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Impacts and Effectiveness of Third-Party Vanpooling: A Synthesis and Comparison of Findings from Four Demonstration Projects

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March 1983

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16. Abstract

This report presents findings from four federally sponsored experiments designed to test the concept of third-party vanpooling. Under this vanpool provider mechanism, some entity other than the employer or individual is responsible for promoting and organizing vanpools. The four projects, implemented in Knoxville TN, Norfolk VA, San Francisco CA, and Minneapolis MN, experimented with a variety of organizational, operational, and financial approaches. Accordingly, the comparative findings regarding implementation issues, vanpool level of service characteristics, traveler response and vanpool economics are widely applicable to other locales.

Given the available evidence, third-party vanpooling appears both workable and effective in a range of settings and markets. There appears to be a sizable market of commuters for whom vanpooling is a viable and attractive mode. Vanpoolers in the four projects are predominantly "choice" riders who do not need a car during the day, rarely work overtime, and commute relatively long distances. For these individuals, the benefits of vanpooling - such as lower commuting costs, less hassle, and the possibility of eliminating a household automobile - more than compensate for the added time spent in collecting and discharging other passengers. Vanpool drivers exhibit considerable entrepreneurship in terms of adapting vanpool operating policies and amenity levels to passenger preferences and setting fares to reflect individual passenger circuity and van occupancy levels. The concept of using third-party vans as "seeds" appears to be an effective means of encouraging privately operated vanpools using purchased or leased vehicles. Finally, third-party vanpooling offers considerable flexibility in terms of how, where, and at what rate vanpool services are introduced within an urban area. Although the cost of operating these four third-party programs was rather high during the demonstration period, there is evidence of substantial declines in unit costs with increasing progam size and maturity. For some transit operators, this mechanism represents a viable alternative to the expansion of peak-period fixed-route transit service in low-density markets.

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PREFACE

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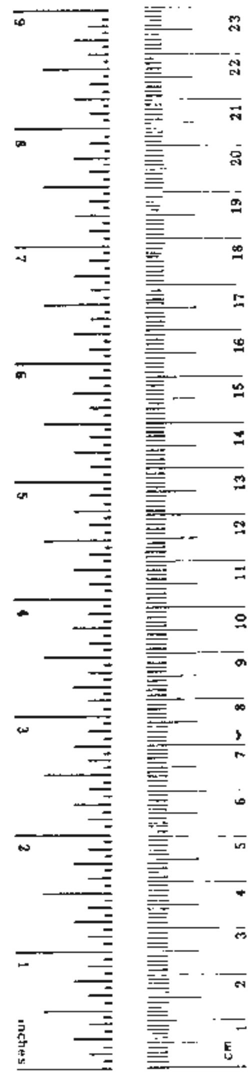
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

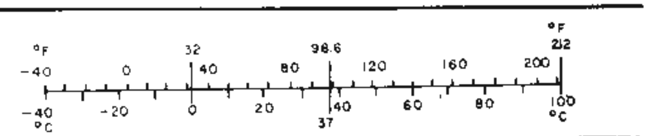
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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1. INTRODUCTION

Between 1975 and 1977 UMTA's Service and Methods Demonstration (SMD) Program* sponsored four projects involving vanpooling in Knoxville, Tennessee, Norfolk, Virginia, San Francisco, California, and Minneapolis, Minnesota. At that time, vanpooling was still a novel commuting mode. Although employer-sponsored vanpool programs were expanding rapidly (accounting for several hundred operating vanpools), there were significant institutional obstacles and market barriers inhibiting the formation of vanpools. These included restrictive state regulations, limited availability of financing and insurance for vanpools, and general uncertainties about the operational and economic viability of large ridesharing units, particularly those comprised of employees of different firms. With national interest in high-occupancy modes mounting in response to energy and environmental concerns, there was a need for an innovative vanpool provider mechanism under which some entity other than the employer or individual (that is, a "third-party") would be responsible for promoting and organizing vanpools. Accordingly, the SMD Program embarked on a multi-project research and demonstration effort to test the feasibility and costs of a third-party provider mechanism and to ascertain the effectiveness of this organizational approach for serving the multi-employer commuter market.

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*The SMD Program sponsors the development, demonstration, and evaluation of innovative transit operating techniques and services which utilize existing technology. A large number of innovative methods of improving the quality and efficiency of urban transportation have been developed both by UMTA and by local areas and transit properties here and abroad over the past few years. The SMD Program focuses on deploying and evaluating these techniques in real world operational environments and promoting the most promising of them to local transit operators, planners, and elected officials across the country.

TABLE 1. COMPARISON OF DEMONSTRATION CHARACTERISTICS

	KNOXVILLE TN	NORFOLK VA	Golden Gate Corridor CA	Minneapolis MN
Grantee	City of Knoxville	Tidewater Transportation District Commission (transit operator)	Golden Gate Bridge, Highway and Transportation District (multi-modal operator)	Metropolitan Transit Commission (transit operator)
Project Services	Vanpools Carpools Social Service Agency Transportation	Vanpools Private-Hauler Buses	Vanpools	Vanpools Carpools Subscription Bus Fixed-Route Bus
Site Data (1970)				
- Population	400,300 (SMSA)	733,000 (SMSA)	411,000 (2 counties)	1,965,000 (SMSA)
- Pop. Density (per sq. mile)	282	1,004	226	861
- Median Income ($)	8,200	8,700	10,500	11,700
- % Using Public Transit to Work	3.9	9.7	1.8	9.1
Vanpool Target Group	Areawide (146,000 commuters)	5 U.S. Navy bases (108,000 commuters)	Corridor north of Golden Gate Bridge (140,000 commuters)	11 multi-employer sites (70,000 commuters)
% Auto Drivers in Target Group	75%	62%	74%	76%
Marketing Orientation	Areawide	Employer-based (with active employer participation)	Commuter-focused	Employer-based
Vanpool Coverage	Restricted to areas not served by fixed-route transit	Restricted to employees at Navy bases and areas not served by fixed-route transit	Restricted to residents of Marin/Sonoma Counties	Restricted to employees at targeted sites
Van Fleet	51 purchased with demonstration funds	50 purchased with demonstration funds	43 purchased with demonstration funds	Vans leased as needed from local dealer
Pricing Policy	User charges cover all costs except administration, promotion, back-up and trial vans	User charges cover all costs except promotion, administration, back-up and trial vans	User charges cover all costs except promotion, administration, back-up and trial vans, seat vacancies	User charges cover all costs except promotion, administration, trial van; idle fleet capacity and insurance
	Driver has full discretion over passenger fares	Driver has full discretion over passenger fares	Fares set by Transportation District	Driver has full discretion over passenger fares
Driver Incentives	Potential for free commute and for retention of excess fares; personal use of van at 9¢/mile	Potential for free commute and for retention of excess fares; personal use of van at 7¢/mile	Free commute; personal use of van at 11¢/mile including gas (350 mile per month limit)	Potential for free commute and for retention of 1/2 of excess fares; personal use of van free for first 200 miles and 8¢/mile thereafter

As can be seen from Table 1, the projects differed in terms of the type of organization(s) performing the third-party function, geographic and target group focus, marketing approaches, van acquisition and deployment strategies, user charge and passenger fare structures, and driver incentives. The Knoxville and Minneapolis vanpool programs were part of broader brokerage operations encompassing other commuter ridesharing modes and (in Knoxville) social service agency transportation, whereas the demonstrations in Norfolk and San Francisco's Golden Gate Corridor were primarily oriented toward vanpooling. Collectively, then, the projects provided an opportunity to examine the third-party vanpooling concept across four distinct urban settings and across a variety of organizational, operational, and financial approaches. Moreover, these demonstrations afforded a unique opportunity to expand knowledge about the operational characteristics and users of this relatively new form of ridesharing.

This report synthesizes findings from the four projects regarding the implementation, operations, and impacts of third-party vanpooling. The next section describes salient aspects of the design and operations of the four demonstrations, including a discussion of institutional accomplishments. Sections III, IV, and V present comparative findings on the transportation and socioeconomic impacts of vanpooling, including level of service characteristics, traveler response, and third-party provider impacts. The report concludes with recommendations regarding future applications of this vanpool provider mechanism.

The comparative information presented herein is based on published evaluation reports for each project (Refs. 3, 4, 6, 9, 12), a comparative report describing the four projects (Ref. 7), project records and reports (for example, Ref. 1), and a variety of data sets assembled specifically for the evaluations. These include (a) project records on the vanpooler applicant pool, vanpool fleet utilization, and third-party program costs; (b) surveys of vanpoolers, ex-vanpoolers, and non-vanpoolers providing information on demographic, work-related, behavioral, and attitudinal characteristics; and (c) van logs providing information on van operations, level-of-service, and occupancy levels.

2. IMPLEMENTATION AND OPERATION OF THIRD-PARTY VANPOOLING

The four projects collectively broke considerable new ground by overcoming institutional barriers to vanpooling and testing different approaches to third-party vanpooling. While the institutional accomplishments and operational features of each project reflect site-specific conditions, the breadth of project designs permits drawing some transferable conclusions about the feasibility of the basic third-party concept and the relative effectiveness of alternative approaches.

2.1 Institutional Efforts

When these projects were starting (in the mid-1970's), there were significant obstacles to vanpooling including (1) restrictive state regulations which treated vanpools as public carriers requiring certification; (2) limited availability of insurance for vanpools (because of insufficient operational experience on which to base actuarial tables); (3) limited availability of financing for vans (reflecting uncertainties about the economic viability of this new mode); and (4) ambiguity as to whether the driver of a third-party van would be considered an employee of the third-party provider and hence subject to minimum wage provisions of the Fair Labor Standards Act.* The project staff had to address and successfully resolve these problems before their programs could become fully operational. On the regulatory front, the active research and lobbying efforts of the Knoxville and Minneapolis project staffs resulted in major legislative changes in 1976 which exempted vanpools from the purview of the Tennessee and Minnesota state regulatory commissions. In the insurance area, it was largely due to efforts in Knoxville that the Insurance Services Office (ISO) in 1977 issued a new classification and rating scheme for various types of vanpools. To overcome financial barriers, the Knoxville, Norfolk, and Golden Gate Corridor projects negotiated with selected local financial institutions to provide (under an abort agreement) 100% financing to project-affiliated van purchasers. Finally, the Minneapolis project provided the impetus for obtaining an interpretation from the U.S. Department of Labor which specifically exempted

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*An additional implementation barrier confronting these projects was the need to negotiate 13(c) labor agreements as a prerequisite to receiving UMTA funding. The Knoxville and Norfolk agreements stipulated that major van maintenance be performed by transit employees and project vans not be allowed to operate in areas served by conventional transit. The Minneapolis and Golden Gate 13(c) agreements contained no such restrictions, primarily because overcrowding was common on the transit routes serving the vanpool program target areas.

the vanpool program from the minimum wage provisions of the Fair Labor Standards Act.

2.2 Organization and Management

One of the most significant differences among the projects was the type of organization responsible for performing the third-party function. In Knoxville, the City government took on this responsibility, largely because it was felt that an organization without any vested modal biases would be more effective at accomplishing regionwide multi-modal transportation brokerage. In the other three sites, the third-party function was performed by the local transit operator. The direct involvement of the transit operator in the promotion and organization of vanpools represented a significant institutional innovation, given the then-prevailing fear on the part of many transit operators that ridesharing programs might be detrimental to transit. It should be noted that the particular transit operators involved in these demonstrations shared a rather unique perspective regarding the role of ridesharing: faced with constraints on the size of their bus fleets and increasing service demands, especially in lower-density areas, they viewed vanpooling as a potentially cost-effective alternative to the expansion of peak-period fixed route service. This attitude might well not be found among larger transit operators servicing predominantly higher-density markets.

Experience with these alternative approaches to third-party vanpooling revealed that both are workable and that there is no clear advantage in having a transit operator versus a local governmental agency perform the third-party function. The major advantages of a transit property are its ability to conduct certain activities such as marketing, maintenance, and accounting cost-effectively within the existing organization in conjunction with transit-related activities. Probably the major disadvantages in having a transit operator in this role are possible restrictions on operations stemming from labor negotiations and possible increases in insurance costs to cover contingent liability on operator assets.

Another organizational variant across projects was the management structure and use of outside contractors. In the Golden Gate and Norfolk projects one organization, the transit operator, handled all functions including start-up activities, marketing, fleet operations, and liaison with pool groups. In Knoxville, the City during certain periods contracted with the University of Tennessee's Transportation Center to operate the vanpool program as well as carry out broader brokerage functions. In Minneapolis, the Metropolitan Transit Commission performed a management and coordination role and contracted with two other organizations for front-end planning and marketing (Public Service Options, Inc.) and for vanpool program operations (Van Pool Services, Inc., a subsidiary of the Chrysler Corporation). The use of outside contractors to perform certain third-party functions minimizes staff requirements for the sponsoring organization (often a constraint in governmental agencies) and may provide more specialized skills than would otherwise be available. However, this approach was found to be susceptible to coordination problems, suggesting the need for a well-defined yet flexible allocation of roles among participating organizations and clear lines of authority and communications. The overall staff size requirements were larger in the projects where more than one organization was involved, but this difference appears to be related to the scope of staff activities (e.g., multi-modal focus with significantly more front-end planning and institutional effort in the first two projects) and does not reflect or suggest inherent inefficiencies in the contract approach.

2.3 Marketing

Marketing techniques were tailored to the target groups being served and involved varying degrees of marketing to and participation by employers. The Knoxville project, whose target market consisted of areawide commuters, used a combination of mass media advertising (e.g., newspaper ads, billboards, and radio and television spots) and employer-based promotion and surveying (over the course of the three-year demonstration 829 employers were contacted, accounting for nearly half of the areawide work force). In the Golden Gate project, with a target market consisting of commuters living in the corridor north of the bridge, there was minimal outreach to or through employers (32 large employers were contacted). Rather, the emphasis was on techniques directly aimed at commuters -- for instance, brochures distributed at toll booths and on buses and direct mailings to corridor residents. In Minneapolis, where the target areas were 11 suburban work sites comprised of over 700 different firms, marketing efforts were directed at employers (direct contact and literature to solicit the cooperation of top management) and employees (multi-media presentations, information booths, newsletters, etc.). Because of the selected geographic coverage of the program, no mass media advertising was used. In Norfolk, with a target market consisting of five

U.S. Navy bases, similar types of employer- and employee-directed techniques were used, but the commanding staff of the bases played a far more active role than Minneapolis employers in distributing marketing material and encouraging employees to pool.

On the basis of project records and survey data indicating the sources of applications for rideshare matching, it appears that passive techniques such as billboards, newsletters, and information booths were far less effective at generating interested applicants than more focused and personalized approaches such as employee presentations and hand-outs of promotional literature. Another noteworthy finding is the importance of top-level management support in both facilitating and improving response to employee-focused marketing efforts. Finally, the Minneapolis experience with multi-employer work sites revealed significant difficulties in eliciting the cooperation of small firms and the consequent need to focus outreach efforts on the larger firms (especially those with over 1000 employees who could generate a critical mass of rideshare applicants). Since the smaller firms tended to be sales or service businesses, their managers were difficult to contact and skeptical that the program could benefit their employees, many of whom had irregular work schedules and needed a vehicle during the day.

2.4 Fleet Operations

The projects differed in terms of van fleet size and composition, the method of acquiring vans, and van deployment strategies. Three of the projects had fleets comprised entirely of bench-seat vans (typically 12-

passenger); however, the Golden Gate Corridor project, serving a relatively affluent market, used a mix of 12-passenger bench-seat vans and 10-passenger luxury reclining-seat vehicles. In three projects, vans were purchased outright using demonstration funds; in Minneapolis, on the other hand, vans were leased from a local automobile dealer. The leasing arrangement clearly reduced the need for a large initial capital outlay and, because of the short-term lease duration, reduced the amount and cost of maintenance work. However, the other potential advantage of leasing -- flexibility in adjusting fleet size to changing levels of demand -- did not materialize: the initial supply of leased vans proved to be far in excess of first-year needs, and the second order for vehicles, coinciding with the spring 1979 fuel shortage, took several months to arrive due to production delays. The three projects which purchased their vehicles differed with respect to their fleet size objectives. All three had originally planned to use their accumulating depreciation funds to purchase additional or replacement vans. In Knoxville, however, a decision was made to liquidate the van fleet (except for two vehicles retained for back-up and promotional purposes) and to use the resulting funds for program operations.

Project vans were made available to pool groups on a lease-type arrangement. As with most vanpooling programs, drivers performed many of the functions associated with organizing and operating the vanpools, in exchange for which they were offered financial incentives such as a free commute and personal use of the van at nominal charge. The total monthly user charge for each van was designed to cover all costs of van operations except for certain "overhead" items such as administration and marketing.* As can be seen from Table 2, there were significant differences across projects in the fixed and variable (mileage-based) components of the monthly user charge, reflecting factors such as vehicle type, vehicle acquisition method, depreciation schedule, insurance coverage, and geographic location. It should be noted that the Minneapolis fixed component included interest charges (borne by the dealer) on the funds used to acquire the vans. Since the other three projects purchased their vehicles outright, no interest expenses were incurred, nor was imputed interest included in the monthly user charge. At an assumed interest rate of 10%, the monthly amortization charge for the Knoxville vans would have been approximately $119 (in comparison, the $84 amount shown in Table 2 under depreciation reflects only the decline in value of the van over the holding period). The Golden Gate vans incurred the highest insurance costs, primarily due to the Bridge District's additional contingent liability coverage of $1,000,000 per vanpool which cost $41 per month per van. Each of the projects from time to time revised the variable cost per mile in accordance with actual cost experience. Maintenance expenses in particular proved to be significantly at variance with original estimates, due to longer-than-anticipated commuting distances and higher-than-expected post-warranty expenses. In Knoxville, for example, the maintenance cost averaged $14 per month per operating van while the vehicles were still under warranty but had risen to approximately $160 per month per van by the close of the demonstration two years later.

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*See Section III for a discussion of how this user charge was allocated among pool members.

TABLE 2. BASIS FOR DETERMINING VANPOOL USER CHARGES

	Knoxville	Norfolk	Golden Gate Corridor		Minneapolis
Van Model Capacity/Seat Type Purchase Price	Plymouth Voyager 12-pax bench[1] $6,035	Dodge B-300 12-pax bench $6,553	Plymouth Voyager 11-pax bench $7,800	 10-pax reclining $9,300	Dodge B-300 12-pax bench Not available
Fixed Component Per Month					
Depreciation	$83.79[2]	$83.00[3]	$108.00[4]	$129.00[4]	Not available
Insurance	63.50	72.00[5]	102.00[6]	114.00[6]	--[7]
Sales Tax Allowance	5.76	--	--	--	Not available
Title, Other Taxes	2.08	--	--	--	Not available
Total	$155.13	$155.00	$210.00[8]	$243.00[8]	$205.00[9]
Mileage-Based Component					
Maintenance	$ .015	$ .025	$ .015		$ .015[10]
Tires	.015	.01	.01		--[10]
Oil	.003	--	.015		.01
Accessories	--	.005	--		--
Gasoline	.06	.07	.07		.065
Total	$ .093	$ .11[11]	$ .11		$ .09

Note: All costs are as of December 1978. Van purchase prices span a two-year period from September 1975 (Knoxville) to August 1977 (Golden Gate).

[1]Five of the 51 vans are 15-passenger vehicles with bench seats, which cost $6,654.

[2]Depreciation is calculated assuming a resale value of $2,000 after a 4-year period or 90,000 miles and does not include interest on capital. The amount shown is for vans traveling under 90 miles round trip. For vans traveling farther, depreciation is figured on a per-mile basis at 4.5¢ per mile.

[3]Depreciation is calculated assuming a resale value of $2,500 after a 4-year period or 75,600 miles and does not include interest on capital. Vans traveling over 75 miles round trip pay an additional mileage charge ranging from .5¢ (75 miles) to 1.7¢ (100 miles) to cover the faster rate of wear-and-tear. Prior to April 1978 the marginal charge was applied to trips of 60 miles or more and ranged from 2¢ to 2.4¢ per mile.

[4]Depreciation is calculated assuming a zero residual after 6 years or 120,000 miles and does not include interest on capital. The amounts shown are for vans traveling under 79 miles round trip.

[5]The Tidewater Transportation District Commission pays $63.58 per vehicle for insurance but charges $72 in order to cover insurance for 3 back-up vans and to provide a fund to cover the $500 deductible on collision.

[6]Insurance costs include the Bridge District's contingent liability coverage and a fee of 25¢ per pooler to cover the deductibility exposure for collision and comprehensive coverage. Costs shown are for Marin County. Sonoma County rates are slightly lower for the 12-passenger van and higher for the 10-passenger luxury van.

[7]Between November 1977 and October 1978, a monthly insurance cost of $65 per vehicle was included in computing the fixed user charge component. Effective November 1978, Van Pool Services began to self-insure for collision and comprehensive, which reduced the monthly insurance policy premium to about $35. In addition, a decision was made at this time to subsidize insurance costs out of demonstration funds.

[8]The monthly user charge also includes, as applicable, a fixed amount ($10 -- not included in table) for parking in CALTRANS-subsidized lots in downtown San Francisco.

[9]This amount represents the lease fee paid to a local Chrysler dealer and includes depreciation, interest, sales tax, title, and dealer profit.

[10]Because of the short-term nature of the closed-end lease (3 years), maintenance costs were expected to be lower and tire wear was not included in the mileage cost.

[11]The amount does not include the surcharge for faster wear-and-tear (see footnote 3).

Vehicle deployment practices were aimed at encouraging vanpool formation by underwriting some of the start-up risks associated with vanpooling. All four projects allowed vanpools with fewer than the recommended number of passengers to operate over a trial period of up to three months. During this period, passengers paid the recommended (break-even) fares, and deficits were subsidized out of project funds. The trial van policy proved to be an effective strategy for overcoming market barriers to vanpooling. In Knoxville, for example, over 60% of the trial pools initiated during the first year and a half reached operational status.

Another innovative vehicle deployment practice tested in the Knoxville and Golden Gate projects was the seed van concept, under which project vans would be used by newly formed pool groups while they worked out operating policies and reached a stable size. After this "break-in" period, the pool group was expected to transfer into a purchased or leased van, allowing the project van to be reassigned to another new group. Project staff actively assisted the transition process by identifying sources of insurance and financing, providing assistance in filling vacancies, and arranging for discounts on new vans, parts, and maintenance. In the Golden Gate project, where a 12-month time limit was strictly enforced, 41% of project vanpools made the transition. In Knoxville, where this policy was pursued less vigorously, there were no instances of a project vanpool transferring into a <u>new</u> purchased or leased vehicle; however, the project was able to sell off its fleet of used vehicles to existing operators.

3. VANPOOL LEVEL OF SERVICE

In order to understand why individuals decided to participate in the four vanpooling programs as drivers or passengers, one must examine the potential level of service and user benefits embodied in vanpooling. Within the spectrum of urban travel modes, vanpooling and carpooling are unique in that modal availability and service attributes such as travel time, cost, and reliability are highly dependent on the volume and distribution (in time and space) of demand. The existence of a unit of capacity to serve a particular individual's travel needs depends entirely on there being one or more other individuals having similar origin-destination and schedule requirements. Unlike conventional transit, where fare and service policies are determined by the operator, ridesharing characteristics such as schedule adherence, vehicle amenities, and social interaction policies are defined by the pool unit, and the addition of each new pool member may significantly affect the cost and travel time incurred by other members. Vanpooling stands apart from carpooling by virtue of having a regular driver who, as will be discussed below, exerts considerable influence over fare and service policies and the financial viability of the vanpool.

3.1 Travel Time

To the prospective vanpooler, one of the major drawbacks of vanpooling is the additional travel time (over and above alternate modes) which is incurred in picking up and dropping off other passengers.* Since travelers' willingness to accept longer travel times in exchange for cost savings and other benefits is a primary determinant of the potential market demand for vanpooling, it is of interest to glean evidence from these demonstrations regarding the actual level of circuity experienced by project vanpoolers.

Analysis of survey data and van logs from three of the projects reveals circuity levels (as measured by the ratio of an individual's travel time or distance by vanpool to his/her drive-alone time or distance) ranging from 1.25 to 1.5. Using Minneapolis data, travel time circuity was examined separately for drivers and passengers; as would be expected, the average increment over drive-alone time was found to be much higher for drivers -- 22 minutes added to a 34-minute drive-alone time (an increase of 64%), vs. a 35% increase for passengers. These circuity levels reflect not only pool group size (which in all three projects averaged 8 persons, after accounting for observed daily attendance rates of 80%) but also specific operational arrangements such as pick-up location and waiting time policies. Well over half of the surveyed vanpoolers walked or drove to a pick-up point (in some cases, a common meeting area). This practice clearly minimized the collection time for the pool as a whole but may have increased the circuity experienced by the individual passenger.

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*Although travel time circuity is probably the most relevant circuity concept for explaining behavioral response, it should be noted that mileage circuity is important for computing fuel consumption and operating costs of vanpooling relative to other modes.

Minneapolis data was also used to analyze circuity as a function of trip length. The finding that the absolute time increment is roughly constant regardless of commute distance is consistent with recent empirical evidence from Australia on carpool spatial structure (Ref. 10), but contrary to the Johnson-Sen postulation (Ref. 8) that vanpoolers are willing to accept greater circuity on longer trips. Further investigation of this issue using data from other projects is warranted to ascertain how vanpoolers trade off travel characteristics such as time and cost and whether there is some sort of threshold circuity level beyond which vanpooling is considered an infeasible travel option.

3.2 Travel Cost

Vanpool passenger fares varied considerably across projects, reflecting not only differences in monthly vanpool user charges but also different policies regarding how these charges should be shared by vanpool members. All of the projects recommended passenger fare schedules based on dividing the monthly user charge by a "break-even" number of passengers (excluding the driver). In the Golden Gate project, the recommended fare schedules assumed full vans. In the other three projects, the break-even number of passengers used to compute recommended fares was lower than the maximum passenger capacity of the van, the intent being to provide a cushion against low load factors and surplus revenue in the case of higher than break-even load factors. In practice, however, drivers in Knoxville, Norfolk, and Minneapolis were allowed considerable latitude in establishing the level and structure of passenger fares. Evidence from two of the three projects indicates that drivers opted for charging fares below the recommended fare schedules, not only forfeiting the incentive of excess passenger revenues from higher than break-even loads but also in some instances forfeiting their free ride or voluntarily contributing a fare.*

This finding regarding driver-determined fare policies suggests one or more of the following: (1) drivers are motivated by incentives other than the heavily touted "free ride plus excess fares" and/or by actual or perceived competition from other providers, (2) drivers are strongly committed to keeping their pools in operation and not raising passenger fares when vacancies arise, or (3) drivers live considerably further from work than their fellow passengers and wish to keep fares competitive with potential shorter-distance vans. Another possible explanation is that pool groups agree to set fares corresponding to the level of service experienced by each individual. A multivariate regression analysis of fares of Minneapolis vanpool passenger reveals that the fare-setting mechanism is in accord with rational economic behavior. In particular, fares for individuals in vans carrying more passengers are significantly lower, and fares for individuals who live farther from work are higher, everything else being equal. Also, fares for individuals who do not commute by van every day of the week are slightly

*In Minneapolis, only one driver charged the break-even fare, and 38% of the drivers actually paid a fare. Of the 46 Norfolk vans for which actual fare information is available, 41 charged fares below the recommended level, including four vans operating with fewer than the break-even number of passengers. Of these 41, 16 charged fares below the actual prorated amount per passenger excluding the driver (implying that the driver was contributing all or a portion of his prorated share and forfeiting his/her free ride), and 6 of the 16 actually charged fares below the actual prorated amount including the driver (meaning that the driver was contributing more than any passenger).

lower. Order of pick-up also appears to have an impact, with fares being higher for passengers picked up later in the collection portion of the trip.

For purposes of intermodal cost comparisons, Table 3 shows each project's recommended monthly vanpool passenger fares vs. the monthly cost to the user of driving alone and carpooling for three different trip lengths. It can be seen that the recommended monthly vanpool fare is, for the three commute distances selected, well below the drive-alone user cost, and that the cost differential between automobile submodes and vanpooling increases with distance and decreases as automobile occupancy increases. The project vanpools are competitive with 2-person and 4-person carpools at round-trip commute distances in excess of 20 miles and 60 miles, respectively. It should be noted, however, that these threshold distances are based on user cost comparisons only; factors such as added travel time and reduced schedule flexibility offset the user cost savings associated with vanpooling, effectively increasing the commute distance at which vanpooling is an attractive alternative to other travel modes.

3.3 Reliability

Turning to other vanpooling level of service attributes, evidence from the four projects indicates high levels of vehicle reliability, reflecting the newness of the vans and the diligent preventive maintenance practices. The availability of service on a day-to-day basis was also very high, due to the availability of back-up vans from the third-party provider (one to three vehicles were reserved for this purpose) and designated back-up drivers.

TABLE 3. COMPARATIVE USER COSTS FOR VANPOOLING, DRIVING ALONE, AND CARPOOLING AS A FUNCTION OF COMMUTE TRIP LENGTH

		Knoxville	Norfolk	Golden Gate Corridor		Minneapolis
Vehicle Capacity		12	12	11	10	12
Break-even Passenger Load (excluding driver)		8	8	10	9	9
Vanpool Daily Round-Trip Mileage						
20 Miles						
Vanpool fare[1]		$24.88	$25.25	$26.00	$33.00	$27.00
Drive-alone cost[2]	$46.83					
2-person carpool cost[2]	24.37					
4-person carpool cost[2]	12.18					
50 Miles						
Vanpool fare[1]		$32.88	$34.00	$33.00	$40.00	$33.30
Drive-alone cost[2]	$112.98					
2-person carpool cost[2]	60.91					
4-person carpool cost[2]	30.46					
90 Miles						
Vanpool fare[1]		$44.38	$48.50	$44.00	$52.00	$41.70
Drive-alone cost[2]	$201.39					
2-person carpool cost[2]	109.64					
4-person carpool cost[2]	54.82					

[1]Vanpool fares are based on December 1978 costs and calculated according to the following formula: Recommended monthly fare = [monthly fixed cost + (variable cost per mile x round-trip distance in miles x 21 days per month)] ÷ break-even passenger load.
See Table 2 for fixed and variable costs for each project.

[2]Drive-alone and carpool costs are based on cost data, assumptions, and methodology presented in Reference 9, p. 5-5. The cost figure of 13.1¢ per mile includes all fixed costs of auto ownership which can be attributed to the commute trip (for simplicity, the attributed portion is assumed constant for all automobile submodes) and all variable operating expenses except for parking, which is typically free in the four sites. Automobile costs are computed for shorter trip lengths than the vanpool daily round-trip mileage to account for circuity. The circuity values used are 1.26 for vanpool vs. drive-alone and 1.11 for carpool vs. drive-alone. For carpooling alternatives, the total vehicular cost is divided by the number of occupants, reflecting the assumption that all members share expenses equally.

Partly as a result of the care taken by project staff in driver selection and training, the drivers turned out to be responsible and interested in maintaining high-quality service. Most vanpool drivers established rules regarding pick-up times and procedures, and were rated favorably by passengers as to their adherence to agreed upon schedules.

4. TRAVELER RESPONSE AND IMPACTS

This section examines the target market response to the four third-party projects, including vanpool formation and termination rates, vanpooler characteristics, and user benefits. Even though the findings presented reflect site-specific conditions and the timing and relatively short duration of the demonstrations (two to three years), they provide a useful indication of the nature of the traveler market for whom vanpooling is most appealing.

4.1 Vanpool Formation

All of the projects were reasonably successful in attracting prospective poolers and placing them in vanpools (see Table 4). Although in most cases vanpool growth was slow during the initial stages of the project, all third-party vans were assigned to operating pool groups within 6 to 18 months of demonstration start-up and stayed in service until or beyond the close of the demonstration period. Vanpool occupancy levels were quite high in all four projects, averaging approximately 10 persons per vehicle (including the driver) once demonstration operations were in full swing. The project

TABLE 4. VANPOOL FORMATION AND VANPOOLER CHARACTERISTICS

	Knoxville	Norfolk	Golden Gate Corridor	Minneapolis
Operational Vanpools at Close of Demonstration	51[1]	46	86[2]	62[3]
Vanpool Occupancy - Year 1 Year 2	10 11	6-8 8-10	9.4 10.2	8 10.2
Vanpool Mode Split	2.1%	3.4%	.5% - 1%	.3% - .7%
<u>Vanpooler Characteristics</u>				
Average Age	N.A.	37	40	40
Percentage Male	64%	71%	63% (yr. 1) 52% (yr. 2)	56%
Average Household Income	$13,680	N.A.	$24,000	$25,200
Auto Ownership/Availability	7% have no auto available	1.87 vehicles per household	1.83 vehicles per household	2.09 vehicles per household
Percentage in Managerial/ Professional Category	20%	N.A.	71%	47%
Former Commute Mode			<u>yr. 1</u> <u>yr. 2</u>	
Drive Alone	36%	52%[4]	15% 31%	27%
Carpool	54%	33%[5]	35% 30%	65%
Transit	10%	3%	50% 32%	8%
Private Hauler	-	12%	- -	-
Job Requirements	N.A.	80% have regular work hours	93% rarely work overtime 95% rarely need car for work	86% rarely work overtime 86% rarely need car for work
Average Round-Trip Distance	61 miles	54 miles	80 miles (yr. 1) 56 miles (yr. 2)	54 miles

1 This number excludes 6 privately formed vanpools which were assisted by the project but did not use project vans.

2 This number is comprised of 35 vanpools in project vans and 51 transitioned vanpools. It excludes 25 vanpools which were assisted by the project but did not use project vans.

3 This number is comprised of 36 vanpools operating at the 11 targeted work sites and another 26 vanpools operating at other sites where no marketing was performed.

4 This percentage includes auto drivers who were in 2-person carpools.

5 This percentage excludes auto drivers who were in 2-person carpools.

vanpools transported a very small percent of target area commuters; nonetheless, the fleet utilization and vanpool occupancy levels experienced in the four sites matched or exceeded local expectations.*

Vanpool termination rates ranged from approximately 15% of all project vanpools formed in Norfolk and Minneapolis to 30% in Golden Gate. The median life of vanpools that disbanded was quite short (approximately 4 months), which is consistent with the finding that the major reason for vanpool dissolution was the inability of trial vans to reach a viable size. In most cases of vanpool termination during the second year of operations, there was a sufficient backlog of interested pool groups that vans were only temporarily unassigned.

Driver and passenger turnover rates were also quite low. Of the 46 vanpools operating in Norfolk at the close of the project, only 7 had experienced a change of drivers, with the predominant reasons being changes in job location and work schedule. The average driver turnover rate in Knoxville during the last six months of the project was 2.6 drivers (representing 7% of the operating vans) per month. As of the middle of the Golden Gate

*It should be noted that the Norfolk, Minneapolis, and Golden Gate projects experienced sharp increases during the spring of 1979 in the number of applicants interested in joining vanpools, the number of vans in operation, and average vanpool occupancy levels. However, the extent to which these increases in vanpool activity resulted from changes in gasoline price and availability (either actual local shortfalls or perceptions of impending shortfalls) cannot be ascertained, primarily because the projects were still in an active marketing and growth phase (Ref. 5). An additional exogenous factor which may have affected response to the Norfolk project was the implementation of stricter parking policies and parking charges in March 1979, coupled with the announcement of impending reductions in parking capacity and federally mandated parking charges.

demonstration, 32 drivers had been used to operate 30 vans. Although lack of a willing driver was sometimes a barrier to vanpool formation in the Golden Gate Corridor, driver resignations or job transfers accounted for only 19% of vanpool terminations. Passenger drop-out rates averaged well under one rider per month per van in Norfolk and Minneapolis and less than 5% of all registered vanpoolers during the course of the Golden Gate demonstration. On the basis of Minneapolis and Golden Gate survey data, the principal reasons for leaving a vanpool appear to be higher-than-anticipated vanpool fares (and, for low-income passengers, difficulties in paying a monthly fare), insufficient flexibility and convenience, and changes in commuting needs.

4.2 Vanpooler Characteristics

Analysis of vanpooler survey data reveals remarkable similarity across projects in demographic characteristics and employment-related attributes. The typical vanpooler is around 40 years old, coming from a household of 3 to 4 persons with higher than average annual income and auto ownership. Vanpoolers are predominantly male, married, and college-educated, with the percent in managerial/professional job categories ranging from 20% in Knoxville to 71% in the Golden Gate Corridor. Drivers tend to be slightly older, better educated, and from higher-income households than passengers, and nearly all of them are married males. Limited information is available from which to assess differences in characteristics of vanpoolers and those of commuters and metropolitan households in general. In Golden Gate, it was found that vanpoolers more often come from households owning autos, have college educations, and are employed in a professional/managerial occupation.

In Minneapolis, comparisons of vanpoolers with solo drivers and carpoolers in the targeted work sites reveals little difference in auto ownership or income levels; however, vanpoolers tend to be older than users of these other modes.

A finding consistent with prior empirical evidence is that project vanpoolers tend to have long commute distances relative to the average target market or metropolitan area resident. Average vanpooler round-trip commute distance ranges from 54 miles in Minneapolis and Norfolk to 61 miles in Knoxville. Analysis of Minneapolis data reveals that the trip lengths of former transit users and solo drivers are considerably shorter than those of former carpoolers. Since the cost advantage of vanpooling over automobile submodes increases with distance (see discussion in Section III), this finding suggests rational economic behavior on the part of vanpoolers in deciding to switch modes.

The former commuting mode of vanpoolers varies significantly across projects, reflecting differences in target area characteristics, explicit marketing priorities, and 13(c) service restrictions. The Golden Gate Corridor project had the largest percentage diversion from transit (50% during the first year), which is not surprising given the active marketing of vanpools on corridor buses. It is interesting to note the rather extensive diversion from carpooling, ranging from 30% in the Golden Gate Corridor to 65% in Minneapolis. This finding may be the result of a high incidence of carpooling among long-distance commuters before the projects began (this possibility is suggested by Minneapolis data on trip length by former mode). Another possible explanation, which merits further examination, is that carpoolers trade off modal attributes differently from users of other modes and are a more receptive market for vanpooling. For instance, it might be that carpoolers are willing to accept greater circuity in exchange for the opportunity to be fully relieved of the driving responsibility. Whatever the explanation, it is clear that the user cost and fuel savings achieved through vanpooling can be considerably overestimated if the diversion from prior ridesharing modes is not accounted for, particularly since vanpoolers diverted from carpooling were found to have longer commute distances than the average vanpooler.

Examination of vanpooler employment characteristics reveals that the types of commuters most likely to vanpool are workers who do not usually need a car for work and rarely work overtime. As can be seen from Table 4, an extremely high percentage of surveyed vanpoolers work overtime less than once per week and need a car less than once a week. Over three quarters of the vanpoolers in Minneapolis neither work overtime nor need a car at work more than once per week. Vanpoolers in Minneapolis also reported flexibility in shifting daily work schedules (33.2%) and permanently changing work hours (46.9%). In contrast, the reported prevalence of overtime requirements and need for a car during the day is significantly higher among non-vanpoolers, especially those who drive to work alone.

As noted earlier, an important objective of these demonstrations was to determine the applicability and effectiveness of the third-party mechanism for serving multi-employer markets, since single employers cannot be expected to provide vanpools to any but their own employees. The projects differed in terms of how extensively they tested this question: in Norfolk, there was only one employer but multiple work sites; in Knoxville and Golden Gate, the focus was on areawide and corridor commuters representing numerous employers, but there was no special attempt to create multi-employer pools; in Minneapolis, on the other hand, the concept was put to the hardest test, since the focus was on suburban work sites with firms of varying sizes. Based on limited data on vanpool composition and operations, it appears that the majority of project vanpools in Knoxville and Golden Gate were single-employer pools, and the employers represented by these vanpools tended to be large (for instance, 44% of Golden Gate vanpoolers work at firms with more than 1000 employees). In Minneapolis, the percentage of multi-employer pools was higher than in other sites (55%); however, varying work schedules and dispersed company locations within a work site constituted major barriers to multi-employer pools. The finding that dispersed work locations (up to one mile apart) inhibited the formation of multi-employer vanpooling suggests that commuters may perceive circuity at the work end of the vanpool trip to be more onerous than circuity at the residence end or, alternatively, that commuters may be unwilling to endure the travel time increases due to circuity at both ends of the work trip.

4.3 User Benefits

Project vanpoolers experienced many benefits as a result of shifting their commuting mode. These included out-of-pocket cost savings of several hundred dollars a year, in part reflecting fuel savings of 300-400 gallons per year (the precise amounts of course depended on their former mode), reduced driving hassle (for passengers who formerly drove alone or carpooled), and decreased travel time (for former transit users). Another important source of cost savings for vanpoolers was the ability to sell a household vehicle or defer purchase of a new vehicle. In the Golden Gate Corridor one percent of vanpoolers sold a vehicle and 15% claimed they deferred purchase of a new vehicle; in Norfolk 5% of vanpool passengers sold a vehicle and 28% claimed to have deferred purchase. The percentage of Knoxville and Norfolk drivers who sold a vehicle was 13% and 21%, respectively, with another 3% in Knoxville and another 29% in Norfolk reportedly deferring purchase of a new vehicle. Drivers were in a relatively better position than passengers to decrease auto ownership because of the availability of the van for personal use at reduced rates. Based on data from Knoxville and Minneapolis, drivers logged approximately 150-200 miles per month on nights and week-ends. In Golden Gate, several vanpoolers reported savings in their automobile insurance premiums of up to $300 per year.

5. THIRD-PARTY PROVIDER IMPACTS

This section examines evidence from the four projects regarding the impacts of third-party vanpool programs on the provider organizations and then concludes with some implications for future third-party programs.

The cost of operating these third-party programs varied considerably across sites, reflecting differences in the nature and scope of staff activities, demonstration duration, and explicit subsidy policies. The demonstration operating budgets exclusive of vehicle capital costs ranged from $162,000 over a 20-month period in Norfolk to $895,000 over a 24-month period in Minneapolis. In the Golden Gate Corridor project, $614,000 was expended over a 33-month period, and in Knoxville a total of $738,000 was spent over 30 months. These operating budgets covered project administration, marketing, matching, and data collection conducted for evaluation purposes. The cost of van fleet acquisition and maintenance was almost entirely offset by revenues from vanpool user charges as explained in Section II. The low cost of the Norfolk project relative to the other three demonstrations can be explained by the focused target market and the extensive in-kind support provided by the Navy. The considerably higher cost of the other three projects reflects their more diverse and geographically dispersed target markets (especially Minneapolis, where there was extensive outreach to small firms), their more elaborate marketing efforts, and their greater emphasis on institutional and multi-modal brokerage activities.

Using available cost and demand data and cost allocation assumptions to obtain the net cost of vanpool-related activities, the unit cost of these four third-party programs is estimated to have ranged from $300 to $500 per operational van-month. These unit cost figures are not, however, felt to be indicative of the cost of operating such a program at the present time. For one thing, they cover many institutional and planning activities which were necessary several years ago because of the prevalent barriers to vanpooling and the novelty of the third-party provider mechanism. Second, these costs reflect only two to three years of operating experience and are thus heavily influenced by start-up costs and low initial van utilization levels, which necessitated subsidies for low-occupancy vans and (in Minneapolis) carrying costs for idle vans. Evidence from three of the projects suggests substantial declines in unit costs over time as the number of applicants and operational vanpools increases and the emphasis shifts from forming new vanpools (a function largely performed by the third-provider) to maintaining existing vanpools (primarily a driver responsibility). In the Golden Gate project, for example, the cost per operational van-month averaged $1440 during the first year and a half and $240 during the subsequent year. The Minneapolis project experienced a similar reduction, with the cost per operational van-month declining from $1300 during the first year to $350 during the second year. In Norfolk, the average cost per operational van-month declined from approximately $125 during the last year of the demonstration to $27 two years later.

All four vanpool programs have continued beyond the demonstration period using other sources of funding to cover administrative expenses. The City of

Knoxville no longer operates its own fleet of vans but has continued to provide assistance to pool groups in the areas of matching and brokering, arranging for insurance and financing, and organization of a driver association. The other three projects have continued to provide a full range of third-party services including project vans. The Golden Gate project has held its fleet size to approximately 40 vehicles and has continued its policies of seeding project vanpoolers into non-project vans and assisting the formation and maintenance of privately operated vanpools. The Norfolk and Minneapolis projects have expanded their scale of operations to 100 vans, and Norfolk's pricing policy has been altered so that vanpool user charges cover a portion of the program administrative costs. Although there have been few instances to date of vanpools being used to replace fixed-route service, the organizations sponsoring these programs continue to see vanpooling as a cost-effective alternative to the expansion of peak-period transit capacity. The Golden Gate Bridge, Highway and Transportation District, for example, has estimated that the per-person subsidy costs for the vanpool program are less than one-fourth the bus subsidy costs.

In recent years there has been a noticeable increase in the number of third-party vanpool programs in operation across the country. These newer programs have benefited considerably from the institutional accomplishments and operational experiences of the four demonstrations. Given the prospect of rising energy costs and increasingly severe fiscal constraints which threaten to force the curtailment of transit service in many metropolitan areas, there appears to be a continuing if not growing role for third-party vanpooling programs in order to attract commuters into this high-occupancy mode. In particular, the third-party mechanism offers considerable flexibility in terms of how, where, and at what rate vanpool services are introduced within an urban area. Moreover, this mechanism represents an effective avenue for promoting greater private sector participation in the provision of urban transportation services and encouraging more entrepreneurship on the part of individuals to organize and operate transportation services for other commuters. It should be noted, however, that many of the policies and operational procedures developed in the four demonstrations may not be applicable or necessary at this time. For instance, seed vans may not be required in all settings now that there is greater public familiarity with vanpooling. Similarly, marketing efforts and policies such as trial van subsidies may not be needed to such a degree. Finally, as the cost of competing modes rises and pressures to contain public costs become even stronger, there may be increasing impetus to find other sources of funding (vanpool user charges and/or employer contributions) to cover third-party program administrative expenses.

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APPENDIX

REPORT OF NEW TECHNOLOGY

A thorough review of the work performed under this contract has revealed no significant innovations, discoveries, or inventions at this time. In addition, all methodologies employed are available in the open literature. However, the findings in this document do represent new information and should prove useful throughout the United States in designing and evaluating future transportation demonstrations.

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