The Mobility Enterprise: Improving Automobile Productivity

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The mobility enterprise is a particular version of a shared-vehicle fleet, which attempts to solve the problem of low automobile productivity. The automobile operates much of the time with unused capacity, i.e., vacant seats and empty cargo space. Because programs to fill those vacant seats (e.g., promotion of ridesharing and high-occupancy vehicle use) have fallen far short of their objectives, a new approach is warranted. The enterprise's central concept is matching vehicle attributes to travel needs. Generally, a household purchases vehicles for those few trips that require a large capacity rather than for the majority of trips (usually to work) that have minimal vehicular needs. If a household could tailor its "immediate access" fleet to these frequent trips and still retain reasonable access to larger-capacity special-purpose vehicles (SPVs), considerable economies could be achieved. The household is relieved of owning seldom-used excess capacity, and automobile productivity and efficiency are greatly improved. Having easy access to a shared fleet of SPVs also affords a household an increase in the quality and economy of its travel experiences. This paper discusses questions of institutional barriers, consumer response, and organization and management that are keys to the fate of the enterprise in the transportation climate of the foreseeable future.

The mobility enterprise proposes a sharing among its participants of special-purpose vehicles (large sedans, trucks, recreational vehicles, and so forth) in order to relax the multipurpose requirements of the family car or cars. Research recently begun at Purdue University is aimed at determining how this concept might become a practical reality.

After years of promoting public transit and carpooling to conserve energy, planners and analysts have begun to recognize that many consumers prefer the convenience of the personal automobile. At the same time, automobile efficiency (fuel economy) has undergone significant improvement while automobile productivity has remained disturbingly low (1,2). Currently, the automobile industry is engaged in a series of redesigns aimed at improving fuel economy. These measures involve a conversion to front-wheel drive, use of lighter-weight materials, and a continuation of vehicle downsizing. But these improvements will be achieved at an ever-increasing cost (1,3,4).

There are undoubtedly a variety of measures for improving automobile productivity. The enterprise concept explores the potential for appealing to that large market segment that has been unresponsive to ridesharing programs. It is based on matching more closely a person's trip requirements to vehicle characteristics. Three features of a mobility enterprise--retained automobile autonomy, easy access to an expanded fleet, and reduced expenditures--are the keys to its success. They are interrelated. An enterprise member's minimum attribute vehicle (MAV) provides him or her, by definition, with the most economical means of accomplishing the most frequent trips. When a trip can be made by using their own MAV, members know they can travel without delay. When a member's MAV is inappropriate for a desired trip, he or she must seek access to the appropriate special-purpose vehicle (SPV). This process may involve delays if the vehicle is garaged elsewhere. It may also involve some advance planning, paperwork, and out-of-pocket costs, depending on the procedures of the enterprise. There is even the possibility that the desired vehicle may not be immediately available because of a prior reservation. Such departures from guaranteed access and instant gratification are aspects of the mobility enterprise that must be offset by clear benefits. Such benefits appear to be possible, since the enterprise can offer several improvements:

1. Wider range of vehicles available for temporary use by an individual,
2. Less-complex set of criteria in buying a car,
3. Trip and ownership economies that can be translated into more disposable income or increased mobility, and
4. More efficient use of society's scarce or expensive resources.

SOME OBSERVATIONS

Capabilities of Personally Owned Automobiles Significantly Underused

Although approximately 80 percent of the trips in this country are taken in vehicles with more than four seats, only about 20 percent require a vehicle that large (5). A car buyer typically considers the maximum number of people, pounds of cargo, or degree of performance that he or she will have to use a certain (often very small) fraction of the time. The result is lengthy off-peak periods with underused capacity. The range requirements for a large percentage of tripmaking are also remarkably low. For example, a golf cart with a 30-mile range and higher speed capability has attributes sufficient for about 70 percent of all trips made.

People Prefer to Drive Themselves

Ridesharing and public transit promotions have failed to generate a widespread willingness to give up the flexibility, accessibility, and personal autonomy associated with individually owned vehicles. Taken together, these higher-occupancy modes still account for only a small amount of the peak-hour travel (2). The prospects for seat filling, therefore, appear less bright than promoting the better use of individually owned vehicles.

Transportation Expenditures Remain Nearly Constant

The increases in the real costs of travel during the past eight years have meant a slightly greater proportion of a household's disposable income being spent on transportation and a reduction in the amount of travel by a household (6). Both trends represent a deterioration in mobility.

The proportion of personal consumption expenditures (PCE) devoted to transportation, which was fairly constant at 12 percent since 1950, rose steadily in the 1970s from 11.9 to 13.6 percent (7). Sudden gasoline price increases had the added effect of curtailing vehicle miles traveled (according to news items from the Federal Highway Administration in May 1980 and August 1981).

Enterprise Idea a Familiar One

The idea of sharing a high-dollar-value item by rotating its use is not new to this country, as the recent increases in shared-vacation real estate indicate. In the area of transportation, the renting of recreational vehicles has proliferated in response to rapidly rising purchase and operating costs. In these and similar cases, individuals have pooled their resources to acquire capabilities they could not reasonably have as individuals. They have made commitments and sacrificed some autonomy to enlarge their options.

Although a majority of the European experiments have been of the "drive it and leave it" variety (starting, predictably, with bicycles), others more clearly resemble the plan envisioned here. Notable among 11 European projects are (a) the "White Bicycle" program begun in the Netherlands in 1965, which lasted two years, and (b) the more recent "Paydrive" shared-car rental scheme in the United Kingdom, which has been in operation since 1979. The bulk of these experiments were carried out with little or no government support, and the overall status of such enterprises in Europe is considered to be "fairly healthy" (8).

Different Demographic Groups Have Different Tripmaking Needs and Vehicle Ownership Patterns

Travel needs differ for a variety of factors such as age, occupation, household size, and income level. Enterprises based in retirement communities, commercial centers, and high-rise residential zones will encounter different travel patterns. In fact, in some cases demographic homogeneity of membership may render the enterprise impractical. A mix of members may be necessary. The seasonal variations of travel patterns and special vehicle needs must also be anticipated, either in terms of membership mix or fleet makeup. Persons of different income levels will have different perceptions of their MAV (described later) and may require significantly different services from the enterprise.

ENTERPRISE DESIGN CONCEPTS

In a successful mobility enterprise, membership should enhance rather than limit the quality of individual mobility. Certain basic structures suggest themselves:

1. Diversified rental fleets: Rental agencies add SPVs (mini-cars, recreational vehicles, and so forth) to their existing car and truck fleet to provide a full range of vehicles. They can offer streamlined discount reservation service to enterprise card holders.
2. Broker-based enterprise: Existing rental companies or new organizations can offer an enterprise management package. It can be assembled by a broker on a subscription or sign-up basis, or "natural enterprises" (neighborhood or employee groups) can work out their own deals.
3. Enterprise-controlled broker scheme: The broker carries out administrative, storage, and maintenance functions under guidelines set by the enterprise. The enterprise may meet monthly to review rules and operations, and the broker may have the right to advise on rules, renegotiate agreements, or insist that financial liability be restricted to enterprise members.
4. Pure enterprise: Enterprise members (probably neighbors) carry out all functions internally through periodic meetings, rotating committees, and so forth.
5. Automobile company enterprise: Automobile manufacturers, working through their dealers, may consider the possibility of selling transportation rather than just automobiles. Each automobile agency could sell or lease the personal MAV to enterprise members. Then it could provide and manage the special-purpose fleet.

These five basic structures are a starting point. They begin the process of formulating and testing the operation of a mobility enterprise. Within a given structure, a variety of schemes can be devised to address questions of enterprise size, membership qualifications, fleet composition, scheduling, reservation system, fees, financing, maintenance, pickup or delivery, insurance, and legal problems.

RESEARCH ISSUES

Research issues related to the mobility enterprise cover a broad range of disciplines: economics, management, law, sociology, operations research, engineering, design, and so forth. The issues described in the following sections require considerable interaction among researchers in the various disciplines. The research needs and data requirements presented are only suggestive at this point, in that in-depth research tasks are still being formulated. For this presentation, we consider four broad categories for research.

Enterprise Membership: Attractions and Obstacles

The demand for mobility enterprises with various alternate designs must be estimated. To do this, an understanding of consumer choice mechanisms is required. Two complementary strands of research activity--disaggregate demand modeling and investigations of social behavior--have produced results that can be of use.

The heart of the enterprise project is to evaluate travel choice by matching trip requirements (a set of attributes) to vehicle characteristics (a set of attributes). Thus, the cost, roominess, performance, range, and comfort of the various automobiles, when matched with necessary trip attributes, determine vehicle choice.

Research will focus on three related decisions: the form of car ownership, vehicle type choice, and vehicle use. The car-ownership decision (e.g., to rent or to buy) is postulated to be determined by the accessibility and cost characteristics of the vehicle and by the socioeconomic characteristics of the individual. Choice of vehicle type is conditioned by the attributes already mentioned (roominess, efficiency, and so forth), while vehicle use is determined by the operating cost of the vehicle and current travel needs of the families.

In addition to economic considerations, a number of social and psychological variables may be significant in the recognition of potential barriers to a successful venture. What kinds of people are typically attracted to such enterprises? Is self-organization more of a middle-class phenomenon? Do the less affluent have a greater need for sharing SPVs? What kind of enterprise structure is most functional, and does function vary by type (food, agricultural, and so forth)? What is the best method for getting people to join the enterprise: word of mouth, media advertisement, or an appropriate combination of both? In fact, how much can be generalized from nontransportation enterprises to mobility enterprises? Answers to these and other pertinent questions could be crucial to the outcome of the project.

Another concern is the cargo-carrying capacity of the MAV that might be covered by an ancillary organization such as a commercial goods delivery system. A major obstacle to asking consumers to give up their large automobiles is their persistent need for consumer goods transportation (e.g., groceries, small appliances, and small furnishings). In a sense, people now take their "cargo vans" with them everywhere they go. In the past, when mass transit was more widely used, merchant delivery systems were commonplace. Demand for such services decreased, however, as personal mobility in large cars increased. An enterprise based on a merchant delivery scheme can be marketed not as an exercise in self-restraint but as a liberating convenience. The participant becomes liberated from the expense and bother of maintaining a personal fleet and the burden of inefficient transportation of goods.

Vehicle Characteristics and Fleet Operations

MAV Design

The MAV may be defined as that vehicle that would meet the highest percentage of the transportation requirements of the household. It may be already apparent that the selection of the MAV is traveler specific, and the attributes of the MAV help determine how much access to the shared fleet would be necessary. There would not necessarily be a universal MAV, at least not in every detail. The configurations of the MAV will be of interest to the project's researchers and, ultimately, to the automobile industry. The central question here becomes, What are the characteristics of the MAV and how do they vary with the socioeconomic characteristics of the families?

Shared Vehicle Fleet

Given a fixed number of members, how many shared vehicles should be purchased? Bounds can easily be set: no more than enough to guarantee availability "on call" and no fewer than the number based on 100 percent utilization, i.e., perfect scheduling. The optimum number should be based on a comparison of the marginal cost of an additional vehicle with the value of the declining marginal increase in accessibility associated with that vehicle. The number of members is also important. It will be shown below that, given a fixed probability of use by each member in an interval of time and a fixed number of vehicles per member, the larger the number of members, the more accurately shared use can be predicted. This increased predictability allows a decrease in the shared-car safety margin necessary to ensure that a car is available, thus decreasing the cost of the enterprise to its members.

Types of Services

All of the possible types of services that can be offered by the proposed enterprise system should be explicitly identified. Hours of operation, methods of pickup and drop-off services, and so forth must be considered.

It will be necessary to develop a set of service functions and determine the demand for the level of each service. For example, the expected delay in getting a desired vehicle will depend on the number of customers predicted for this type of vehicle during a given time period. An appropriate relation can be developed to represent delay as a function of volume (9).

Reservation System

How shall a reservation system work? Recent advances in minicomputers will probably allow the development of an interactive scheduling network that will permit reservations to be processed at fairly low costs. Nevertheless, the concept of a shared, prescheduled fleet, with each member having a terminal where he or she can check the current status of the idle fleet and make reservations, requires careful planning and experimentation.

Pricing System

Another major issue, of course, will be how the system should be priced. Will guaranteed access be allowed at a price? Will there be a "parking sticker" system with a different fee for differing likelihoods of access? Will people reserve and then not use a car? (A penalty system based on the airlines' experience is a possibility.) Should the reservation system be based on a first-come first-served basis, on rewarding planning, or on a continuous auction of time slots with the possibility that someone would be "bumped" at the last minute by someone willing to pay more? Should peak-period users be charged a premium? If so, should the proceeds be used to subsidize off-peak users or be used to purchase more cars, thereby increasing peak-period capacity? Efficiency and equity trade-offs will be involved in the final selection.

Organization and Administration

Any organizational structure suggested for a mobility enterprise can be evaluated in terms of how well it is suited to operational requirements and members' attitudes. Certain universal considerations apply.

Membership Mix

A basic issue is the diversity of enterprise member characteristics. The optimum amount of diversity is clearly an open question. It would be impractical to have the population so homogeneous that there would be peak load problems for particular vehicles. That is, if the enterprise consisted primarily of college professors, many members might want a recreational vehicle in order to go on vacation at the end of a semester. Some amount of diversity in the membership of the enterprise would be necessary to balance the loads over time. Conversely, too much diversity may result in missing some scale economies that would be present if there were fairly large use of a particular type of vehicle.

Legal and Institutional Matters

With respect to societal reaction to the enterprise concept, in general or with respect to transportation, what have been the main legal, institutional, or other factors that have aided or impeded their development and use? What laws (e.g., automobile licensing, insurance regulations, reserved parking spaces, tax legislation) will make it easier or harder for the enterprise to survive? If MAVs are a key to success, will it be necessary to get special legislation to allow them on the streets? In a more heterogeneous transportation modal environment, how would traffic safety be ensured?

Demonstration Project

A large-scale demonstration will likely be necessary at some point to prove the concept. Before that, there is need for some small-scale experiments in scheduling, vehicle design, and consumer behavior. A simulation model (9) will help choose the best combination of strategies to employ in the actual demonstration project.

Table 1. Comparison of automobile-ownership alternatives.

Alternative	Vehicle Type	Vehicle Price ($)	Ownership Cost ($)	Operating Cost ($/mile)	Miles Driven	Total Annual Cost ($)
1	GAV	8100	1851	0.18	10 000	3656
2	MAV	3800	626	0.13	7 000	1512
	GAV[a]	8100	757	0.18	3 000	1280
Total[b]			-	-	10 000	2792

[a]Alternative 2 GAV averages 0.4 vehicle/member. [b]Totals are on a per-member basis for alternative 2.

Table 2. Total vehicle expenses: major components.

Expense	GAV	MAV
Purchase price ($)	8100	3800
Value after four years (10) ($)	4133.69	3249.58
Avg miles per year	10 000	7000
Avg miles per gallon	25	45
Annual payments[a] ($)	2607.62	1223.33
Annualized present worth of resale ($)	756.70	596.81
Annual gasoline cost at $1.40/gal ($)	560	217
Maintenance[b] ($)	688.70	370.72
Insurance[b] ($)	555.96	297.96
Total annual cost[c] ($)	3655.58	1512.20
Total four-year cost[c] ($)	14 622.32	6048.80

[a]Interest rate = 0.13.
[b]Maintenance and insurance costs for $3000 vehicle are $0.05/mile and $250/year, respectively; these values increase linearly with purchase price.
[c]Includes depreciation.

How big should a demonstration program be? It is fairly clear that many of the major benefits of the enterprise to the traveling public will be evident only when a large enough fraction of the traveling public has joined the enterprise. For instance, congestion benefits that arise from a fleet of smaller vehicles will be felt only when those vehicles make up a significant percentage of the traffic stream. In addition, the safe operation of smaller vehicles will be enhanced when they comprise more than a small fraction of the traffic stream. The demonstration should be sufficiently large to examine scale effects on fleet operations. At that same time, questions concerning start-up and transition that are difficult to model must be at least partly answered.

PRELIMINARY ECONOMIC ANALYSIS

Economic Incentives

To complement the simulation model (9), an analytical economic approach is being developed. This approach begins by quantifying the possible economic incentives to join a mobility enterprise and then seeks an effective user fee structure.

Consider an individual who has the option of either buying a standard all-purpose family vehicle or joining the enterprise, where he or she will obtain a MAV plus access to a fleet of shared vehicles. Let us consider a modest case, wherein the standard family vehicle will be a compact car that costs $8100, has 25 miles/gal fuel economy, and would be driven 10 000 miles/year. The individual's MAV would cost, say, $3800 and get 45 miles/gal. Either car, if chosen, would be kept four years. If he or she joined the enterprise, assume the MAV would be useful for only 7000 miles of the household's travel each year, thereby leaving 3000 miles of travel to be made by higher-attribute vehicles. To simplify this first analysis, we will assume that the individual borrows the all-purpose car from a shared fleet to travel those 3000 miles that have special requirements.

Table 1 compares two alternatives. Alternative 1 is the common practice of buying a general attribute vehicle (GAV). Alternative 2 estimates the costs associated with owning or leasing a MAV while having access to a shared fleet of GAVs. GAVs are used only for trips in which MAVs do not suffice, so their per-driver mileage is only 3000 annually. But since they are shared among several users, their utilization rate (miles per vehicle per year) should increase, thereby decreasing per-mile costs. Table 1 is based on a ratio of 0.4 shared vehicles per enterprise member. The accuracy and impact of this ratio on the analysis and design is discussed later. Table 2 gives the assumptions used in the cost analysis. These, of course, are subject to modification and refinement as the research proceeds.

The difference between the $3656 yearly GAV cost and the $2792 enterprise cost is a measure of economic incentive to join the mobility enterprise. The notion of economic incentive assumes that an individual makes such a rational economic assessment. Modal choice in urban travel has traditionally defied pure economic rationality, but increased travel costs have caused some recent modal shifts to ridesharing, if not to transit. Furthermore, the level-of-service differences are so small in this MAV versus standard car comparison, especially when compared with the magnitude of the total cost disparity, that this analysis merits proceeding further.

A GAV-only household pays $3656/year for its automobile travel. Switching to a MAV for 7000 miles results in total costs of $1512. The remaining amount, $2144, can be spent on the shared vehicle for the 3000 miles for which the MAV is unsuited. If the household does not choose to use a shared GAV that much, its membership in the enterprise can enable it to decrease its total travel budget even further.

Managing the Shared Fleet

The proper ratio of shared cars per member depends on member demand. Let the probability that a given member will want to use a shared vehicle during a time interval t be P_t and assume that all members have the same probability. The value of P_t will be influenced by the socioeconomic characteristics of the member, the attributes of the MAVs, and the shared fleet's pricing policy.

Preliminary consideration of the dependence of the probability that no shared car will be available--the failure probability--on P_t, the number of shared vehicles, and the number of members has produced some interesting results. Let P_t be the same for each household during time interval t, m represent the size of the shared-vehicle fleet, and n represent the number of households in the enterprise. If α represents the number of vehicles actually demanded in time interval t, the probabil-

Figure 1. Shared-vehicle availability.

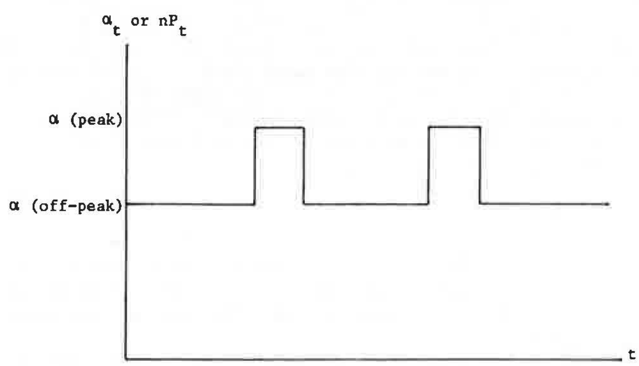
Assume Enterprise has 40 members (n=40) and ...

Number of cars in shared fleet (m)		P_t = .40	P_t = .50	P_t = .60
	m = 16	.56 (.5)	.92 (1.0)	.99 (1.0)
	m = 20	.13 (0)	.56 (.5)	.87 (1.0)
	m = 24	.008 (0)	.13 (0)	.44 (.5)

Cell Entries = Pr (cars demanded exceeds supply) = Pr (α > m)

P_t = Pr (each member wants car)

Figure 2. Time-demand diagram.



ity that more than m cars will be demanded in t is as follows:

$$\Pr(\alpha > m) = \sum_{\alpha=m+1}^{n} \binom{n}{\alpha} P_t^{\alpha} (1 - P_t)^{n-\alpha} \quad (1)$$

A simple example (n = 2, m = 1, P_t = 0.5) produces Pr(α > m) = 0.25. Figure 1 shows how the failure probability for a fixed number of members is influenced by changes in P_t and m. Further, it can be shown that Pr(α > m) approaches the following limiting values as n increases, holding m/n and P_t constant:

$$\Pr(\alpha > m) = \begin{cases} 0 \text{ if } m/n > P_t \\ 0.5 \text{ if } m/n = P_t \\ 1.0 \text{ if } m/n < P_t \end{cases} \quad (2)$$

These limit values for Pr(α > m) are the parenthetical cell entries in Figure 1. Large enterprise membership will bring with it greater certainty that sufficient cars are available; this increased certainty must be traded off against possible diseconomies of scale, which leaves the optimal membership size to be determined.

Another trade-off involves the use of a peak and off-peak price differential to decrease peak P_t and the purchase of more cars; both reduce failure probability at the expense of the consumer. Early modeling efforts reveal the peak/off-peak pricing structure to be a potentially complex and delicate area. Certainly, P_t and therefore Pr(α > m) will vary between time intervals t. A time-demand diagram for a representative family or for the membership as a whole (Figure 2) illustrates this variation. In designing a mobility enterprise's shared fleet, we can directly vary fleet size (m) by simply purchasing more cars, but we can only influence P_t by a peak/off-peak differential use charge. Influencing P_t, especially with respect to variations with time, requires as much a clear concept of management objectives, as it requires an accurate understanding of consumer response to management actions. The classic confrontation between efficiency and equity seems to arise here, as does a need to develop accurate information regarding peak-period direct price elasticities and peak-period price and off-peak use cross elasticities.

We could set fleet size m so high as to cause Pr(α > m) to approach zero, but at such a considerable cost that user fees would be prohibitive. Efficiency argues that we manage the peak demand to maintain shared-vehicle availability at minimum cost. If we are determined to minimize the cost of ensuring that Pr(α > m) = 0, we can institute some congestion pricing scheme to drive off some peak demand. The extra revenue so generated can be applied either to (a) increase the fleet size or (b) provide a subsidy to off-peak users. Option a seeks an equilibrium that provides better peak service to peak users as a direct result of the peak surcharges. Option b transfers this extra revenue within the enterprise and rewards those who avoid the peak periods. Both options carry elements of efficiency and equity, and it may be that a combination of the two may be most effective.

The use of congestion revenues may induce some members to switch to off-peak times, others not to use the shared fleet at all, and some even to drop out of the group. Quantifying the first action requires a knowledge of cross-elasticities between time periods with respect to fares, a brand of information in very short supply [as American Telephone and Telegraph (AT&T) found out in its now classic long distance dialing peak/off-peak price experiments]. Analyzing the decision not to use the shared fleet at all involves a knowledge of direct elasticities. The need for both sorts of information will require a specific data-gathering and survey effort. Analysis of option b (the extent to which peak demand is curtailed and off-peak use is subsidized by a transfer of revenues) involves the same possible membership responses and data need.

A moment's reflection on the possible extreme shapes of the time-demand diagram (Figure 2) gives us some clues as to the type of information we should gather. If the diagram had no peaks (P_t or

α essentially constant with t), no peak surcharge would be necessary and $m = \alpha = nP_t$ would be the ideal fleet size. If the diagram had very pronounced peaks, might we expect very inelastic demand for those periods? Not necessarily. The peaks may simply reflect multitudinous, but mild, preferences expressed in the absence of surcharges. Data on the substitutability or changeability of expressed time-of-travel choices must be collected.

A survey instrument is currently being refined that will attempt to gather preliminary data regarding trip substitutability and advance planning. The survey has two objectives:

1. To determine what techniques the enterprise could use to effectively and equitably reduce temporal variations in shared-vehicle demand, and
2. To determine the optimal mix of attributes to look for in the enterprise's shared GAV, once the MAVs attributes have been established.

Demographic information will be cross-tabulated with various data obtained from retrospective trip diaries. In addition, it will be necessary to bracket a dollar saving per household, which must be present in order to elicit any trip planning or postponement on the part of prospective members. Initial work has begun in the area of focus-interview formulation as a necessary precursor to the actual survey instrument. Preliminary data should include not only the current trip demands of a wide cross section of family units but also the degree of education with regard to the concept of vehicle sharing and MAVs that will be needed in order to obtain valid survey results. The concepts of a mobility enterprise will be foreign to many interview (and survey) participants; therefore, education of the respondent is a necessary step in ensuring validity from these techniques. Once the survey instrument is refined, it is planned to be administered locally, regionally, and nationally.

A simplified but illustrative relation between MAV and shared-GAV attributes is given in the table below:

MAV Price ($)	Shared Vehicles per Member
6210	0.40
5720	0.425
5240	0.45
4750	0.475
4260	0.50
3770	0.525
3280	0.55
2790	0.575
2310	0.60

As MAV attributes decrease (represented by decreasing price), the need for access to a GAV must increase. Fortunately, so does the amount of money available to each household after the MAV purchase. Translating the resulting demand rate for shared GAVs into the expected required shared-fleet size produces the column on shared vehicles per member. This relation indicates a potentially delicate trade-off. The more economical a MAV, the less versatile it is likely to be. How much versatility can an enterprise member retain before the efficiency of the MAV is lost and/or the advantages of access to a GAV fleet are nullified?

SUMMARY

The goal of the mobility enterprise is to improve automobile productivity by matching individual trip requirements to vehicle characteristics. Within this framework, some specific objectives are to

1. Predict the membership of such an enterprise according to the probable public reaction vis-à-vis automobile autonomy, access to an expanded fleet, and reduced expenditures;
2. Consider basic enterprise service structures (e.g., diversified rental fleets, broker-based enterprises, and so forth);
3. Research issues in the various disciplines (e.g., law, economics, sociology, operations research, and so forth) as they relate to the enterprise concept;
4. Determine the user fee structures that achieve the best combination of efficiency and equity;
5. Describe appropriate vehicle characteristics and designs; and
6. Develop a large-scale demonstration model that involves scheduling, vehicle description, and consumer behavior.

ACKNOWLEDGMENT

Michael Doherty and Norman Lafond are responsible for developing Table 2 and Figure 1, respectively. Special thanks are due to Helen McMahon, who is responsible for making the most readable portions of this paper possible, and to Barbara Yeoman, Lori Berthold, Nancy Lein, and Sherry Johnson, whose skills and stamina enabled us to meet deadline after deadline.

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Publication of this paper sponsored by Committee on New Transportation Systems and Technology.