incentives to avoid accidents and mishaps (4). Typical liability coverage for personal injury specifies a minimum of $50,000/person of $100,000/accident. The recent safety performances of the Orange and White Cab Company of Hicksville, New York, and the Royal Cab Company of Davenport, Iowa, were examined to gain an idea of the types of accidents in which taxicabs are involved. This information was provided by means of questionnaires completed by the managers responsible for safety in the Davenport and Hicksville systems. One questionnaire was completed for each accident recorded in the indicated time periods. From January to May in 1973, Orange and White Cab Company vehicles were involved in 18 accidents that required repair work ranging from $75 to $300; average vehicle damage per accident was $88.22. Only 4 of these accidents involved personal injury; required medical expenses ranged from $18 to $65. Royal Cab Company vehicles were involved in 19 accidents from January to September in 1973; damage ranged from $49.59 to $802. Three of the 19 accidents involved injury, and medical expenses were $43, $115, and $2,050 respectively. Both Orange and White Cab Company and Royal Cab Company seek to avoid insurance settlements whenever possible by having company representatives at the scenes of accidents as soon as possible. These companies feel that case settlements are preferable to insurance settlements primarily because insurance rates are not affected and the company's image is not subject to the possible implications of extended claims settlement cases. Between January and May in 1973, 14 of the Orange and White Cab Company's 18 accidents were settled through cash settlements, and between January and September in 1973, 5 of the Royal Cab Company's 19 accidents were settled through "in-house" cash settlements.

The taxicab system may become involved in 2 different aspects of advertising and promotion: (a) promoting its own services and (b) advertising for others to gain revenue. The taxicab company may put its high exposure level on city streets to effective use by keeping the vehicles clean, selecting distinctive vehicle paint designs and colors, and encouraging drivers to drive courteously and safely. The best advertising methods for taxicab service are those that customers see when they need service. Demand-responsive taxicab systems typically advertise in the Yellow Pages and on the covers of telephone directories and offer direct telephone lines from major trip-generating locations to the dispatching office. The system may want to use its high exposure in traffic to act as an advertising agent for other commercial concerns by carrying signs on the roofs and backs of vehicles. In some cases, however, taxicab ordinances or other legislation may limit or forbid taxicab advertising (5).

A few other secondary functions should not be neglected. Among these are the purchasing of equipment and supplies, telephone answering, driver and dispatcher training, safety education, public relations, and secretarial and clerical work.

Methods of Providing Operational Services

Demand-responsive taxicab firms are organized as fleet, owner-operator, or lease systems (1, pp. 79-82). Provisions for functional services fall into the following 3 organizational categories:

1. Self-contained operations,
2. Contractual operations, and
3. Parent company and subsidiary operations.

The ramifications of analyzing and implementing the proper methods of providing operational services can be significant in organization and operation of a demand-responsive service.

Self-contained operations are those in which all required work is done by taxicab company employees. Involved in this type of operation are salaried or commission drivers, company-owned and company-operated maintenance and dispatching facilities and personnel, and all workers on the company's payroll. This technique for providing functional services is used by relatively small owner-operators who form taxi associations or corporations with other owner-operators. These cooperating owner-operators may band together in large enough numbers to set up their own operational facilities and staffs for functions such as maintenance and dispatching. The primary advantage of self-contained operations is that the taxicab system itself has complete control over the quality, quantity, and costs of the services provided. However, if system volume ever drops to the point where it is not high enough to fully use company-owned facilities, these self-contained operations can cause steady drains in profits.

Contractual operations are those in which a taxicab system enters into contracts with other firms for the various services needed to provide service. Although complete contractual operations are rare, many taxicab firms contract for vehicle maintenance and cleaning. Contractual arrangements are prevalent in cases where some segment of taxicab operations has reached the point where additional equipment or personnel or both can be obtained at a lower cost by contracting the function to specialists. In some cases, contractual agreements may be used as temporary provisions for functions until the system can supply the functions itself.

Parent company and subsidiary operations are those in which the various functions of service are furnished by subsidiary companies of a parent corporation that may or may not be the actual taxicab operation. These subsidiary companies usually are set up as profit centers in and of themselves and deal not only with their fellow subsidiaries but also with other customers. The advantages in parent company and subsidiary operations lie in the high degree of cost control, preferential treatment, favorable tax structure, and limiting of corporate liability. Also, with each subsidiary treated as a separate profit center, the incentive to supplement related company business with outside business whenever possible to maximize facility and staff use is strong. Another important advantage of parent company and subsidiary arrangements is the business that the component companies can generate for each other through publicity and referrals. For example, if the limousine company cannot handle all of the traffic in a given day, it can refer the business to the taxicab company.

REQUIREMENTS FOR AND CHARACTERISTICS OF TAXICAB SYSTEM PERSONNEL

Like fixed-route, fixed-schedule bus transit, taxicab service is highly labor intensive. This labor intensity extends from the driving to the dispatching function as well as to management itself. The level of achievement and professionalism exhibited by the workers in a taxicab system, especially in terms of the amount and quality of interaction among the 3 functional groups—drivers, dispatchers, and managers—is a major determinant of the success of a demand-responsive system.

Demand-Responsive Managerial Personnel

It is the manager's duty to oversee the day-to-day operations of the system, be ready to take advantage of opportunities that arise, be able to handle all problems that appear, and plan for the future. The managers of the Orange and White Cab Company and

Royal Cab Company have not spent their entire careers in the taxicab business. Previous occupations of managers include retail sales, vending machine operations, commercial advertising, and national sales management for manufacturers. Length of experience outside the taxicab business ranges from 10 to 16 years. Although some taxicab managers have followed the seemingly natural progression from driver to dispatcher to manager, others have entered taxicab management directly from other occupations. Apparently, lengthy experience in taxicab operations is not a requirement for effective taxi system management. The taxicab manager's goal is to get vehicles and drivers out on the community's streets where and when they are needed.

The taxi manager should possess high levels of both general business knowledge and knowledge of the taxicab industry. Most important here are a good understanding of individual riders' needs in relation to the laws of supply and demand, a keen awareness of the regulatory environment, and a familiarity with the current technical states of the art of all modes of urban public transportation. The taxicab manager also must be able to motivate or bring out the best in his or her employees. Because of the high level and importance of communications among telephone answerers, dispatchers, and drivers, the manager should find good workers and then see that they work together effectively. Most personnel problems require both effective communication skills and the ability to make clear-cut, final decisions. When speaking of their personal feelings for their occupation, taxicab managers offer a diverse assortment of thoughts. Most managers are satisfied with their jobs, but they have different ideas on the good and bad parts of their work. Some complained about the long hours that they have to work, and others say that they thrive on activity throughout the day. Some complain that their pay is not enough; others do not even mention it. The major displeasure expressed is not with the job itself but with the lack of recognition that the taxicab industry has received and with the slowness of innovation in the industry. Many managers like the job because of its independence, the public service it provides, and the satisfaction of putting together a smooth-running system of people, facilities, and equipment. It was found that most managers are fairly well satisfied.

Demand-Responsive Dispatchers

None of the dispatchers questioned had spent his entire occupational career in the taxicab business; all have worked in areas such as retail sales, vending machine operations, and postal and package delivery. From discussions with dispatchers, it appears that there is no commonality in terms of types or lengths of employment in or out of the taxicab business. Dispatchers consider it their underlying responsibility to serve customers by minimizing the time and trouble to which they must go to be provided with urban public transportation service. The Davenport, Iowa, and Hicksville, New York, dispatchers feel that to be effective they must have a working knowledge of the streets over which the cabs operate, the locations that they serve, and the problems that drivers can encounter. This knowledge comes primarily from cab driving experience. Many drivers get dispatching experience by serving as dispatchers in a backup capacity, and, therefore, are prepared to move on to full-time dispatching. Dispatchers should be able to function consistently in an atmosphere of constant urgency. A dispatcher handling 100 trips/h can devote an average of only 36 s to all of the decisions that must be made for each trip. To counteract this urgency, the dispatcher's job requires continuity in all of its phases. Dispatchers should be consistent in their methods of assigning vehicles to passengers and in radio dispatching to avoid confusion. They should be consistent in their dealings with the drivers to avoid complaints of favoritism. Both commission and lease drivers depend almost entirely on the dispatcher for passenger assignments. Thus, if any animosity at all existed between a dispatcher and a driver, a driver might suspect a dispatcher of deliberately limiting his or her number of trips or of favoring other drivers.

Most dispatchers like the job because of its complexity and requisite skills and because of the importance of dispatching as the key to efficient use of drivers and vehicles. Common sources of dissatisfaction are the high-pressure conditions and the

required impersonality of the job.

Demand-Responsive Drivers

Drivers have the most continuing and intimate contact with the consumer. A driver must integrate flexibility, which is an essential part of the occupation, into all of the skills required for taxicab driving. The ages of drivers tend to be 20 to 30 and 40 to 50 years according to statistics of the International Taxicab Association. This finding probably illustrates both the turnover in the lower age group and the career-oriented natures of personnel in the upper age group. The ages of the taxicab drivers of the Davenport, Iowa, and Hicksville, New York, systems ranged from 18 to 50. One driver had only an elementary school education, and 3 drivers had college degrees. The majority of drivers had a high school education. Occupational experience varied widely for all ages. Most had experience in the labor trades, but some had been professionals (bookkeeper, musician, and the like). Only a small percentage were in their first jobs as taxicab drivers. The younger drivers earned an average of $7,000; the older drivers earned from $13,000 to over $15,000. The vast majority of attitudes toward the job reflected a congeniality directed to riders and their various desires and needs. Motivational aspects of the taxicab drivers included aid to the public, little requirement for heavy work, flexible work schedule, opportunity to hold 2 jobs, desire to drive, contact with different people, ability to move around, and ease of termination without much notice being necessary. Another area of motivation was found in the family-like atmosphere that prevailed throughout the Royal Cab Company. Several of the drivers reported a feeling of belonging to not only the total complement of workers in the formal organizational structure but also the riders. Most drivers state that the money is highly reflective of the amount of time and effort expended. The most important occupational performance requirement is driving ability. This includes not only a fundamental knowledge of automobiles and their functions but also a desire for continuous driving. Excellent stamina is necessary because 12-h shifts are normal in a 6- or 7-day week.

REGULATORY ISSUES CONFRONTING TAXICAB SYSTEMS

Since the nineteenth century, the transportation industry has been viewed as a public utility, thus requring regulation to permit the yield of maximum utility to the public. Regulation on the interstate level began in 1887 with the Interstate Commerce Act. Its primary purpose was to stop monopolistic pricing practices by the railroads. Later, in 1920, the Interstate Commerce Commission recognized that the transport modes were pricing themselves out of business and took steps to amend this action. Since 1920 this has been the general trend, and most regulation has been in support of it. Taxicab regulation also has followed this trend (6).

Regulatory Background

Regulation of the taxicab industry has been based largely on concepts developed from the regulation of railroads and public utilities. These regulatory precepts contain 4 basic premises (7).

1. The regulated industry is basically a natural monopoly with substantial economies of scale or use.
2. The regulated industry is imbued with a broad public interest; consequently, it is strongly in the public interest that a minimum level of service be provided to all in a nonprejudicial and nondiscriminatory manner.
3. Because the public, through its regulatory agency, has the authority to set service levels and prohibit discrimination or prejudicial treatment of unprofitable business,

then the public has an obligation to the carrier to ensure that it receives an adequate rate of return, given honest and efficient management.

4. Because the carrier is providing the service deemed necessary for the public at a price deemed reasonable by the regulatory agency, the only effect of competition would be to increase the unit cost of the natural monopoly. Therefore, strict entry controls are established to protect the carrier (or carriers) that operates according to the strict directives of the local regulatory commissions.

Taxicab regulation in many communities has been based on these concepts as has the regulation of transit, motor trucks, and intercity buses. Therefore, taxicab regulations usually concern themselves with controlling entry, setting fares, qualifying management's fitness, and minimum service standards required by the community.

Entry Control

The taxicab industry opposed the first suggestions of entry control, but, by 1930, the taxicab association was strongly in favor of controlling entry. Their reason for changing their policy was built on the pretense of public welfare. However, after examination of the industry's motivation to change, it becomes clear that they could see that unrestricted entry had led to actual hand-to-hand combat between drivers in Chicago and New York. Entry control is practiced in 2 basic ways: restriction on the number of firms in a city and restriction of total number of taxicabs in operation. By limiting the total number of firms, the regulatory bodies hope to create an oligopolistic environment with only as many firms as the market will support. They hope this will stimulate some semblance of competition while not creating a glut that could prove ruinous to a single company. Probably the most prevalent method of entry control is accomplished by restriction of the number of individual taxicabs in a city. Two basic methods are used in determining the number of licenses that are sold. One way is to charge a very high initial price, which effectively limits the number of licenses. The second method is to link the number of licenses with the population and size of jurisdiction (1, p. 16).

Fares and Charges

Fare regulation is naturally of utmost concern. Regulation is exercised in determining the rate structure. The 2 basic structures are zone and meter. The purpose for regulating the rate structure is to pick the "fairest" system for both driver and passenger. More important, the actual fare is set. The practice has been for the regulatory body to set a specific price for all taxicabs, explain how the fare should be calculated, and require that the scale be displayed in the taxicab. The objective is to have all taxicabs charge equal rates and have service as the only means of competition (1, pp. 17-18).

Management Regulation

Most regulation concerning management and ownership has changed little since being initiated. Its basic concerns are that management have sufficient financial strength to meet accident costs or debts on termination and that the system not be used for illegal activity. Financial requirements consist of minimum insurance requirements and cab ownership requirements (8).

Service Standards

Service standard regulation has embraced the following 4 basic issues:

1. Driver and vehicle safety,
2. Method of operation,
3. Service refusals, and
4. Minimum service.

Driver and vehicle safety standards usually include periodic vehicle inspections, periodic testing of drivers, and vehicle equipment specifications. Regulation of operating methods includes prohibition of "cruising"; control of the number of vehicles allowed at a stand, parking or staging practices at major traffic points, picking up people at bus stops, and the number of people that can ride at one time; allowance of shared riding; upholding of the right of a passenger to refuse to ride with other people; and the authority to carry packages. Service refusals cover prejudicial treatment of individuals, areas, and times of service. Minimum service levels specify hours of operation and minimum number of cabs available depending on the individual needs of the community (9).

Format of Regulation

Almost all major city taxicabs are regulated by state, county, or city government agencies. The states have the authority to regulate, but most state legislative bodies pass the authority to the city government. The guides that the cities establish are in the form of city ordinances. Usually public service or utility commissions or police departments have regulatory power vested in them. Nevertheless, the ordinances by which the regulatory agencies are bound are virtually the same in every community (8).

ALTERNATIVE PRICING MECHANISMS FOR TAXICAB SERVICE

Little attention has been focused on the availability of alternative fare structures and the effect of each of these fare structures on ridership patterns. The 4 major pricing schemes (meter, zone, multiple zone, trip length) will be compared in this section.

Meter Pricing

A meter-based pricing mechanism is probably the most frequently used and consists of charges for trip length and time en route. The fare rate is preset into the meter and is a function of both distance traveled and time spent. Most companies charge a given amount for the first portion of a mile (1.6 km) and another (usually lower) rate for each successive mile (1.6 km). A timer in the meter activates fare increases when the taxicab is involved in longer-than-normal waiting periods such as in heavily congested traffic at stoplights or when it stops en route. Group-riding fares are calculated by pushing a button that increments the meter by a fixed amount. Shared riding is virtually impossible with the meters currently available. The meter system is the most universally used and, therefore, is quite well understood by the riding public. Visual dials for fare charges offer a quick and easy reference for all riders. Initial cost of the units permits an economical feasible entrance by even the smallest of companies. A lack of professional knowledge about the metering method presents no hindrance to efficient operations. Fares are route independent, and, regardless of path to destination, the charge will reflect the total amount of distance or time or both involved. Training time for drivers is the shortest of all methods, for all that is required is the ability to "throw" the flag on the meter and read the fare from the dials.

Zone Pricing

The zone pricing system divides the service area into zones that are used to determine fares. Generally, the zone system is oriented around a central base point with emanating concentric rings that are themselves subdivided. The base point is usually located according to a major population or activity area and frequently in or closely adjacent to the downtown area. This is logical because, historically, the population and activity center was the central business district. Fare charges can be computed on the basis of either zones traversed or the zone farthest from the central point. In Davenport, Iowa, the passenger is charged the fare to the farthest point whether it be origin or destination. A fare structure based on zones traversed is ideally suited for cruising operations. Dispatching here is minimized or eliminated because taxicabs cruise for fares and charges are computed by the number of zones traversed. This non-base-point zoning more closely approximates the distance actually traveled by the rider. Another form of zoning involves a grid pattern instead of the radial pattern. This grid system is used where the streets of a given city form a square or rectangular outline and may be more appropriate in some of the newer metropolitan areas or midwestern cities. Again, a base point may or may not be used depending upon population densities, form of dispatching, and passenger traffic. Most zoning outlines do not follow geometrical guidelines but rather are shaped by existing landmarks, population densities, and heavily traveled areas. A base point frequently houses the operational center for all taxicabs through which maintenance, communications, and dispatching are controlled. All that is required to implement the zone system is the appropriate maps with the zones marked on the maps. However, the zone system is highly personnel dependent and especially dispatcher dependent. A well-trained dispatcher is a must for a smoothly functioning company. Although the driver will learn the zone system in a relatively short period, it is the dispatcher who must serve as backup for the calculation of zone fares. Shared riding is easily facilitated through dispatcher coordination, and flexible pricing is optimized for markets with different demand elasticities. Costs incurred in implementation are usually low and can be absorbed totally within a short period. Nevertheless, there seems to be a poor public understanding of the zone fare structure. Zoning is geographically dependent and may not be flexible enough to allow penetration of evolving suburban markets. A base-point zone fare structure limits the effective market area of the service to the base-point and near-base-point clientele.

Mupltiple-Zone Pricing

A multiple-zone pricing structure involves a construct similar in theory to that for the single zone. The difference between the 2 arises from a multiple basing of operations. Fares are derived from the most applicable base point. In Hicksville, New York, the Orange and White Cab Company system has base points at each of the major commuter train stations and at several shopping centers. If a person is picked up or delivered at 1 of the base points, he or she pays the lowest possible fare—the zone fare from that base point. If, however, a person rides between zones that might be in either base point then fare calculation becomes much more complicated. The multiple-base-point zone structure allows greater market penetration by reducing fares in high-traffic-generator sections where base points are located and allows rapid updating of service to meet evolving land use patterns by establishing new base points. On the other hand, it is difficult for the general public to understand and virtually impossible to graphically display the fare structure in the vehicle. It is also difficult for a new driver to learn the fare structure. Occasionally a taxicab company will operate each base-point area as an entirely independent business with separate dispatcher, stands, vehicles, and drivers.

Trip-Length Pricing

Although manual operation of trip-length pricing is possible, this scheme usually involves the integration of a computer for amassing the large amount of information concerning all possible origin and destination points. The basic configuration used in a program involves a grid placement over the geographical region to be served by the taxicab company. A computer calculates the closest taxicab to passenger origin, the trip length to destination, and the corresponding fare. Pricing rates can be programmed to reflect such critical characteristics as most frequently traveled routes, group riders, peak travel periods, and trip time approximations to optimize equipment use and customer acceptance. Trip-length fare structures can be more expensive than the other systems, but they allow greater market penetration, greater productivity of vehicles, less geographical dependence, and better dispatching without favoritism. The Royal Cab Company leased a computer for approximately $18,000/year (including rental, programming, and software) but this computer was not fast enough to handle the complex dispatch operation in Davenport, Iowa. The Orange and White Cab Company of Hicksville, New York, had an estimated cost of $500,000 for installation of a computerized dispatching system. The trip-length (computer-based) fare structure has the highest initial cost. A computer that is able to control a major portion of the dispatcher's actions is expensive and must be counterbalanced by greater actual and potential effectiveness. Fewer personnel may be necessary because of the functions absorbed by the computer. This also implies a shorter training time for dispatching because of the reliance on a programmed scheme for taxicab charges and routing. A primary requirement before any rational consideration can be made is company size. It is generally conceded that only enterprises with 20 or more taxicabs can adequately afford the cost of computer leasing. Smaller firms may be able to afford a shared-time system by means of leased lines. Programming the computer, however, to create an acceptable working relationship with critical personnel, dealing with machine breakdowns (with a correspondingly effective contingency plan), initial capital outlay, and continuing periodic costs are some of the considerations that must be examined before a computer-based system can be an acceptable alternative.

SUMMARY

This paper has presented an overview of the organization and environment in which a shared-ride demand-responsive company operates. It has looked at primarily the following 4 areas:

1. Organizational aspects of privately owned demand-responsive transportation systems,
2. Requirements for and characteristics of taxicab system personnel,
3. Regulatory issues confronting taxicab systems, and
4. Alternative pricing mechanisms for taxicab service.

More detailed studies of specific systems will be facilitated if one uses this study as a starting point and guideline.

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