UMTA-MA-06-0126-84-01
DOT-TSC-UMTA-83-57

U.S. Department of Transportation
Urban Mass Transportation Administration

Morgantown People Mover Phase II Impact Assessment

Paul S. Jones
John G. Shaw

SYSTAN, Inc.
343 Second St.
P.O. Box U
Los Altos CA 94022

February 1984
Final Report

UMTA Technical Assistance Program

LIST OF EXHIBITS (Cont.)

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UMTA-MA-06-0126-84-1	PB84-169366	

4. Title and Subtitle
Morgantown People Mover Phase II Impact Assessment

5. Report Date
February 1984

6. Performing Organization Code
TSC/DTS-64

7. Author(s)
Paul S. Jones and John G. Shaw

8. Performing Organization Report No.
DOT-TSC-UMTA-83-57

9. Performing Organization Name and Address
SYSTAN, Inc.*
343 Second Street
P.O. Box U
Los Altos, California 94022

10. Work Unit No. (TRAIS)
MA-06-0126(UM364/R3674)

11. Contract or Grant No.
DOT-UT-90019

13. Type of Report and Period Covered
Final Report
Sept.80 - Oct.83

12. Sponsoring Agency Name and Address
U.S. Department of Transportation
Urban Mass Transportation Administration
400 Seventh Street, S.W.
Washington, D. C. 20590

14. Sponsoring Agency Code
URT-42

15. Supplementary Notes
*Under contract to: U.S. Department of Transportation
Research and Special Programs Administration
Transportation Systems Center
Cambridge, Massachusetts 02141

16. Abstract

This report describes an assessment of the Morgantown People Mover (MPM) system, which is an automated guideway transit system extending over 5,300 meters (3.3 miles) of double lane guideway, connecting West Virginia University's downtown campus with three complexes on its new Evansdale Campus and with the Morgantown central business district. It provides demand responsive, non-stop service between any two of the five stations in small, 21-passenger automated vehicles. The objectives of the Phase II Impact Assessment is to measure and assess: 1) the contributions that the Phase II MPM has made to travel and mobility in the Morgantown area; 2) the impact that the Phase II MPM has had on business and life in the community; and 3) the impact of the MPM construction activities on business and life in the community.

The vehicles of the MPM are managed by a central computer system that maintains a vehicle inventory at each station and releases vehicles for use on demand. The study finds that the MPM technology is a technical success. The vehicles perform as designed with a high degree of reliability. They satisfy service demands with few delays. Most technical problems that do occur are handled promptly and with only minor delays to passengers. The MPM carried almost three million passengers during the first full year of operation, attracting nearly fifty percent of those travelers who could conveniently use the service. The report points out that the MPM is more reliable than the bus system it replaced, but on the other hand, waiting times for buses were shorter and the wait more comfortable, and the bus operating costs were only one-third of the MPM operating costs. Students are by far the heaviest users of the system. Both users and non-users have a high opinion of the system. Users, however, uniformly object to the waiting times, which are perceived to be unacceptably long. Because of the inefficiency of dispatching vehicles to meet each individual trip request, a vehicle is delayed in filling a demand for five minutes or until fifteen passengers have requested service between the same origin and destination stations.

Although esteemed by all resident groups in Morgantown, the MPM's commercial success must be judged marginal. Its service is slightly better than the buses that it replaced and its impacts on the local economy have been marginal. The authors point out that the marginal benefits fall far short of justifying the MPM's high capital and operating costs.

17. Key Words	18. Distribution Statement
Automated Guideway Transit; AGT; Morgantown People Mover System; Morgantown, West Virginia; MPM; MPM Impact Assessment; People Mover Systems	Available to the Public through the National Technical Information Service, Springfield, Virginia 22161.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	190	A09

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

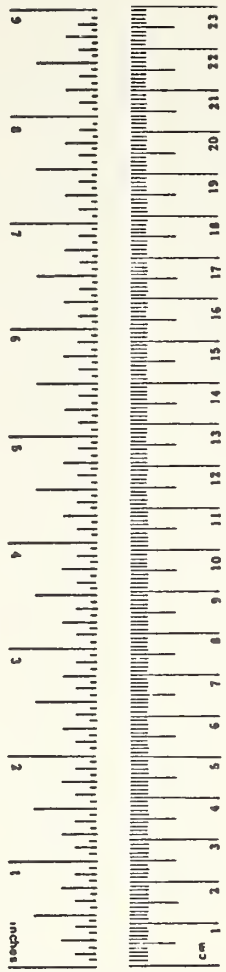
LIST OF EXHIBITS (Cont.)

CONTENTS

METRIC CONVERSION FACTORS

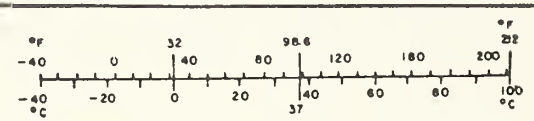
Approximate Conversions to Metric Measures

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)		
	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



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



PREFACE

This report describes an assessment of the Morgantown People Mover (MPM), an Automated Guideway Transit (AGT) system that extends over 5,300 meters (3.3 miles) of double lane guideway and connects West Virginia University's Downtown Campus with three complexes on its new Evansdale Campus and with the Morgantown Central Business District.

The research described in this report was sponsored by the U.S. Department of Transportation, Urban Mass Transportation Administration, Office of Technical Assistance, Office of Methods and Support. Initial guidance was provided by Mr. John Durham of the Transit Technology Evaluation Program. Subsequent guidance has been provided by Mr. Michael Wolfe and Dr. Arthur Priver of the Transportation Systems Center.

The work was performed by SYSTAN, Inc., under the direction of Dr. Paul S. Jones. Mr. John Shaw supervised the surveys, the data processing and the statistical analysis of the completed questionnaires.

The project team is deeply indebted to Dr. Samy Elias, Claude Worthington Benedum, Professor of Transportation at West Virginia University (WVU), and to Mr. Robert Bates, Manager of the Morgantown People Mover (MPM) for permission to conduct the survey and for their support throughout the project. The team is also grateful for the support and services that it received from many sources. Ms. Janet Alderman and Mr. Ted Barker of WVU were most helpful in the distribution of the faculty/staff survey and in providing data on the MPM. The WVU students and Morgantown residents who assisted with the surveys provided an essential attitudinal data base for analysis. Morgantown officials and merchants were generous with their time and with their insights. The survey results and the conclusions presented in this report are the sole responsibility of the authors.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UMTA-MA-06-0126-84-01		

4. Title and Subtitle	5. Report Date
Morgantown People Mover Phase II Impact Assessment	February 1984
	6. Performing Organization Code: TSC/DTS-64
	8. Performing Organization Report No.: DOT-TSC-UMTA-83-57
7. Author(s): Paul S. Jones, John G. Shaw	
9. Performing Organization Name and Address: SYSTAN, Inc.* 343 Second St., P.O. Box U Los Altos, CA 94022	10. Work Unit No. (TRAIS): UM364/R3674
	11. Contract or Grant No.: DOT-UT-90019
	13. Type of Report and Period Covered: Final Report September 1980-October 1983
12. Sponsoring Agency Name and Address: U.S. Department of Transportation, Urban Mass Transportation Administration, Office of Technical Assistance, Washington DC 20590	14. Sponsoring Agency Code: URT-42

15. Supplementary Notes

*Under Contract To: U.S. Department of Transportation
Research and Special Programs Administration
Transportation Systems Center
Cambridge, MA 02142

16. Abstract

This report describes an assessment of the Morgantown People Mover (MPM), an Automated Guideway Transit (AGT) system. This system extends over 5,300 meters (3.3 miles) of double lane of guideway, connecting West Virginia University's Downtown Campus with three complexes on its new Evansdale Campus and with the Morgantown Central Business District. It provides demand responsive, non-stop service between any two of the five stations in small (21 passenger) automated vehicles. The vehicles are managed by a central computer system that maintains a vehicle inventory at each station and releases vehicles for use on demand.

The study finds that the MPM technology operates with a high degree of reliability. It carried almost three million passengers during the first full year of operation, attracting nearly 50 percent of those travelers who could conveniently use the service.

The MPM is more reliable than the bus system it replaced. On the other hand, waiting times for buses were shorter and the wait more comfortable, and the bus operating costs were only one-third of the MPM operating costs.

Students are by far the heaviest users of the system. Both users and non-users have a high opinion of the system. Users, however, uniformly object to the waiting times, which are perceived to be unacceptably long.

Although esteemed by all resident groups in Morgantown, the MPM's commercial success must be judged marginal. Its service is slightly better than the buses that it replaced and its impacts on the local economy have been marginal. These marginal benefits fall far short of justifying the MPM's high capital and operating costs.

17. Key Words	18. Distribution Statement
Automated Guideway Transit (AGT) Urban Transit	DOCUMENT IS AVAILABLE TO THE PUBLIC THROUGH THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VIRGINIA 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED	190	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

For example, consider the transit portion of a trip from Engineering to Downtown Campus (Beechurst). The average wait plus travel time is 7.88 minutes, with a maximum time of 10 minutes. By bus the average time was 12.1 minutes, with a maximum time of 25 minutes. Given 20 minutes between classes, the student using the bus could expect to be late 26 percent of the time. The average MPM load of 6.2 passengers is less than the 8-passenger seating capacity, while the average bus load was greater than the bus seating capacity (more than 3/4 of the bus loads included standees).

The MPM is more glamorous and provides a more scenic ride than the bus. However, buses had some important advantages:

1. Waiting times for buses were shorter and the wait often more confortable than waiting for MPM vehicles.

2. Bus operating costs were only about one third of MPM operating costs.

Extensive surveys were conducted in the Fall of 1980 of each of Morgantown's three major population groups:

1. WVU students;

2. WVU faculty and staff; and

3. Morgantown residents not affiliated with WVU.

Of the three groups, students are by far the heaviest users of the MPM, averaging 24 MPM rides per month. On the average, faculty and staff use the MPM 4.8 times per month; while non-University affiliates use it only 1.4 times per month. Almost half of the non-University affiliates have never ridden on the MPM.

Both MPM users and non-users have high opinions of the service that it provides. Faculty/staff and non-University affiliates find the MPM particularly attractive because it allows them to avoid some parking and traffic problems. All users are unanimous in their objection to waiting time which is perceived to be unacceptably long. During the period in which passengers were waiting for a vehicle, they were most anxious about arriving at their destination on time. It is particularly difficult for passengers to wait when they see idle vehicles standing in the stations throughout their waits. Seats in stations would make passengers more comfortable. Other steps are needed to reduce the length of the perceived wait.

Both MPM users and non-users like the MPM system design. They particularly like the vehicle design. While many dislike the appearance of the protective rust on the guideway structural beams, there is little objection to visual impacts of the elevated guideway.

EXECUTIVE SUMMARY

The Urban Mass Transportation Administration (UMTA) and West Virginia University (WVU) have created a unique transportation system that connects WVU's Downtown Campus with three complexes on its new Evansdale Campus and with the Morgantown Central Business District. This system, the Morgantown People Mover (MPM), provides demand responsive, non-stop service between any two of the five stations in small (21 passenger) automated vehicles. The vehicles are managed by a central computer system that maintains a vehicle inventory at each station and releases vehicles for use on demand. Because of the inefficiency of dispatching vehicles to meet each individual trip request, a vehicle is delayed in filling a demand for five minutes or until fifteen passengers have requested service between the same origin and destination stations.

The MPM is a technical success. The vehicles perform as designed with a high degree of reliability. Vehicles satisfy service demands with few delays. Most technical problems that do occur are handled promptly and with only minor delays to passengers. Mean waiting time of 3.13 minutes is about what one would expect from the dispatching algorithm.

The objective of the Phase II Impact Assessment is to measure and assess:

1. The contributions that the Phase II MPM has made to travel and mobility in the Morgantown area;

2. The impact that the Phase II MPM has had on business and life in the community; and

3. The impact of the MPM construction activities on business and life in the community.

The MPM is well used. Almost three million passengers were served during the first full year of service by the complete system. On peak days, as many as 27,000 passengers have been served. Mean daily traffic is just under 10,000 passengers. The MPM serves about half of the trips for which it can provide convenient service. With this high mode share, substantial patronage growth is unlikely unless steps are taken to serve additional classes of trips. The steps most likely to expand patronage involve creating additional public parking adjacent to some or all of the MPM stations.

The MPM replaced an excellent University bus system that provided transportation between the two campuses. Bus service was provided at five minute intervals on the most heavily used route. Compared with bus service, the MPM provides much more dependable travel time, enabling students with classes on both campuses to follow more efficient schedules.

Only a very few users (12 percent) were concerned about the safety and security of the MPM system. Women were more concerned than men. Their anxieties focused on system malfunctions, night time travel, and danger from other passengers.

The MPM has had an emotional impact on the lives of almost every resident of Morgantown. There is near unanimous agreement that the MPM is beneficial and that it has been good for Morgantown. However, specific impacts are difficult to identify. The MPM has attracted tourist attention from around the country and throughout the world. This attention has brought new money to Morgantown and benefited innkeepers and merchants. The MPM has generated about 1,100 daily trips that would not otherwise have been made. Although there is no clear evidence, some of these trips doubtless benefit downtown merchants. The MPM has diverted about 1,100 daily trips from the congested highway corridors that connect the two campuses. This diversion is perceived by most residents, although it is masked by general traffic growth. MPM construction impacts were small because most of the investment was used for equipment, materials and services supplied from outside the Morgantown area.

The technical success of the MPM is a tribute to its developers. Although highly esteemed by resident groups in Morgantown, its commercial success must be judged marginal. Its service is marginally better than the buses that it replaced and its impacts on the local economy have been marginal. These marginal benefits fall far short of matching the MPM's high capital and operating cost. The $141 million capital cost and the $2 million annual operating cost can be justified only in terms of the contributions made by the project to the maturation of automated guideway technology.

Exhibit 1

MORGANTOWN PEOPLE MOVER

1. INTRODUCTION

The Urban Mass Transportation Administration (UMTA) and the West Virginia University (WVU) have constructed a unique personal transit system to facilitate travel between university campuses in Morgantown, West Virginia. This Morgantown People Mover (MPM) transports passengers non-stop between pairs of stations using driverless vehicles operating under automatic control. Twenty-one passenger vehicles move over an exclusive guideway that connects five stations in a linear configuration.

The Morgantown People Mover is one of a class of Automated Guideway Transit (AGT) systems that are being developed and deployed in the United States and elsewhere. Most AGT systems are installed in airports and recreation centers. Travelers at these sites use AGT as a diversion or because they have no other means to reach their destinations. Morgantown is one of only a few AGT sites where travelers may elect either to use AGT or to use other means to satisfy their transportation needs.[1] Thus a unique opportunity exists at Morgantown to assess the real and perceived value of the MPM to the community.

1.1 THE MPM SYSTEM

In the Morgantown People Mover, 72 automatic cars travel over 5,300 meters (3.3 miles) of double lane guideway that connects five stations. The geographical layout of the system is illustrated in Exhibit 1. The route extends from the Walnut station in the Morgantown Central Business District (CBD) through three intermediate stations to the West Virginia University Medical Center. The Beechurst station serves WVU's downtown campus; the Engineering, Towers and Medical Center stations serve the Evansdale campus which is on a ridge north of the older part of the city.

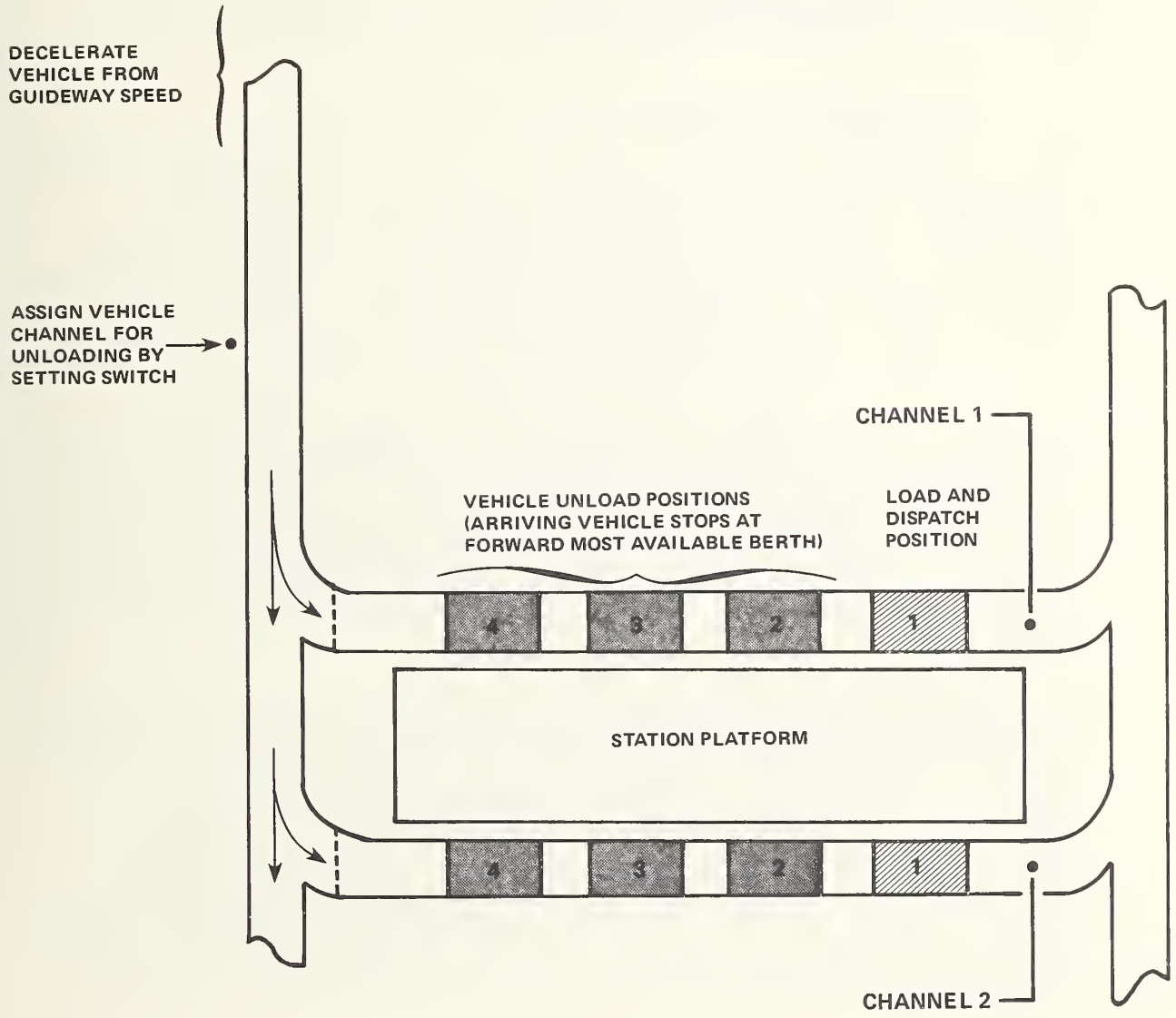
MPM vehicles travel between stations in response to passenger demands, with no intermediate stops. Service is available in either direction between each of the ten possible station pairs:

---

[1] Other sites that offer travelers a choice include the Atlanta International Airport terminal, Fairlane Town Center, and urban systems in Osaka and Kobe, Japan and Lille, France.

Exhibit 2

IN-STATION VEHICLE MANAGEMENT



Source: Reference 5

Walnut - Beechurst;
Walnut - Engineering;
Walnut - Towers;
Walnut - Medical Center;
Beechurst - Engineering;
Beechurst - Towers;
Beechurst - Medical Center;
Engineering - Towers;
Engineering - Medical Center; and
Towers - Medical Center.

Individual vehicles follow a succession of movements between station pairs. A vehicle path may be:

Towers-Beechurst-Engineering-Walnut-Medical Center-
Engineering-Towers- etc.

All vehicles that enter the stations located at the ends of the guideway (Walnut and Medical Center) stop there to discharge and board passengers. A vehicle may bypass an intermediate station without stopping, or it may switch to a station siding and stop to discharge passengers. Vehicles that stop at intermediate stations may continue in the same direction, or they may reverse direction. Vehicles may be held at any station to await future demand. The central control system can dispatch empty vehicles to meet demands as they develop.

Service to passengers is good. Each passenger designates a destination station when paying his/her fare. However, in the interest of economy, the system does not dispatch a vehicle as soon as a need is registered. Instead, the central control system waits to release a vehicle until fifteen or more travelers have indicated a desire to travel to the same station or when the first passenger to make a request has been waiting for five minutes, whichever occurs first. These parameters--15 passengers and five minutes--can be changed by the system operators.[2]

Station platforms are perpendicular to the guideway as illustrated in Exhibit 2. On entering the station a vehicle may be switched to any channel that has an empty unloading position. The entering vehicle stops at the forwardmost available unloading position, whereupon its doors open to discharge passengers. Doors close when the vehicle is empty and it waits in the unloading position until needed. When a vehicle is called for a trip, it moves to the loading and dispatch position, its doors open, and a sign illuminates its destination. After waiting a short time for loading, the doors close and the vehicle leaves the station. Passengers can delay door closing by pressing the door edge sensors.

---

[2] A three minute wait criterion was used for a time but it was abandoned because the operators felt that it resulted in an excessive number of daily vehicle movements.

begun on Phase II, which included major revisions to correct the deficiencies of Phase I and the completion of the system.

After almost three years of operation, revenue MPM service was suspended on June 30, 1978 so that Phase II could be completed and integrated with Phase I. This work was executed in an orderly manner and completed on schedule. The Phase II service was inaugurated in September 1979 with a minimum of problems. Service since then has been reliable and dependable. Even so, one still hears negative references to the early Phase I problems. Thus, when assessing the impact of the MPM on the community, it is important to keep the system's history in mind and to adjust for residual negative perceptions.

1.3 TIME PERIODS

Four distinct time periods can be associated with the MPM:

1. Pre Phase I, 1973 through September 1975;
2. Phase I, October 1975 through June 1978;
3. MPM Shutdown, July 1978 through August 1979; and
4. Phase II, September 1979 to date.

During the pre-Phase I period, the MPM Phase I guideway and stations were in evidence, but no service was offered to the public. Transportation between campuses was provided by University buses. Rumors and stories about the MPM abounded -- many were negative.

Phase I operation was different from the Phase II operation that has been described. In Phase I, vehicles were regularly scheduled between station pairs -- a somewhat easier task with three stations than with five. Some experiments were conducted with demand responsive service, but this service was rarely offered.

During the shutdown period, University buses were once again used to transport students and others between campuses. With the inauguration of Phase II MPM, University buses were restricted to short feeder routes and other University needs.

1.2 HISTORY

The MPM has had an interesting and at times controversial history. It was first conceived in 1967 as an alternative to the extensive bus fleet that the University then operated to transport students between its Downtown and Evansdale campuses (see Exhibit 1). By 1970, detailed design was underway and in October 1971, construction began.

Early events distorted the execution of the project. Because of the extensive technical development needed, it became apparent at an early stage that the initial cost estimates had been far too low. To continue work without excessive cost escalation, the system was divided into two phases. Attention was restricted to the first phase which included only three stations (Walnut, Beechurst and Engineering), connecting guideway and support facilities. The project also became tied to the 1972 presidential election, with a system dedication and public demonstration scheduled for October 1972. Eighteen months was hardly sufficient time to design, develop, and construct so complex a transportation system. Nonetheless, with enormous effort the dedication and demonstration were held as scheduled; but only a few vehicles were available and these were operated in a restricted fashion. The project was widely but unjustly criticized because the dedication could not be followed by revenue service and because the Phase I costs were greater than expected. When one considers the work that was done, the time schedule and the administrative difficulties, even token completion was a major accomplishment.

After the dedication, much work was needed to complete the system and to correct short cuts taken to maintain the schedule. Phase I was completed in 1975 and revenue service began on October 3 of that year.

Early operations were plagued with difficulties -- a situation not uncommon with complex projects, particularly those requiring a great deal of new development. As a result, students missed classes while stranded in stalled vehicles; operation ceased at irregular and unexpected times; and troups of visitors were treated to a variety of "horror stories." For three months, January to April 1976, university bus service was operated in parallel with the MPM. Despite the operational uncertainty and in spite of private and public criticism, the MPM carried more passengers during this period than the buses operating over parallel routes. In due course the major technical problems were solved and the system was operated reliably. Some design and construction deficiencies remained that were attributable to the newness of the concept, the short design and construction schedule, the desire to cut costs or a combination of these factors.

During the Phase I operating period there was also considerable controversy over the future of the MPM. Some federal officials argued that it would be inappropriate to spend the necessary funds to complete the system. The abbreviated Phase I system was sufficient to demonstrate the concept. University officials clung to the terms of the Phase I agreement which provided for the MPM to be completed or removed. A satisfactory agreement was reached in September 1976 and work was

supervising faculty members.

Assessment Reports

UMTA's Office of Socio-Economic and Special Projects sponsored an engineering assessment of the Phase I MPM [5]. The assessment team thoroughly investigated the physical components of the MPM and examined both operation and performance. A small public acceptance survey was conducted. The assessment has been a valuable reference for technical detail. The survey has been useful in conjunction with other attitudinal work.

In 1980, an energy assessment of the Phase II system was conducted [6]. This report provided a useful energy perspective and a valuable benchmark for comparison with alternative transit systems.

1.5 OBJECTIVE

The objective of the Phase II Impact Assessment is to measure and assess:

1. The contributions that the Phase II MPM has made to travel and mobility in the Morgantown area;

2. The impact that the Phase II MPM has had on business and life in the community; and

3. The impact of the MPM construction activities on business and life in the community.

1.6 SCOPE

The MPM impact assessment is oriented toward the broad community interests in Morgantown. Thus, it is concerned with the role that the MPM plays in University life and with the role that it plays outside of the University. The assessment is concerned with the attitudes of individuals and groups toward the MPM and their perceptions of the MPM's usefulness. The assessment deals in values and perceptions and compares these with factual data to the extent that they are available.

The impact assessment is directed toward Phase II of the MPM and concerns the period from September 1979 through December 1980. The Phase II MPM provides service between the Morgantown Central Business District (CBD) and the West Virginia University Medical Center in addition to service between University campuses. The expanded service has potential value to non-University affiliates who are seeking medical care, their families and friends and to persons with business at the Medical Center.

1.4 PRIOR LITERATURE

The Morgantown MPM was built in a fishbowl under the scrutiny of many interested parties. It has been subjected to many examinations and is the subject of continued research by University faculty. No effort will be made here to enumerate all past work. Rather, attention will be directed to that work which is most closely related to the impact assessment.

WVU Traffic and Travel Studies

Under the direction of Dr. S.E.G. Elias, the WVU Engineering College has produced seven report volumes [1,2,3,7][3] on travel and traffic in the corridor served by the MPM. The first set of three reports describes travel before the Phase I MPM entered service. It includes traffic counts on key routes, a travel survey, a transportation model and the results of interviews of transit users and others in the Morgantown community. This is a complete and detailed description of pre-MPM Morgantown travel. The second set of three volumes give similar data for the period during which Phase I was operated. Most data were collected during the spring of 1977 when many of the early problems had been resolved. Reference [3] compares Phase I MPM service with University bus service. Reference [7] is an extensive comparison between Phase II MPM service and the University bus service that was provided during the shutdown period. Updated travel data are presented for the MPM corridor together with results of surveys conducted during the two periods. The consistent approach and methods used by this team provide a valuable series of records. The impact assessment team has used this material extensively.

WVU Panel

Under the direction of Dr. Roger B. Trent, a team from the WVU Department of Sociology and Anthropology assembled a panel of approximately 200 Morgantown citizens for the purpose of assessing changes in public acceptance over time. One very useful article has been published [4] that describes public reaction to the MPM before it was placed in revenue service. Additional surveys were taken during both Phase I and Phase II operation. A detailed time history of Morgantown public attitudes is published in Reference [8]. This work has also been used extensively by the impact assessment team.

Additional WVU Studies

Other studies and surveys have been undertaken by WVU faculty and students as class projects or to support theses. These reports are not available, but some insights have been gained through discussions with

---

[3] Numbers in brackets [] refer to references.

The analysis has been concerned with the quality and amount of service that is available to MPM passengers. Some knowledge of system performance has been necessary to compare perceived service with actual service. However, no effort has been made to document or display the technical characteristics of the Phase II MPM.

Care has been taken to build the assessment on past work and to avoid repetition. Data collected and work performed by others are presented to give a complete picture. The work of others is cited when used.

1.7 REPORT ORGANIZATION

The report begins with a brief description of the Morgantown setting (Section 2). Principal stakeholders are identified together with their values and viewpoints. Next (Section 3) the Morgantown travel patterns and services are presented together with changes that have occurred during the MPM deployment. MPM performance (Section 4) is presented to document the level of service that is available. Some of this information was collected by the assessment team; some has been collected by others. The Morgantown transportation alternatives (Section 5) are presented in terms of a representative set of trips. Data are also presented on traveler attitudes. Section 6 describes the three surveys that were conducted by the SYSTAN team. Section 7 gives the principal results of the attitude surveys. The full set of community impacts is presented and discussed in Section 8.

2. MORGANTOWN SETTING

This chapter describes the physical and economic setting of the Morgantown People Mover and it identifies the principal stakeholder groups that use and are affected by the MPM system.

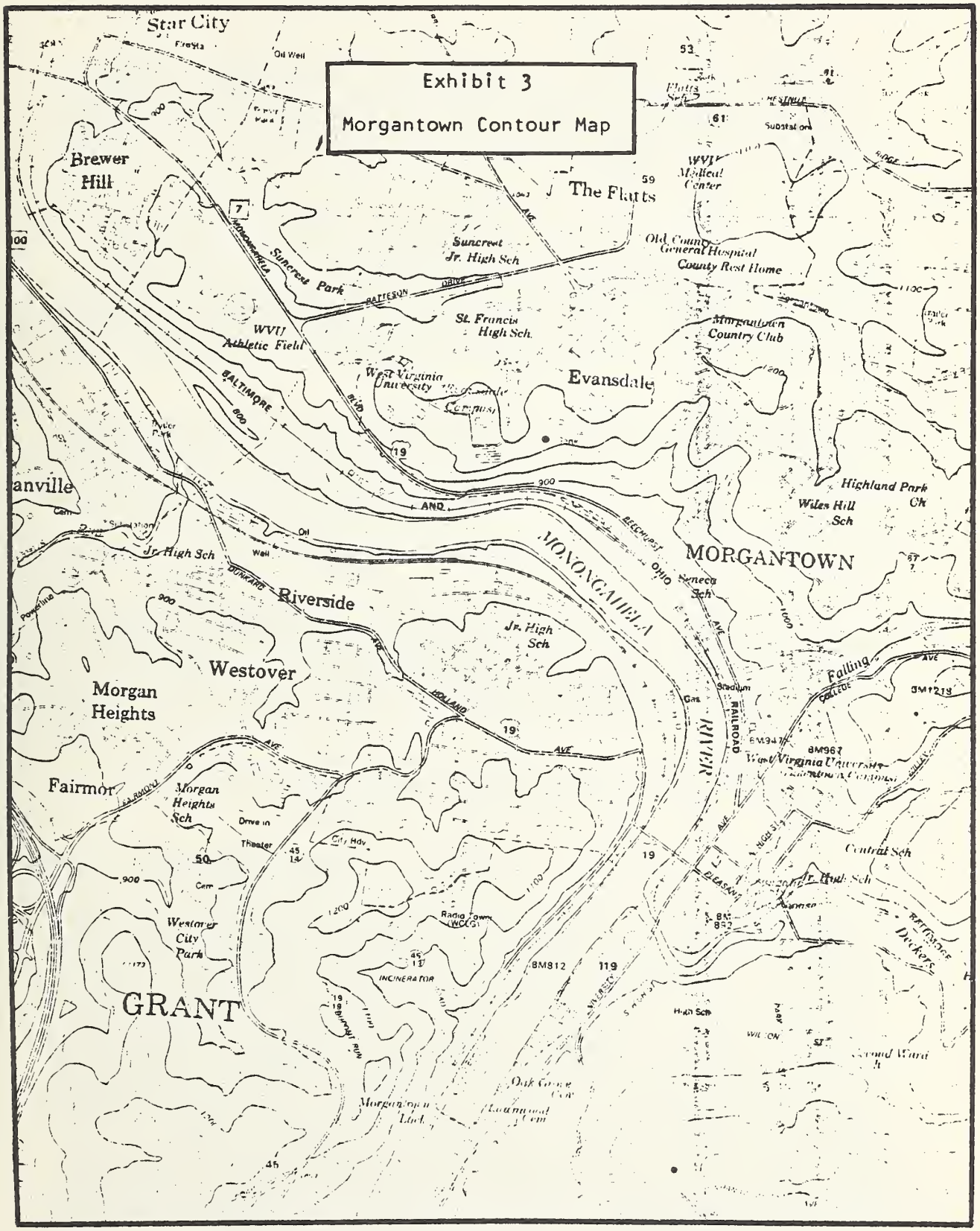
2.1 MORGANTOWN TOPOGRAPHY

Morgantown is a University dominated community in northern West Virginia that is nestled in the Appalachian Mountains against the east bank of the Monongahela River. The urban area includes the communities of Westover (on the west bank of the River) and Star City and adjacent unincorporated areas. Pittsburgh is about 115 km (70 miles) north; Fairmont is about 32 km (20 miles south); and Cumberland, Maryland is about 130 km (80 miles) east. Morgantown is the county seat of Monongalia County.

The terrain in and around Morgantown is hilly and the riverbank is steep. The CBD is located on relatively flat land that is almost 30 m (100 feet) above the River (see Exhibit 3). The Downtown campus of West Virginia University is adjacent to the north boundary of the CBD and slightly higher. There is some residential development on the east side of the CBD and south across Deckers Creek. The city long ago exhausted the available flat land around the city center and began expanding both up the hillsides and to flat areas beyond the immediate hills. Major commercial and industrial development has occurred on the Decker's Creek flats 2.4 km (1-1/2 miles) and more from the CBD. A large shopping mall has been built adjacent to Cobun Creek two miles south of the CBD.

Residential development has occurred on the steep hillsides and on the crests of the hills. Most of the new development has occurred north and northeast of the Evansdale campus. Much of this area lies outside of the city limits.

The University has faced similar problems in its expansion. When the building sites on the Downtown campus were exhausted, the only available sites were on higher ground some distance from the campus. The Evansdale campus is on the top of a ridge 2.4 km (1-1/2 miles) from the Downtown campus and 61 m (200 feet) above it. The Engineering College is located 0.8 km (0.5 mile) from the river. The University Medical Center is 1.6 km (one mile) farther along the ridge at about the same elevation.



Source: Monongalia County Planning Commission

2.2 THE MORGANTOWN ECONOMY

Morgantown is an historic community that was founded in 1768 by Colonel Zackquill Morgan. It was chartered by the Virginia Assembly in 1785 and incorporated in 1875. Today the city proper has a population of about 35,000; the urbanized area has a population of about 60,000, exclusive of WVU students.

Morgantown's industrial development has been varied and interesting. With the opening of the west in the early nineteenth century, Morgantown became a major river port of embarkation for travelers destined down the Ohio River. It was also an early coal mining area, and continues to load local coal into barges for transport to steam power plants. Because of the high sulphur content of local coal, Morgantown is only minimally participating in the current renaissance of the coal extraction industry.

The presence of West Virginia University has provided Morgantown with greater economic stability than other communities in northern West Virginia. The University is by far the largest employer in the city and dominates the area's economy. In addition, the University contributes appreciably to the area's consumer market through its student population. Nonetheless, there are other important economic activities in the Morgantown area.

Glass manufacturing has been important in Morgantown for many years. The crystal and glassware produced at Morgantown plants is famous throughout the country for its high quality. However, the industry is suffering a general depression due to large imports of low cost glassware from Eastern Europe.

The energy crisis has brought new industry to Morgantown. The U.S. Bureau of Mines has located a major Energy Technology Center in Morgantown. Other new projects are contemplated.

The commercial health of Morgantown is mixed. Merchants in the CBD are having some difficulties, with parking a major problem. The CBD's only department store closed a few years ago. This closure is blamed on management rather than the downtown market; nonetheless, the city has not yet attracted a new department store to take its place. A number of businesses in the CBD have closed, but with one exception high quality clothing stores and specialty stores are doing well. The downtown merchants are considering evening hours, beautification and other steps to enhance business. To date no single plan has emerged. The city is attempting to stimulate downtown development. An unused junior high school has been secured, and plans are underway to develop this property for parking and commercial businesses. The Mountaineer Mall, 3.2 km (two miles) south of the CBD, is prosperous. It has two large department stores, many small shops, and adequate parking. There are other commercial centers in the area that are also prospering, including developments along Decker's Creek, upper University Avenue and Patteson Drive (see Exhibit 3).

2.3 WEST VIRGINIA UNIVERSITY

Founded in 1867 as a land grant institution, West Virginia University has acquired and maintained a reputation for high quality education in many fields including agriculture, engineering, and medicine. The University is a substantial force in the Morgantown community. Its 7400 faculty and staff members comprise more than one third of the area's work force. The University's 20,000 students provide a substantial part of the retail market, and generate a good deal of travel in the area.

Students live all over Morgantown; however, there are important concentrations. Most freshman live in the Towers Dormitories, adjacent to the Towers MPM station. Many students live in residential areas that are adjacent to the Downtown campus. Others live wherever housing is available.

The Downtown campus, just north of the Morgantown CBD, is largely responsible for the northern migration of the dominant CBD retail activity. The principal retail corner has moved two blocks north from its historic location at High and Walnut (adjacent to the MPM station) to the corner of High and Fayette.

The creation of the Evansdale Campus has generated a great deal of travel between the two campuses. With classes given on both campuses, many students travel between campuses three and four times a day. Because of limited parking and strict enforcement of parking permits, automobile travel between campuses is almost impossible. It is a long uphill walk from the Downtown campus to the Evansdale campus, taking an energetic person about twenty-five minutes. Walking is awkward; sidewalks are not available all of the way and motor vehicle traffic is heavy throughout the day.

2.4 INTER CAMPUS ROUTES

The Morgantown topography makes travel difficult between the Downtown and Evansdale campuses. There are only two possible routes to follow: (1) Beechurst street-Monongahela Boulevard and (2) University Avenue. Near the Downtown Campus Beechurst-Monongahela is a two lane street with a center two way left turn lane. On the portion that ascends the hill, leading to the Evansdale campus, it is a four lane street without sidewalks and has a 50 mph posted speed limit. It is accessible to University parking on the river side of Beechurst and it can be reached from other downtown locations. University Avenue is a two lane street that passes through the center of the Downtown campus and continues to the vicinity of the Towers Dormitories. There is some commercial activity along University adjacent to the two campuses. Use of University Avenue for commercial parking causes considerable traffic congestion. In addition there are two major intersections that introduce traffic congestion: (1) Stewart Street near the Downtown campus and (2) Patteson Drive near the Evansdale campus.

A third arterial street, Stewart Street, leads to the top of the ridge and can be used for access to the Medical Center and to new housing northeast of Morgantown. Stewart Street is accessible from both Beechurst and University. Its use as an alternative route does not ease traffic in the more congested downtown portions of these routes.

2.5 MPM STAKEHOLDERS

The impact of the MPM on Morgantown is the sum of the impacts that it has had on a large number of different individuals and groups. Some groups are completely indifferent to the MPM, its construction and operation. Others have been influenced by the MPM in a variety of ways. To understand the different impacts, one must begin by examining the values and viewpoints of each important group.

MPM Users

The MPM users may be viewed as the primary beneficiaries of the MPM system. Presumably, it was built to serve their needs. Two principal classes of users can be identified: (1) WVU students; and (2) WVU faculty and staff. Each has a different viewpoint and each uses the MPM to fill a different need. Non-University affiliates do use the MPM but few use it regularly and those who do lack a community of interest.

WVU Students. To a large extent, WVU students are captive riders of the MPM. Each student is required to pay a $25 transportation fee each semester, for which he/she receives an MPM pass. Some students resent the high fee, particularly in view of the much lower transportation fee charged for the pre-MPM University buses. Nonetheless, students ride the MPM in large numbers for the following purposes:

1. For travel between classes on the Downtown and Evansdale campuses;

2. For access to more convenient parking. It is almost impossible for students to get parking permits for the Downtown campus; however they can get permits for parking lots on the Evansdale campus. They also park in a municipal downtown garage that is easily accessible to the Walnut Station;

3. To gain access to the medical center for health services, and to downtown Morgantown for shopping;

4. To gain access to the Cultural Arts Center for evening activities;

5. For travel to and from football games, and other activities where the MPM can provide access between travel destinations and residences or parking.

A major institutional concern of the University is meeting the MPM's on-going operating costs. At present, student fees and other revenue cover about one-third of the cost, the state pays one-third and UMTA has provided the balance. Total operating costs are about two million dollars per year. The UMTA grant is not expected to continue, leaving a large potential void in future finances. The University would like to secure as much additional revenue as possible. Two major sources are possible: raising student fees, and attracting faculty/staff and non-University affiliates. Increased student fees are a sure source of revenue; but may create an unpleasant reaction. By raising parking fees and including MPM passes in the package, faculty and staff would become captive riders. This step could generate as much as $280,000 per year -- a large sum, but not enough to fill the void. Non-University riders will be actively solicited when parking facilities are ready near the medical center. About 4,800 fares per day would be needed. The MPM system has adequate capacity for such an increase.

It is unlikely that the University will discontinue MPM operation, but vigorous action will be needed to raise additional revenue.

Morgantown Residents

Non-University affiliated residents of Morgantown appear to be disinterested in the MPM except as a curiosity. Many residents have not ridden the MPM, or have done so only once. There is some indication that the MPM has generated civic pride, but otherwise it is a matter of little concern.

Morgantown residents cannot conveniently use the MPM. The only opportunity for non-University persons to park near the MPM is in the downtown area. Few persons live close enough to an MPM station for convenient walking access. Nonetheless, there are some who find it useful for trips between downtown and the Medical Center. A University project that will release a large parking lot near the Medical Center for public use will increase the MPM's utility to the non-University community, allowing residents who live northeast of the Evansdale campus to drive to the Medical Center and to take the MPM downtown.

Morgantown Institutional View

The city and county governments have about the same view of the MPM as do their non-University affiliated citizens -- one of indifference. The MPM is viewed as a University project that was designed by and for the University with no consideration given to community needs. There is a notion that the MPM has reduced congestion on the two arterial streets that parallel its route -- University Avenue and Beechurst Avenue-Monongahela Boulevard. However, this congestion reduction has been accomplished at the cost of overcrowding downtown parking spaces with student automobiles -- particularly the city-owned parking

A third arterial street, Stewart Street, leads to the top of the ridge and can be used for access to the Medical Center and to new housing northeast of Morgantown. Stewart Street is accessible from both Beechurst and University. Its use as an alternative route does not ease traffic in the more congested downtown portions of these routes.

2.5 MPM STAKEHOLDERS

The impact of the MPM on Morgantown is the sum of the impacts that it has had on a large number of different individuals and groups. Some groups are completely indifferent to the MPM, its construction and operation. Others have been influenced by the MPM in a variety of ways. To understand the different impacts, one must begin by examining the values and viewpoints of each important group.

MPM Users

The MPM users may be viewed as the primary beneficiaries of the MPM system. Presumably, it was built to serve their needs. Two principal classes of users can be identified: (1) WVU students; and (2) WVU faculty and staff. Each has a different viewpoint and each uses the MPM to fill a different need. Non-University affiliates do use the MPM but few use it regularly and those who do lack a community of interest.

WVU Students. To a large extent, WVU students are captive riders of the MPM. Each student is required to pay a $25 transportation fee each semester, for which he/she receives an MPM pass. Some students resent the high fee, particularly in view of the much lower transportation fee charged for the pre-MPM University buses. Nonetheless, students ride the MPM in large numbers for the following purposes:

1. For travel between classes on the Downtown and Evansdale campuses;

2. For access to more convenient parking. It is almost impossible for students to get parking permits for the Downtown campus; however they can get permits for parking lots on the Evansdale campus. They also park in a municipal downtown garage that is easily accessible to the Walnut Station;

3. To gain access to the medical center for health services, and to downtown Morgantown for shopping;

4. To gain access to the Cultural Arts Center for evening activities;

5. For travel to and from football games, and other activities where the MPM can provide access between travel destinations and residences or parking.

Some students believe that the MPM provides a higher level of service than was available from the University buses. By providing a grade separated guideway, the MPM has removed the exigencies of street traffic congestion from intercampus travel.

Certainly, the MPM has provided more consistent travel times between the two campuses. With irregular traffic congestion along both Beechurst and University, it was not always possible for university buses to travel between campuses in the period allowed for class changes. As a result, students were forced to schedule vacant class periods to accommodate travel. These vacancies created scheduling problems and inefficient schedules. By providing consistent travel times, the MPM allows students to follow more efficient class schedules.

Early MPM reliability problems caused a great deal of difficulty. Students missed classes while trapped in MPM cars or while waiting for a system failure to be corrected. Although all major problems have now been solved, reliability stories still abound. However, as new students enter the University, there is greater acceptance of the MPM. Many students are proud of their unique transportation system.

WVU Faculty and Staff. Unlike students, WVU faculty and staff are not obliged to purchase MPM passes. Some do, but only if the MPM suits their needs. Others pay the cash fare for their periodic MPM trips. Despite the fact that MPM passes are supposed to be personal and non-transferrable, many departments purchase one or two passes for the general use of their staff.

Without some form of intercampus transportation, the mobility of faculty and staff members would be seriously impeded by the parking situation. In exchange for a parking fee, a University employee is granted parking privileges in one of the 47 controlled parking lots, generally one near the individual's principal work location. Although somewhat complicated, parking regulations do not generally permit parking at both the Evansdale and Downtown campuses. Thus campus parking adequately serves work trips, but it does not provide easy mobility between the campuses. The MPM does so. Thus, the typical faculty/staff member views the MPM as a convenience for short trips during the day, and perhaps useful for access to football and basketball games and to cultural events. The MPM is not part of the daily commute trip for very many faculty or staff members.

University Institutional View

The Regents of West Virginia University own and operate the MPM. It was initially intended to replace the University bus system with a high quality service that would facilitate class changes between the Downtown and Evansdale campuses. When viewed in terms of its initial purpose, the MPM is an unqualified success. In addition, the MPM has brought worldwide attention to the University. Initially, much of the public reaction focused on the cost overrun, and was critical. Now, the MPM is recognized as a developmental landmark and is well regarded by the technical community.

A major institutional concern of the University is meeting the MPM's on-going operating costs. At present, student fees and other revenue cover about one-third of the cost, the state pays one-third and UMTA has provided the balance. Total operating costs are about two million dollars per year. The UMTA grant is not expected to continue, leaving a large potential void in future finances. The University would like to secure as much additional revenue as possible. Two major sources are possible: raising student fees, and attracting faculty/staff and non-University affiliates. Increased student fees are a sure source of revenue; but may create an unpleasant reaction. By raising parking fees and including MPM passes in the package, faculty and staff would become captive riders. This step could generate as much as $280,000 per year -- a large sum, but not enough to fill the void. Non-University riders will be actively solicited when parking facilities are ready near the medical center. About 4,800 fares per day would be needed. The MPM system has adequate capacity for such an increase.

It is unlikely that the University will discontinue MPM operation, but vigorous action will be needed to raise additional revenue.

Morgantown Residents

Non-University affiliated residents of Morgantown appear to be disinterested in the MPM except as a curiosity. Many residents have not ridden the MPM, or have done so only once. There is some indication that the MPM has generated civic pride, but otherwise it is a matter of little concern.

Morgantown residents cannot conveniently use the MPM. The only opportunity for non-University persons to park near the MPM is in the downtown area. Few persons live close enough to an MPM station for convenient walking access. Nonetheless, there are some who find it useful for trips between downtown and the Medical Center. A University project that will release a large parking lot near the Medical Center for public use will increase the MPM's utility to the non-University community, allowing residents who live northeast of the Evansdale campus to drive to the Medical Center and to take the MPM downtown.

Morgantown Institutional View

The city and county governments have about the same view of the MPM as do their non-University affiliated citizens -- one of indifference. The MPM is viewed as a University project that was designed by and for the University with no consideration given to community needs. There is a notion that the MPM has reduced congestion on the two arterial streets that parallel its route -- University Avenue and Beechurst Avenue-Monongahela Boulevard. However, this congestion reduction has been accomplished at the cost of overcrowding downtown parking spaces with student automobiles -- particularly the city-owned parking

structure adjacent to the Walnut station.

Operators of Other Transportation Services

In addition to the MPM, there are three public transportation services in Morgantown: City bus service, County bus service, and Taxi service. None of the operators view the MPM as a direct competitive threat except in competition for state transit subsidy funds. Bus operators contend that they serve a different clientele than the MPM and hence are indifferent to the existence and operation of the MPM. Neither the city nor the county bus lines compete directly with the MPM route, but both provide service between downtown and the University medical center. Taxis can compete with MPM trips, but don't, because of high taxi fares.

Patronage of both bus services has been growing steadily over the period during which the MPM has been installed and operated. In both services, the highest volume routes more or less parallel the MPM, but bus routes do not serve MPM stations, except for Walnut and Medical Center. In part, increases in bus patronage can be attributed to population growth and to the quality of bus service.

Business Community

The business community sees the MPM as a University project that has little business impact. The MPM has been both a help and a hindrance. It provides easy access to downtown for students and faculty. It may or may not contribute to the drifters and derelicts who congregate in the vicinity of the Walnut station, which is located across the street from the rear of the county jail.

Student parking in the city parking building adjacent to the Walnut station concerns downtown business persons. Off-campus students fill about half of the parking spaces, denying parking to mid-day shoppers. This problem is important because of the shortage of parking in and about the CBD.

For its part, the University is studying parking at its downtown campus. The study will measure student encroachment on city parking and estimate parking needs. Once needs are known, however, it may be difficult to provide facilities because of the limited land available downtown, and the high cost of parking structures.

3. TRAVEL IN MORGANTOWN

Like in most American cities, travel in Morgantown is dominated by the private automobile. The vast majority of trips are made by drivers and passengers of automobiles. Other means of travel are used when an automobile is not available; when a non-driver cannot secure a chauffeur; or when some obstacle like traffic congestion or the absence of parking facilities makes automobile travel particularly unattractive.

The residents of Morgantown tend to have a small city outlook on transportation. The typical traveler expects to be able to park his/her automobile next to both origin and destination. Residents do not particularly object to public transit, but it must be convenient. Walking distances of up to 600 feet are generally acceptable; however, the notion of walking a half-mile to a transit station is generally unacceptable. This outlook severely limits the potential impact of a transit service, even a spectacularly different one like the Morgantown People Mover.

Some persons in Morgantown do not have first claim to the use of an automobile. Others are non-drivers. Still others may use non-automotive transportation to avoid traffic congestion and parking problems. An abundance of non-automotive transportation facilities are available for use when automobile travel is awkward or unavailable. In this chapter, the non-automotive services will be described together with changes in travel conditions that have occurred during the life of the MPM.

3.1 UNIVERSITY BUS SERVICE

At the time that MPM service was inaugurated, WVU had one of the largest university bus fleets in the country. Under the Director of Parking and Transportation, the University provided bus service at five minute intervals between the Downtown campus and the Evansdale campus. The route followed is illustrated in Exhibit 4. Buses traveled north on Beechurst to the Creative Arts Center (CAC) then to Engineering, Forestry, Towers and back to Campus Drive. Buses were staged on Campus Drive and near the Towers Dormitory. A second, less frequent (15 minute headway) route connected the Medical Center and the Coliseum; and a third route (30 minute headway) connected the Coliseum with the campus. The University operated this service with a fleet of 16 school buses, 13 of which were needed to meet the schedule. Bus running times varied widely depending on the amount of traffic congestion encountered along each route and the number of passengers boarding and leaving the buses.

Exhibit 4

UNIVERSITY BUS ROUTES

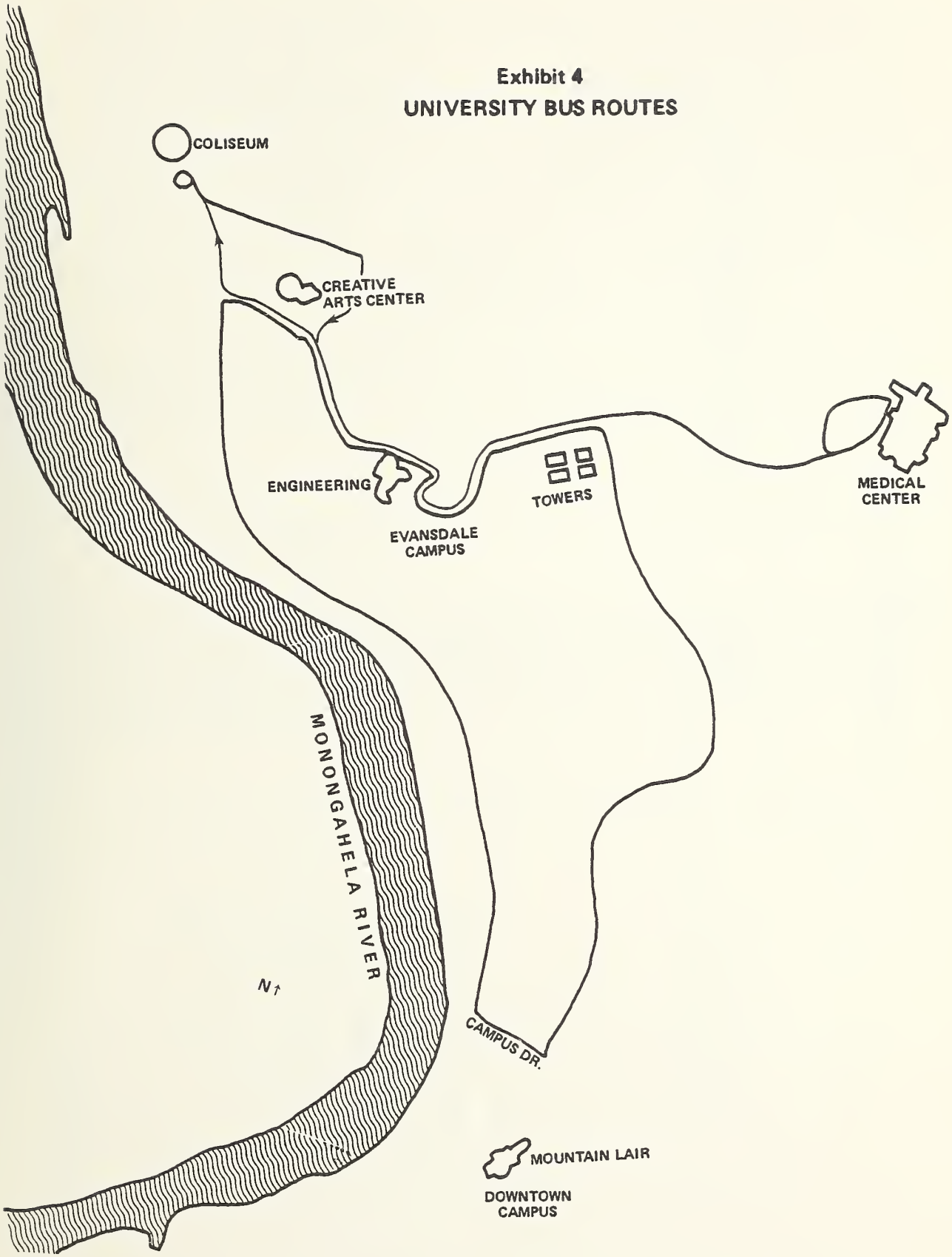


Exhibit 5
UNIVERSITY BUS TRAVEL TIMES

ROUTE SEGMENT	LENGTH MILES	BUS RUNNING TIME (Minutes)		
		MEAN	FASTEST	SLOWEST
Campus-CAC	1.1	4.78	3.0	10.0
Campus-Engineering	1.3	6.02	4.0	12.0
Campus-Towers	2.1	8.86	7.0	15.0
Towers-Campus	1.4	6.77	4.0	17.0
Coliseum-Medical Center	2.0	8.57	6.0	13.0
Campus-Coliseum	1.9	4.02	3.0	8.0
Coliseum-Campus	2.3	10.94	6.0	21.0

Source: Reference 1

Running times are listed in Exhibit 5 for a sample of about 90 bus trips. For all route segments, there are large differences between the fastest and the slowest trips. Trip times between Towers and the Downtown campus were particularly erratic because of congestion along University Avenue. When one adds walking and waiting times to bus running times, the maximum trip time exceeds 30 minutes. For example, the student traveling from a class in Engineering to a class at the Downtown campus would spend 3 minutes descending from his/her classroom, 2.5 minutes waiting for the bus, 9.6 minutes on the bus and 3 minutes walking to his/her next class. On the average, this trip would take 18.1 minutes. At best, it would take 13 minutes, and at worst, it would take 31 minutes. Given 20 minutes between classes, the student could expect to be late 26 percent of the time.

Within the limits imposed by traffic congestion, University bus service was good. A review by a WVU project team [1] revealed that all scheduled runs were made over a one week period, with extra runs provided on the heavily traveled Downtown-Evansdale route when demand was high.

The University bus service was heavily used. On a typical weekday, 10,000 bus trips were made -- over two thirds of these were between the Downtown campus and the Towers dormitories. More than three fourths of the bus loads included standees.

University bus service was reestablished when the MPM was shut down in June 1978 for the Phase II conversion. The routes and frequencies were the same as had been used in 1975. Once again, the service was good, reliable and well patronized. Exhibit 6 is a comparison between running times in 1975 and 1979 for the critical route segments along Beechurst and University.

Exhibit 6: COMPARISON OF UNIVERSITY BUS RUNNING TIMES: 1975-1979

	1975	1979
Campus - CAC (along Beechurst)		
Mean Running Time	4.78	4.19
Minimum observed	3.0	3.0
Maximum observed	10.0	9.0
Towers - Campus (along University)		
Mean Running Time	6.77	7.80
Minimum observed	4.0	4.0
Maximum observed	17.0	23.0

Source: References 1 and 7

Running times along Beechurst were slightly shorter in 1979 than in 1975. Minimum running times were the same, but fewer congested trips were recorded in 1979 than in 1975. The opposite result was obtained for University Avenue. Minimum running times were the same, but more congestion was observed in 1979 than in 1975. This result is consistent with the changes in vehicular traffic volumes on the two arterial routes.

3.2 CITY BUS SERVICE

The Morgantown Transit System was organized in 1972 following the termination of private bus service. A comprehensive six route service is offered that effectively covers the city of Morgantown, and some parts of the adjacent county. This service is provided by nine Mercedes 16 passenger buses that were purchased in 1972 and 1973. Buses are assigned to the different routes as indicated in Exhibit 7.

Exhibit 7: CITY BUS SERVICE

Route	Buses Assigned	Departure Times from CBD	Round trip time (minutes)
Suncrest	3	:10, :30, :50	60
South Park	1	:15	60
South Side - Mall	1	:30	60
Sabraton - Mall	1	:00	60
Woodburn - Airport	1	:30	60
Stewart Street	1	:00	60

Source: Morgantown Transit System

Service begins at 7:00 AM and continues uniformly through the day until 5:30 PM, Monday through Saturday. There is no service on Sunday.[4] Drivers work eleven hours per day for three and one-half days a week.

---

[4] Monday evening service was offered on all routes until January 1980 when it was discontinued because of low patronage.

All bus routes originate in the CBD at one of two departure points. Once outside the CBD, there are no fixed stops; buses will stop at any point along their routes to pick up or discharge passengers. With drivers assigned to the same routes for long periods of time, considerable rapport has developed between drivers and passengers so that service is both good and appreciated. The public has responded warmly to the bus service. Patronage has grown each year, as indicated by Exhibit 8.

Exhibit 8: ANNUAL CITY BUS PATRONAGE

Year	Annual Passengers	% Increase From Previous Year
1975	289,422	
1976	320,219	10.6%
1977	324,797	1.4
1978	333,662	2.7
1979	346,156	3.7

Source: Morgantown Transit System

There is no significant peak in travel demand which remains relatively heavy throughout the day. The average bus load is seven passengers -- almost half of the seating capacity.

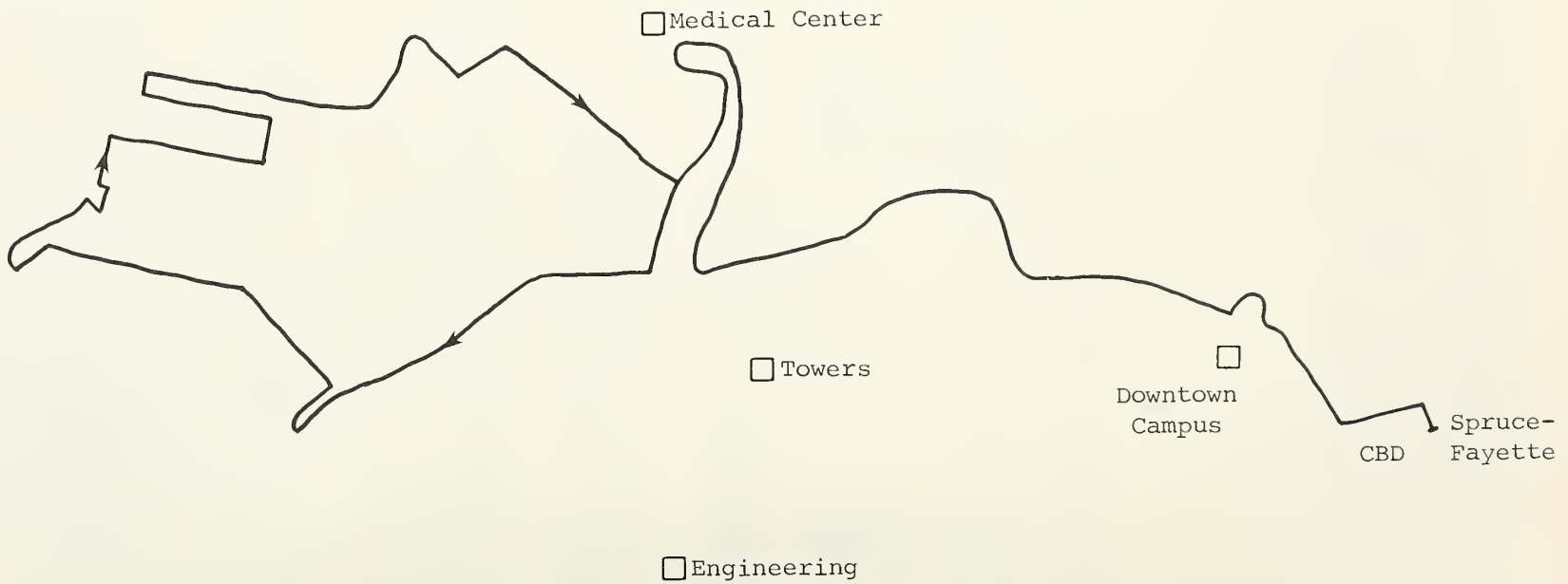
In 1979, revenues exceeded $135,000, over half of the operating costs. The balance of the cost was covered by the local coal tax and by state support. In January 1980, fares were raised to $.50 per ride or five tickets for $2.00. The initial 4 to 6 percent decline in patronage that followed the fare increase was restored by mid-year.

The Suncrest route, which serves the MPM corridor is the busiest of the city bus routes. This route is illustrated in Exhibit 9. Three buses support departures from downtown each 20 minutes. Buses travel from the CBD (Court House or Fayette Street) up University Avenue to the Medical Center, around the Suncrest area, back to the Medical Center and return to the CBD via University Avenue. Although this route closely parallels the University bus route (passing within one block of the Towers dormitories), it does not parallel the MPM route. Students who could take the city bus between the Downtown campus and Towers or the Medical Center do not. They appear to be discouraged by the high bus fares, whereas MPM travel is marginally free. Townspeople who ride the city bus do not seem to be attracted to the MPM. Those who board the bus at the Court House could easily walk to the MPM Walnut station for a cheaper ride to the Medical Center. However, townspeople bound for

Exhibit 9

MORGANTOWN TRANSIT SYSTEM

SUNCREST ROUTE



other Suncrest destinations are better served by the city bus than the MPM. The Transit manager does not view the MPM as a threat. This feeling is supported by bus patronage data which give no evidence of riders lost to the MPM.

3.3 COUNTY BUS SERVICE

Monongalia County operates a bus service that connects Morgantown with other county communities. This service which was initiated in 1973, includes eight routes (see Exhibit 10) that are served by a fleet of eight Mercedes diesel buses. The focus of the route structure is a Morgantown terminal that lies directly beneath the Walnut MPM station. Buses concentrate on County destinations, making few stops within the Morgantown City limits.

Exhibit 10: COUNTY BUS SERVICE

Route	Buses Assigned	Departure from Morgantown Station	Round trip time (minutes)
Cassville	1	:00	60
Star City	1	:00	60
Over Cheat	1	9:30,11:30,2,4,5:10	70
Crown	1	7:30,1:00,3:40	70
Van Voorhes Road	1	8:30,10,11,1:30,2:30,4	60
Mountain Heights Run	1	Wed.&Sat. 9:00, 2:00	60 min
Grafton & Fairmont Roads		Wed. 10:30, 3:30	

Source: Monongalia County Transit System

Patronage on county bus routes has shown some growth, and considerable stability. Daily patronage is about 600 passengers (roughly half of the City Bus Service). Demand through the day is reasonably uniform, though there is a slight concentration in the morning. Fares are $0.60 for County destinations and $0.50 for Morgantown City destinations.

The Star City route, which roughly parallels the MPM route, is the most heavily patronized of the County routes. It accounts for thirty percent of the system's patronage. However, this route is oriented toward Star City rather than Morgantown. Buses travel from the Morgantown CBD out Beechurst to Star City. From here they turn back up University to the University Medical Center, to the County Hospital, which is 2.2 km (1.5 miles) distant, and then back over the reverse route to the University Medical Center, Star City and Morgantown. Morning, evening and some midday runs deviate from this route to provide more areawide service. Although a portion of the route parallels the MPM, only a few county bus passengers traveling between the CBD and the University Medical Center could be served by the MPM.

The County Bus Manager does not consider the MPM to be a threat to his service. However, it may become a threat to his state subsidy. The 13 County bus systems in West Virginia share a $1.5 million annual state subsidy. If a part of this were given to the MPM, all of the county systems would suffer.

The Manager sees nothing to be gained by serving other MPM stations. The notion of a stop at the Engineering or Towers MPM stations has no appeal whatever.

3.4 TAXI SERVICE

Morgantown has a single Taxi company which operates nine radio dispatched cabs in Morgantown and the surrounding area out to about a ten mile radius of the Morgantown CBD. Long trips, particularly to the Pittsburgh Airport, are reasonably common. There are generally seven active cabs in the daytime and two to three at night. All cabs operate in a shared-ride mode; the terrain makes it impractical to do otherwise.

A limited sampling of taxi trips by the research team suggests that service is good but not outstanding. Waiting times after calls for immediate service ranged from ten minutes to one hour -- with a norm of about fifteen minutes. Some delays were experienced for multiple pick-ups and drop-offs. Drivers were always courteous and helpful and always used the most direct route that circumstances would allow. Travel times, including waiting time, ranged from 20 minutes to 1.5 hours for trips that could be made with a maximum of 15 minutes driving time.

Taxicab patronage has been declining for a number of years. High taxi fares carry some of the burden: a four mile single person trip costs $5.00. Some trips to the Mountaineer Mall have been lost to the city bus system. Trips between the CBD and the Medical Center have been lost to the MPM. It is also likely that many visitors to Morgantown rent automobiles in preference to using taxicabs.

3.5 AUTOMOBILE TRAVEL

Automobile travel is limited by the availability of automobiles and parking and by traffic congestion. Automobile availability is a problem, but not the most serious problem in Morgantown. Only a third of the students interviewed indicated that they have first claim on the use of a motor vehicle. Even these fortunate few stand last in line for parking permits and rarely are able to park near the Downtown campus. The community's permanent residents are better off. Almost ninety percent of the University faculty and staff members have first claim on an automobile and over eighty percent of the non-University affiliated adults that were interviewed do.

Parking

Parking is a serious problem both on the University campus and in the Morgantown CBD. The only new parking facility that has been provided during the life of the MPM is a large 421 space parking garage that the Morgantown Parking Authority built at University, Walnut and Chestnut Streets. This facility has been a boon to off-campus students who can park for $.60 per day and take the MPM to their classes.

The Parking Authority lots in the CBD can accommodate 1,117 vehicles (see Exhibit 11) in addition to on street parking for about 400 vehicles. The development of the junior high school property will add 200 more spaces, giving an aggregate of 1,700 parking spaces in the CBD. This is probably adequate for normal CBD functioning, but it is not sufficient to support student parking.

The Downtown campus can accommodate 547 vehicles in the sticker parking lots and an additional 500 vehicles in the Mountainlair garage, which is open to the public. Parking stickers are issued only to a few faculty members. Parking for other faculty and students is restricted to the Mountainlair garage which is almost always full, particularly after 9:00 A.M.

Parking on the Evansdale campus is better but not abundant. There are 1,241 spaces near the MPM's Engineering Station -- 361 of these are adjacent to the station. These spaces are available to assigned faculty and to some assigned students. Other students and the general public can use lots at the Coliseum, CAC and Towers with an aggregate capacity of 1,550 spaces. There is almost always space available at the large Coliseum lot, which is located 0.8 km (1/2 mile) from the Engineering MPM station. If this lot were closer to the MPM,[5] there would be good public access in the Suncrest area for persons wishing to use the MPM to avoid CBD parking problems.

---

[5] Or if the Coliseum branch of the MPM had been built as originally planned.

Exhibit 11
PARKING LOT CAPACITIES

Parking Lot No.	Name	No. of Spaces
MORGANTOWN PARKING AUTHORITY (CBD)		
1	Beside Massulo's	87
2	Fayette — Chestnut	82
3	Ruff Stone — Chestnut	22
4	University — Wall Street (R.S.)	71
5	Chestnut — Pleasant	67
6	Pleasant — Spruce	67
7	Wall — Spruce	25
8	Spruce Street South	74
9	Spruce Street North	71
10	Willey Street	43
11	North High	87
12	Parking Garage (University, Walnut & Chestnut	421
MAIN CAMPUS PARKING		
1	Appalachian	30
2	Woodburn Hall	22
3	Science Hall	20
4	Personnel	20
5	Falling Run	75
6	Maiden Lane	58
7	Tennis Courts	24
8	Beechurst	12
9	Old Forestry	15
10	Stadium Outside	25
11	I.A.B.	50
12	Oglebay Hall	18
13	Spruce Street	10
14	Armstrong Hall	2
15	Music School	6
16	Health Service	7
17	College Avenue	10
18	Old Bookstore	3
19	Bookstore	4
20	M.I. Building	4
21	Speech and Hearing	10
22	Old Mountainlair	18
23	Administration Building	16
24	Woman's Hall	8
25	Mountainlair	18
26	Stadium Inside	15
27	Glasscock House	2
28	New Computer Center	35
29	Beechurst Avenue	10

Exhibit 11 — Continued

Parking Lot. No.	Name	No. of Spaces
PUBLIC LOTS		
	Mountainlair Upper	250
	Mountainlair Lower	250
EVANSDALE CAMPUS		
40	Engineering Faculty	141
41	Engineering Rear	45
43	Agriculture Science Side	219
44	Agriculture Science Front	35
45	Creative Arts Center	185
46	Forestry	119
47	Engineering Student Lot	220
48	Twin Towers	78
49	Communications	38
50	Forestry Tower	161
MEDICAL CENTER		
60	Lot A	65
61	Lot B	59
62	Lot C	13
63	Lot F	222
64	Lot D	12
65	Lot E	342
66	Lot G	10
	Law School	169
FREE PARKING LOTS		
	Towers	250
	Coliseum	1,200
	CAC	100
	Medical Center	700
	Natatorium	400

Source: Reference 8

Parking at the Medical Center has been a problem. The 723 spaces that were available to faculty and staff were almost always full. The 700 spaces available to the general public were also full, particularly during visiting hours. This situation has recently changed. With the completion of the new football stadium adjacent to the Medical Center, its 6,000 space parking lot became available to persons visiting the Medical Center. This lot is 1/3 to 1/2 mile from the MPM station. Faculty/staff parking has been shifted to the stadium lot so that 750 spaces on Van Voorhes Road, nearer the MPM station, can be made available to the general public. This shift makes it possible, and convenient for some residents of Baker Ridge, Braewick Woods and Chestnut Ridge to drive to the Medical Center and take the MPM downtown. Unfortunately this change had not been accomplished when the MPM surveys were conducted, and hence its impact cannot be estimated in this report.

The University is well aware of its parking problems. In early 1981 it commissioned a study of the downtown parking situation. The study produced a comprehensive plan for faculty/staff, student and visitor parking in the Downtown campus area. It was coordinated with the Parking Authority's activities in and about the CBD. Unfortunately, the new facilities identified by the study have not been built.

Traffic Congestion

Contrary to the normal diurnal pattern of morning and evening peaks, traffic along Beechurst and University Avenues is heavy throughout the day. The peak hour traffic for any day may occur between 12:00 and 1:00 PM, between 7:00 and 8:00 PM, or between 11:00 PM and midnight on Saturday. Exhibit 12 illustrates the traffic on Beechurst Avenue. These northbound traffic counts were taken in March 1980. Similar traffic data are available for northbound and southbound traffic on Beechurst and University Avenues for one or more weeks in each of the following months:

March 1975,
April 1977,
March-April 1979, and
March 1980.

Data are also available for Stewart Street traffic for the last two periods. These measurements correspond to the four time periods of interest: PreMPM, Phase I, Interphase, and Phase II.

The traffic data provide a valuable resource for investigating the impact of the MPM on traffic along parallel arterial streets. One can argue that some of the changes in traffic were the result of MPM use. Other changes were clearly due to exogenous factors, such as:

- Population growth in the northern and northeastern parts of the city;
- Changes in the amount of traffic passing through Morgantown on U.S. 19, U.S. 119 and West Virginia 7;

Exhibit 12
BEECHURST AVENUE TRAFFIC COUNT, NORTHBOUND
Week of March 17, 1980

		TIME											
		12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
MONDAY	A.M.	87	38	21	9	12	59	384	657	782	619	627	643
	P.M.	729	762	860	812	825	892	682	591	470	371	287	168
TUESDAY	A.M.	92	49	30	23	21	59	349	622	659	596	617	671
	P.M.	731	768	814	842	828	851	742	534	452	421	330	153
WEDNESDAY	A.M.	97	55	32	18	17	69	357	616	787	602	607	684
	P.M.	776	772	859	895	943	920	886	704	472	445	284	205
THURSDAY	A.M.	122	66	40	38	25	54	365	624	680	643	703	803
	P.M.	938	880	935	938	953	1,072	913	868	521	444	348	273
FRIDAY	A.M.	160	104	78	64	37	61	346	667	786	690	812	908
	P.M.	999	1,008	1,007	981	1,025	1,003	914	878	633	507	400	488
SATURDAY	A.M.	271	166	108	99	57	54	101	147	292	454	640	912
	P.M.	1,083	936	871	810	812	866	908	951	632	634	372	356
SUNDAY	A.M.	225	201	145	120	55	34	58	72	134	283	421	451
	P.M.	671	603	581	646	622	566	598	435	376	285	225	152

Source: West Virginia Department of Highways

- Changes in employment due to the growth of the Evansdale campus and the Morgantown Energy Technology Center;

- Changes in regional travel patterns; and

- Unique events that occurred during the weeks for which data were collected.

Daily University bus traffic in 1977 and 1979 amounted to 126 vehicles northbound on Beechurst and 108 vehicles southbound on University. These numbers are hardly visible on the scale of other traffic; however, the 10,000 student trips per day that they served would have had significant impact on traffic volumes if the students had used other means.

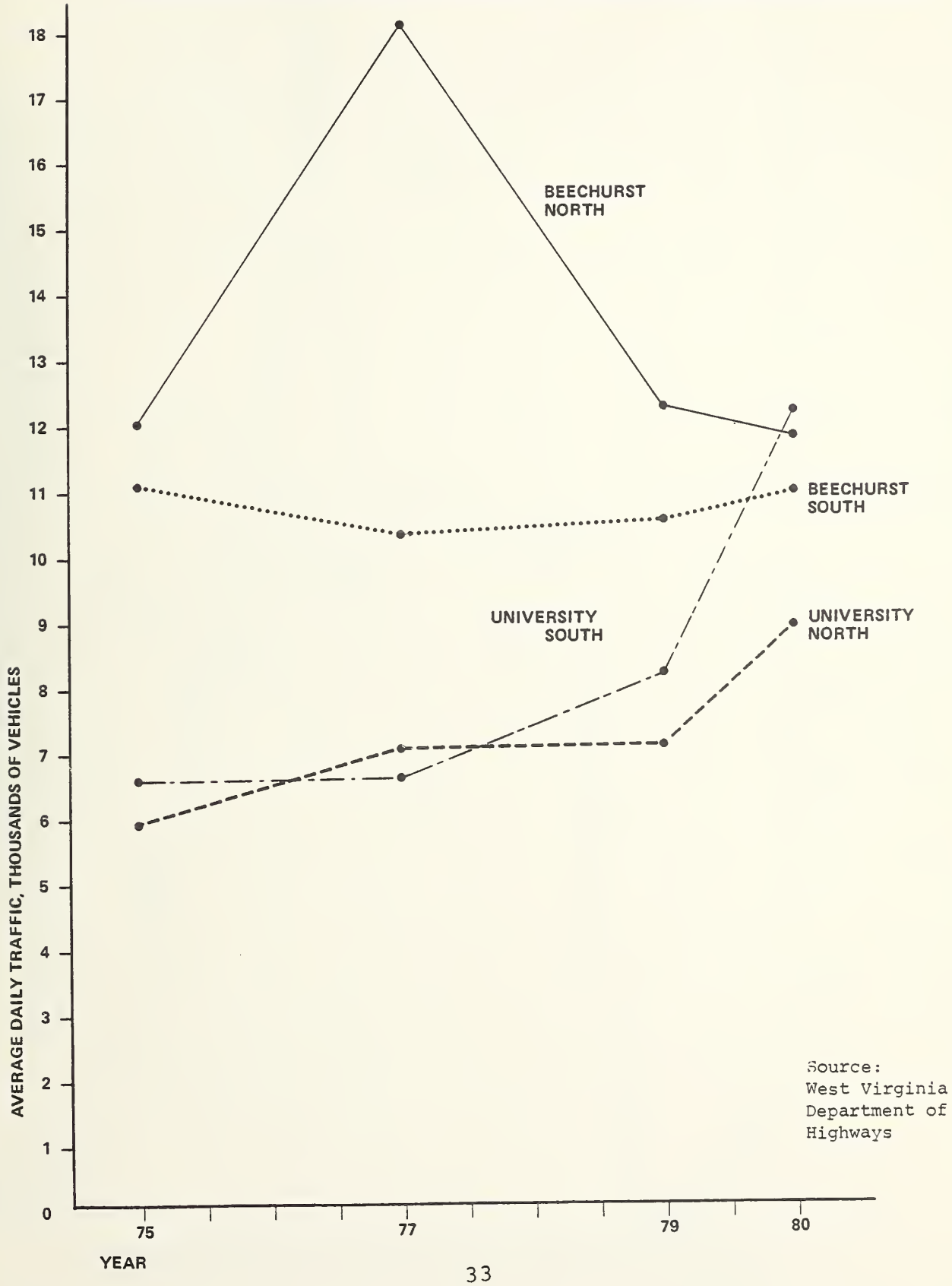
The problem of separating the exogenous effects from the MPM effects was approached in several ways. Exhibit 13 illustrates the daily traffic for the two routes by direction for each of the four time periods. Two changes are evident: (1) the large 1977 increase in northbound traffic on Beechurst; and (2) the 1980 growth in University Avenue traffic in both directions. Neither change can be attributed to the MPM, unless one is willing to concede that the MPM serves fewer trips than the University bus did. An examination of the hour by hour data reveals that the traffic is fairly steady throughout the day at or near the limit of congestion. Special circumstances give rise to very heavy traffic on particular days such as those illustrated in Exhibit 14. On these days, there must have been intense northbound traffic congestion for a considerable period. Southbound, there was a sharp afternoon peak in 1980, but otherwise the traffic was reasonably uniform during the busy part of the day. The 1979 northbound traffic was substantially higher than the 1980 northbound traffic. However, except for the 1980 afternoon peak, the traffic was nearly the same in 1979 and 1980. This suggests that there may have been northbound diversion to the MPM, but the evidence is far from clear.

The next step was to examine hourly traffic variations as a characteristic of the traffic flow. Hourly traffic flows, except for the six early morning hours, were treated as random variables for each of the four time periods. Exhibit 15 lists summary data for these variables. Southbound traffic on Beechurst did not change significantly over the years -- the higher mean values for 1975 and 1980 can be attributed entirely to four peak hours. The pattern for northbound traffic is different; 1977 traffic is clearly 300 vehicles per hour higher than the other years. However, the difference among 1979, 1975 and 1980 can be attributed to six peak hours. 1979 traffic was higher during those hours than it was in 1975 and 1980. Traffic on University Avenue grew steadily over the time period, particularly in the southbound direction.

Tests of significance using the Student's t distribution bear out the intuitive findings. There are no significant differences in Beechurst traffic except for 1977 northbound, which is significantly different from the other three years. University Avenue traffic

Exhibit 13

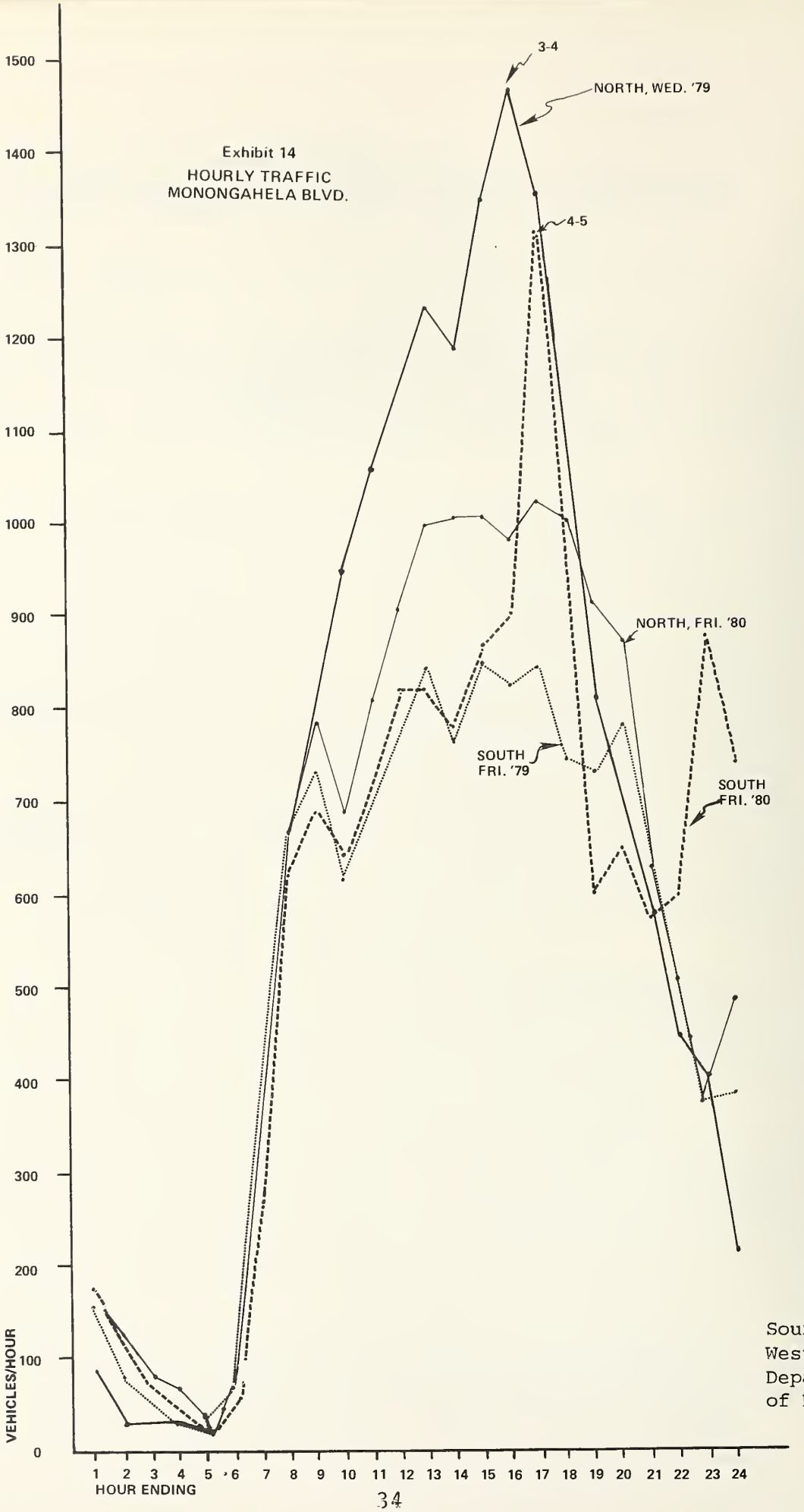
AVERAGE DAILY AUTOMOBILE TRAFFIC ON BEECHURST AND UNIVERSITY



Source:
West Virginia
Department of
Highways

Exhibit 14

HOURLY TRAFFIC
MONONGAHELA BLVD.



Source:
West Virginia
Department
of Highways

Exhibit 15

HOURLY TRAFFIC CHARACTERISTICS

	BEECHURST							
	NORTHBOUND				SOUTHBOUND			
	'75	'77	'79	'80	'75	'77	'79	'80
MEAN VEH/HR.	647.3	954.3	674.3	637.8	593.4	562.1	574.9	598.4
STD. DEVIATION	235.8	337.3	266.0	245.0	206.3	185.2	197.0	232.2
OBSERVATIONS	126	128	124	126	125	125	126	126
DISTRIBUTION								
MAX.	1,074	1,583	1,463	1,083	1,049	890	918	1,319
HOURS >1500		2						
1400-99		5	1					
1300-99		14	2					1
1200-99		14	1					1
1100-99		12	2					2
1000-99	7	22	3	6	4			
900-99	9	14	13	15	3		2	6
800-99	19	9	16	20	8	5	11	9
700-99	18	5	21	12	26	29	26	21

	UNIVERSITY							
	NORTHBOUND				SOUTHBOUND			
	'75	'77	'79	'80	'75	'77	'79	'80
MEAN VEH/HR.	320.7	382.4	389.8	475.7	362.1	353.1	459.5	658.8
STD. DEVIATION	75.7	102.5	109.7	132.9	83.0	77.6	141.3	218.7
OBSERVATIONS	126	118	232	126	18	127	206	126
DISTRIBUTION			DIST/2		DIST/7		DIST/2	
MAX.	455	621	626	936	469	501	768	1,190
HOURS >1100								2
1000-99								6
900-999				1				8
800-99				1				16
700-99				2			3	15
600-99		1	1	11			12	32
500-99		11	17	47		1	27	24
400-99	17	35	48	25	49	38	29	7

northbound shows significant growth, except for the middle years 1977 and 1979. Southbound traffic on University Avenue shows significant growth after 1977.

The conclusion drawn from the traffic analysis is that exogenous events are responsible for changes in the measured levels of traffic. It is not possible to support any conclusion that alludes to traffic diversion from the streets to the MPM. Such conclusions as might be drawn have conflicting counterparts (e.g. 1980 Beechurst northbound vs. 1979 Beechurst northbound suggests traffic diversion to the MPM, but southbound traffic changes lead to the opposite conclusion).

4. MPM PERFORMANCE

Morgantown People Mover performance can be viewed from the perspective of both the user and the operator. Both views will be taken here. To the user, the MPM is a means to travel part of the distance from a trip origin to a trip destination. The user is concerned with the availability of service and the conveniences of that service. Fare is important but little if any thought is given to the cost of the service. In sharp contrast, the operator is interested in providing the minimum acceptable level of passenger service with the greatest possible efficiency and economy. To the operator, loaded vehicles are more important than short waits; and empty vehicle movements are an undesirable expense. Some compromises are clearly needed if the service is to be attractive to both the users and the operator.

The user's attention is generally focused on an individual trip -- the one contemplated, the one in process, or the one just completed. These trips vary by purpose, urgency, origin and destination. Regardless of the dominant transportation mode, most trips require some walking, some waiting and other predictable and unpredictable activities. Most trips begin with a walk to the first conveyance. This walk could be a long walk to a transit stop or a short walk to an automobile parking space. Trips also end with walks to the final destination. In between, the user's activities will depend on the nature of the trip and the user's choice of conveyance. The simplest MPM trips require at least six specific user activities:

1. Walk to the MPM station;
2. Climb (descend) stairs to the station platform[6],
3. Pay fare and record the MPM destination;
4. Wait for an MPM vehicle bound for the selected MPM destination;
5. Board and ride the MPM vehicle; and
6. Walk from the MPM platform to the destination.

If the user's complete trip is not conveniently served by the MPM, there may be an additional vehicular trip by automobile or bicycle that adds more activities and detracts from the user's view of MPM convenience.

---

[6] Elevators are available for elderly and handicapped travelers.

The MPM operator is interested in providing sufficient service to accommodate the demand in an acceptable and efficient manner. Key issues from the operator's viewpoint are:

1. Travel demand;
2. Vehicle load factors;
3. Empty vehicle movements;
4. System reliability;
5. Operating schedules;
6. Personnel assignments; and
7. Operating cost.

Most operators are ready to sacrifice quality of service to reduce cost. They are deterred by fear of lost revenue through patronage decline. Unfortunately, there are few reliable data that can guide operators in their juggling acts with patronage and cost.

This chapter is concerned with present MPM performance from both the user and operator viewpoints. Particular attention is given to station configurations, waiting times and travel times. Additional attention is given the user perceptions in Chapter 5 in the analysis of sample trips.

4.1 STATION CONFIGURATIONS

With the exception of the Towers station, all MPM stations are located on hilly terrain that requires passenger access by climbing or descending stairs or using elevators. The hilly terrain suits the MPM design by facilitating grade separations for guideways carrying through vehicles.

The station designs are greatly complicated by the intricate vehicle movements that are needed to provide direct service between all station pairs. All vehicles stop and reverse direction at terminal stations (Walnut and Medical Center). Vehicles stopping at intermediate stations may continue in the same direction after deboarding and boarding passengers or they may reverse direction. The choice between these two moves is made by the central computer and depends on the travel demands that have been entered into the system, the available holding space at the station being entered, and the distribution of vehicles over the system.

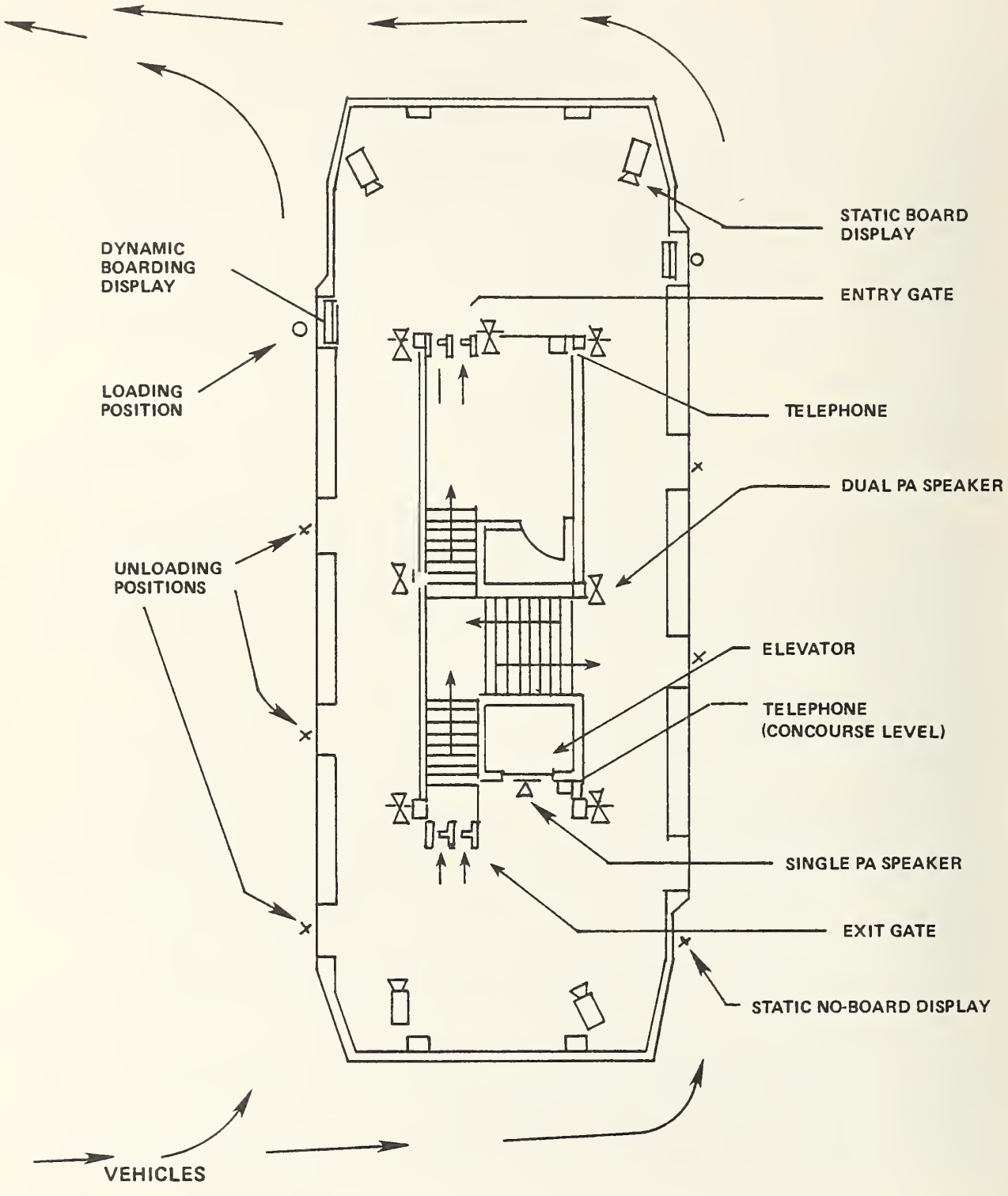
The MPM stations were designed with two platform types, an "A" platform (Exhibit 16), and a "B" platform (Exhibit 17). At an "A" platform all vehicles are obliged to reverse directions. For example, in Exhibit 16, all vehicles would enter from the left at the bottom of the page. A switch allows a vehicle to turn to either the left side of the platform or the right. An arriving vehicle stops at the forwardmost available unloading position (marked X) and discharges its passengers. When a vehicle is selected to make a trip, it moves to the boarding position, its doors open and passengers board. After an interval of about 15 seconds, the doors close, the vehicle starts and moves off to the left. Boarding passengers reach the platform via a stairway or, if handicapped, by elevator. At the top of the stairs, the passenger must pass through a turnstyle where he/she pays his/her fare, and selects a destination station by pressing one of the four bars on the top of the turnstyle. When the fare has been paid and the destination selected, the passenger can pass through the turnstyle to the departing platform area. Passengers wait for departing vehicles in the area between the two loading positions. When a vehicle is ready to depart, a bell or chime sounds, a display illuminates the destination station and the vehicle doors open. Departing passengers leave vehicles at one of the unloading positions, walk across the arriving platform, pass through the exit gate and descend the stairs.

A "B" platform has greater versatility for vehicle movements than an "A" platform -- it can receive vehicles from either direction and dispatch them in either direction. For example, in Exhibit 17, vehicles can arrive from both the lower left and the upper right. Vehicles arriving from the lower left can turn and unload along the left side of the platform or they can continue straight and unload at the bottom of the platform. Similarly, vehicles arriving from the upper right can turn and unload along the right side of the platform or they can continue and unload at the top of the platform. The "B" platform has a total of ten unloading positions and four loading positions. As soon as an entering vehicle is assigned to a station channel, its next destination is limited. For example, if the "B" platform of Exhibit 17 is located at Beechurst Station; then vehicles arriving from the lower left that turn to the left side of the platform are available for future service to Engineering, Towers or Medical Center. They cannot reach Walnut from that channel. Vehicles that do not turn, but discharge passengers at the bottom side of the platform are obliged to travel to Walnut next. The nature of the traffic at Beechurst requires most entering vehicles to use the "A" platform or the sides of the "B" platform. Only a few vehicles use the ends and continue to Walnut.

"B" platforms must be available at all intermediate stations in order to dispatch vehicles in both directions. Each intermediate station in the MPM -- Beechurst, Engineering and Towers -- is equipped with one "B" platform and one "A" platform. During the SYSTAN data collection, only the "B" platform was operated at the Engineering station.

Double platforms at Beechurst and Towers pose problems for the uninitiated traveler. The "A" platforms were used primarily for the

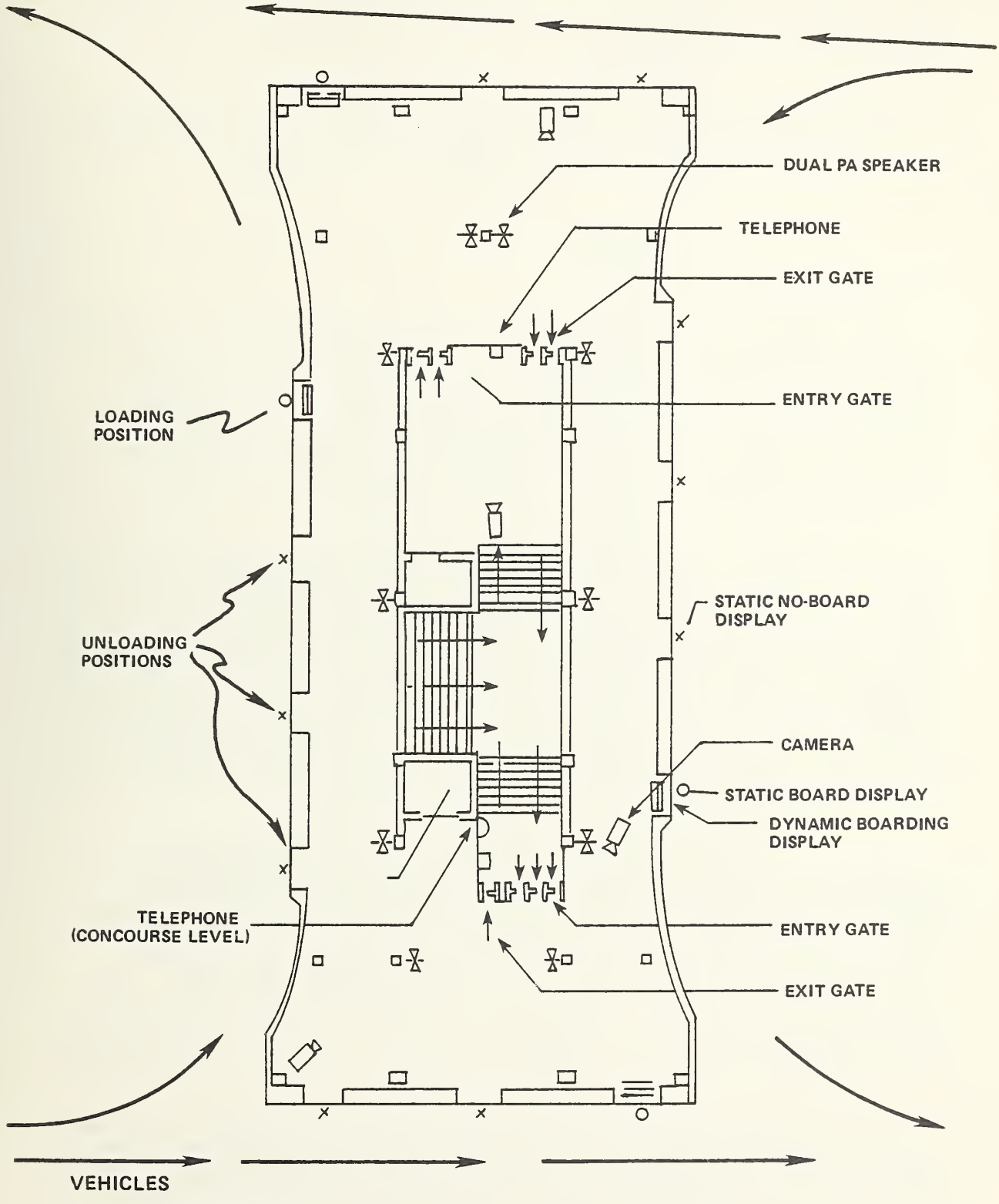
Exhibit 16
"A" PLATFORM



Source: Reference 5

Exhibit 17

"B" PLATFORM



Source: Reference 5

high volume traffic between Beechurst and Towers, while the "B" platforms were used for all other services. The control algorithm would dispatch a vehicle from Beechurst "A" to Engineering or Medical Center, but the traveler requesting this service would have a longer than usual wait. Similarly, vehicles were dispatched from Beechurst "B" to Towers, but travelers requesting this service generally had to put up with the maximum wait of five minutes.

The Walnut and Medical Center Stations have one "A" platform each. All vehicles turn around at these stations before or after coming along either side of the platform to discharge and load passengers.

4.2 WAITING TIME

The dispatching algorithm used to control the movements of the MPM vehicles establishes a maximum wait criterion of five minutes or 15 passengers bound for the same destination, whichever occurs sooner. A wait may exceed 5 minutes if there is a shortage of vehicles at the station, if there is a surplus of vehicles at the destination station, if a single vehicle cannot accommodate all of the passengers bound for a single destination, or if other unusual circumstances prevent a vehicle from being dispatched on time.

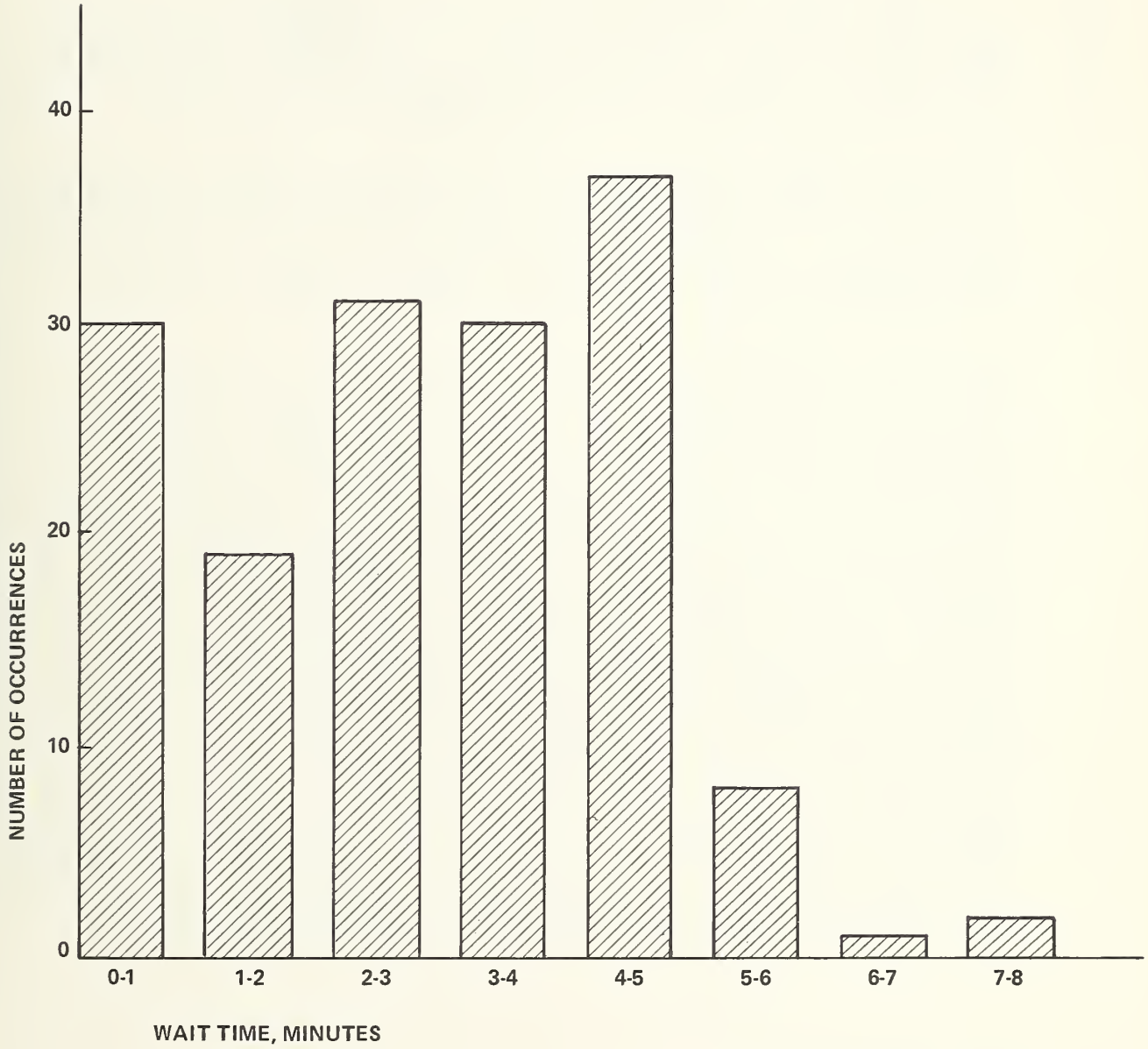
The performance of the dispatching algorithm was checked during the week of November 3, 1980. On Monday, Wednesday and Thursday, a total of 156 trips were made among all station pairs between the hours of 7:00 AM and midnight. Waiting commenced when the traveler passed through an entry turnstile and ended when the destination display board lighted the desired destination and the vehicle doors opened. A zero wait time was recorded if a vehicle was loading for the desired destination when the traveler passed through the turnstile and if the traveler successfully boarded the vehicle. If the first vehicle to the desired destination was filled to capacity, waiting time continued until the display was lighted for the vehicle that was successfully boarded.

Of the 156 waits that were recorded, only nine exceeded five minutes. The longest wait was eight minutes. Exhibit 18, which shows a frequency distribution of all waits, clearly indicates that the algorithm is working. It also suggests that the maximum wait algorithm produces a disproportionate number of five minute waits -- twenty-six (16.7 percent) of the 156 waits were exactly five minutes long. The single traveler or small travel party that enters an MPM station can expect to wait precisely five minutes for service unless a prior arrival has requested service to the same destination, or unless a crowd follows that is seeking the same destination.

Although the dispatching algorithm offers a maximum wait time that is the same as the University bus headway had been, it produces a longer expected wait. With University buses departing each five minutes, the random arrivee would expect to wait one-half of the headway or 2.5

Exhibit 18

WAIT TIME FREQUENCY DISTRIBUTION



minutes, with a maximum wait of five minutes. The MPM passenger has the same maximum wait, but because of the dispatching algorithm, the mean wait is 3.13 minutes (not 2.5 minutes). Thus, the expected wait for the MPM is twenty percent longer than the expected wait for the University bus.

Exhibit 19 illustrates a distribution of waiting time by time of day. There appears to be no particular time of day when waiting times are especially long or especially short. A disproportionate share of the long waits occurred in the evening hours, when traffic was light and many travel parties waited the full five minutes for service.

Exhibit 20 illustrates the relationship between waiting time and the number of boarding passengers. Single travelers experienced a full spectrum of waiting times; but the largest number (15) waited precisely five minutes. In two of the three instances in which there were 15 or more passengers, there was some wait, suggesting that the travelers accumulated over time, rather than arriving in a body.

There is a relationship between waiting time and the particular station pair selected for a journey. Exhibit 21 lists the mean, standard deviation, maximum and minimum waiting times for each of the station pairs of the MPM system. The shortest average waiting times were experienced by persons traveling from Beechurst to Towers. This value reflects both the very high volume of traffic between these two stations and the nature of arrivals at the Beechurst station. Shortly after the end of each class on the Downtown campus, the Beechurst station is deluged with students, many of them heading to Towers, the largest dormitory complex. At these times, the 15 person limit is quickly reached and many vehicles are dispatched from Beechurst to Towers. In contrast, travelers from Towers to Beechurst generally do not arrive in groups large enough to trigger dispatching assignments. As a result, the Towers-to-Beechurst mean wait time is similar to that of other station pairs. The longest waiting time occurred for trips from Towers to Walnut. Demand for this service is low and passengers tend to arrive infrequently and individually or in small groups. Long times were also noted between Walnut and the Medical Center and between Towers and Engineering. The expected wait of 3.94 minutes for the trip from Towers to Engineering is about equal to the walking time for that short trip and discourages a number of persons from using MPM.

4.3 TRAVEL TIME

Barring a vehicle or system failure, travel time between station pairs is relatively fixed. When loading is complete a vehicle's doors close and the computer checks the availability of space on the main guideway. If no space is available, the vehicle pauses until space is available. When a guideway space is available, the vehicle moves onto the acceleration ramp, accelerates and moves onto the main guideway. Vehicle positions on the main guideway are synchronized moving points,

Exhibit 19
MPM WAIT TIME BY TIME OF DAY

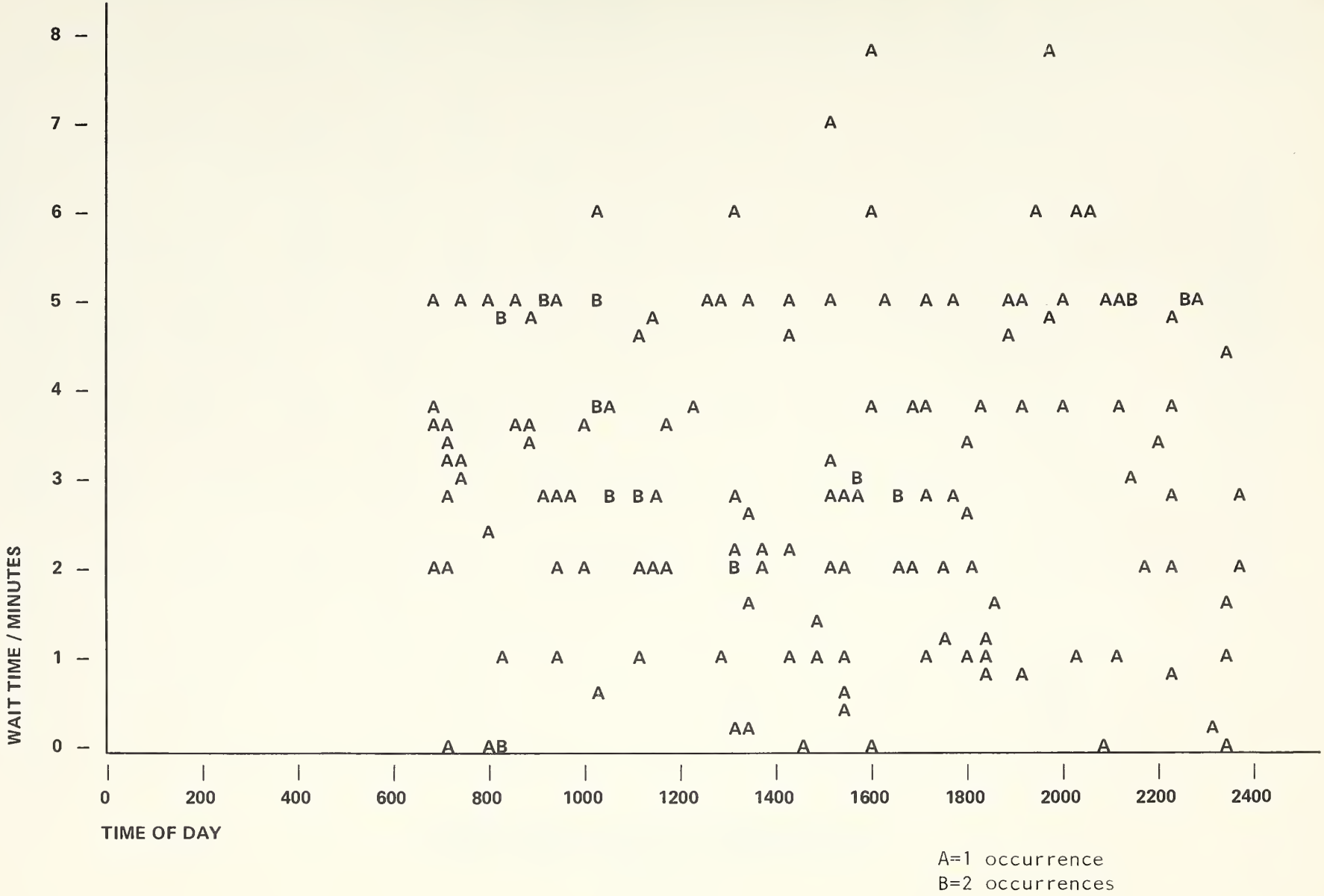


Exhibit 20

RELATIONSHIP BETWEEN WAITING TIME
AND NUMBER OF BOARDING PASSENGERS

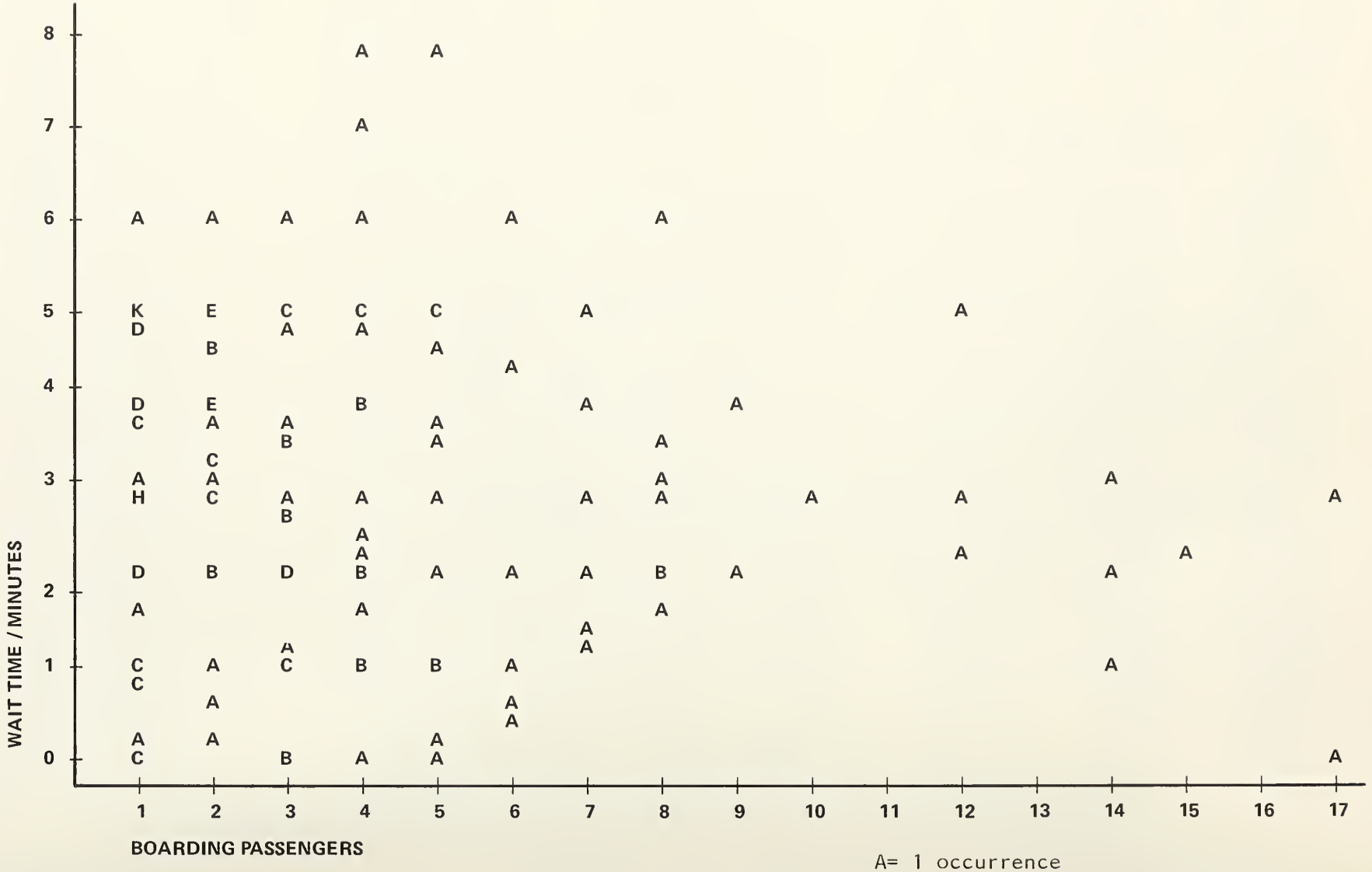


Exhibit 23

1980 INTERSTATION MPM DAILY TRAVEL
AS ESTIMATED BY WVU

TO / FROM	WALNUT	BEECHURST	ENGINEERING	TOWERS	MEDICAL CENTER	TOTAL
WALNUT		241	324	258	254	1,077
BEECHURST	253		1,833	2,554	613	5,253
ENGINEERING	271	1,691		452	165	2,579
TOWERS	251	2,760	512		154	3,677
MEDICAL CENTER	250	610	209	161		1,230
TOTAL	**1,025**	**5,302**	**2,878**	**3,425**	**1,186**	**13,816**

Source: Reference 7

Exhibit 24

MPM PASSENGER TRAFFIC

November 5, 1980 – 7:00 a.m. to 12:00 midnight

TO / FROM	WALNUT	BEECHURST	ENGINEERING	TOWERS	MEDICAL CENTER	TOTAL
WALNUT		222	441	439	386	1,488
BEECHURST	274		2,373	3,279	919	6,845
ENGINEERING	396	2,090		575	317	3,378
TOWERS	300	3,416	738		259	4,713
MEDICAL CENTER	383	834	288	242		1,747
TOTAL	**1,353**	**6,562**	**3,840**	**4,535**	**1,881**	**18,171**

Exhibit 22

STATION TO STATION MPM TRAVEL TIMES
(Minutes)

FROM / TO	WALNUT	BEECHURST	ENGINEERING	TOWERS	MEDICAL CENTER
WALNUT		2.17	6.57	7.17	9.07
BEECHURST	2.23		5.15	5.57	7.58
ENGINEERING	7.05	5.00		1.18	3.22
TOWERS	7.68	5.37	1.15		2.62
MEDICAL CENTER	9.70	7.78	3.53	2.82	

Source: MPM Staff

On Wednesday, March 12, 1980, a WVU research team collected terminating data (exit turnstile counts) at each station and used these to adjust the origin-destination data generated at the entrance turnstiles. The results of this analysis produced the estimated daily interstation traffic listed in Exhibit 23.

On Wednesday, November 5 and Thursday November 6, 1980, members of the SYSTAN survey team recorded the departure times, destinations and passenger loads for all MPM vehicles, including empty vehicles. On November 5, measurements were taken from 7:00 AM to 12:00 midnight and on November 6, from 7:00 AM to 8:00 p.m. The passenger traffic estimated by these measurements is presented in Exhibits 24 and 25.

The variations in total travel demand among the three periods are consistent with MPM experience. Wide daily fluctuations reflect differences in university activities. Nonetheless, the distribution of daily traffic among station pairs is reasonably consistent. Exhibit 26 lists the percent of daily trips occurring between each station pair for the three time periods of Exhibit 23 to 25. Most variations are small. The largest variation occurs between Engineering and Beechurst where the November 6 traffic was distinctly lower than traffic for the other two dates. This difference could well be a Thursday phenomenon because traffic for the two Wednesdays' was very close for all station pairs. Exhibit 27 lists monthly turnstile counts for the first year of Phase II operation, together with peak daily demand. Monthly demand is heavily influenced by the university calendar. Demand drops sharply during vacation months (November, December, January, and March) and even more sharply at the end of the academic year (May).

During the academic year, peak daily traffic varied between 12,000 and 27,000 passengers. Peaks occurred on Mondays during the fall semester and Wednesdays during the spring semester. There is generally a decline in patronage as the semester proceeds. Perhaps this decline is due to a decline in recreational travel as academic pressure builds. The daily counts taken fall within the umbrella of experience listed in Exhibit 27.

4.5 VEHICLE LOAD FACTOR

The demand responsive nature of the MPM in combination with the dispatching algorithm assures that a vehicle will be supplied for any travel party, no matter how small. As a result, a large number of vehicles are dispatched with one, two or three passengers. Exhibit 28 is a frequency distribution of vehicle loads for November 5 and 6, 1980. Of the 5,339 loaded vehicle trips, there were 2,361 trips (44 percent) in which vehicles carried one, two, or three passengers. These 2,361 vehicle trips accounted for only 13 percent of the passenger trips. In sharp contrast, the 1,023 vehicle trips (19 percent) with loads of twelve or more passengers accounted for 49 percent of the passenger trips. The average loaded vehicle carried 6.2 passengers.

Exhibit 23

1980 INTERSTATION MPM DAILY TRAVEL
AS ESTIMATED BY WVU

TO / FROM	WALNUT	BEECHURST	ENGINEERING	TOWERS	MEDICAL CENTER	TOTAL
WALNUT		241	324	258	254	1,077
BEECHURST	253		1,833	2,554	613	5,253
ENGINEERING	271	1,691		452	165	2,579
TOWERS	251	2,760	512		154	3,677
MEDICAL CENTER	250	610	209	161		1,230
TOTAL	**1,025**	**5,302**	**2,878**	**3,425**	**1,186**	**13,816**

Source: Reference 7

Exhibit 24

MPM PASSENGER TRAFFIC

November 5, 1980 — 7:00 a.m. to 12:00 midnight

TO / FROM	WALNUT	BEECHURST	ENGINEERING	TOWERS	MEDICAL CENTER	TOTAL
WALNUT		222	441	439	386	1,488
BEECHURST	274		2,373	3,279	919	6,845
ENGINEERING	396	2,090		575	317	3,378
TOWERS	300	3,416	738		259	4,713
MEDICAL CENTER	383	834	288	242		1,747
TOTAL	**1,353**	**6,562**	**3,840**	**4,535**	**1,881**	**18,171**

Exhibit 25

MPM PASSENGER TRAFFIC
November 6, 1980 – 7:00 a.m. to 8:00 p.m.

TO / FROM	WALNUT	BEECHURST	ENGINEERING	TOWERS	MEDICAL CENTER	TOTAL
WALNUT		191	318	330	353	1,192
BEECHURST	247		1,808	2,865	827	5,747
ENGINEERING	301	1,491		474	233	2,499
TOWERS	287	2,979	597		198	4,061
MEDICAL CENTER	322	752	283	212		1,569
TOTAL	**1,157**	**5,413**	**3,006**	**3,881**	**1,611**	**15,068**

Exhibit 26
PATTERN OF DAILY TRAVEL

Station Pair	Percent of Daily Travel		
	March 12 1980	November 5 1980	November 6 1980
Walnut – Beechurst	1.74	1.22	1.27
Walnut – Engineering	2.35	2.43	2.11
Walnut – Towers	1.87	2.42	2.19
Walnut – Medical Center	1.84	2.12	2.34
All Walnut Departures	7.80	8.19	7.91
Beechurst – Walnut	1.83	1.51	1.64
Beechurst – Engineering	13.27	13.06	12.00
Beechurst – Towers	18.48	18.04	19.01
Beechurst – Medical Center	4.44	5.06	5.49
All Beechurst Departures	38.02	37.67	38.14
Engineering – Walnut	1.96	2.18	1.99
Engineering – Beechurst	12.25	11.51	9.90
Engineering – Towers	3.27	3.16	3.14
Engineering – Medical Center	1.19	1.74	1.55
All Engineering Departures	18.67	18.59	16.58
Towers – Walnut	1.82	1.65	1.90
Towers – Beechurst	19.97	18.80	19.78
Towers – Engineering	3.71	4.06	3.96
Towers – Medical Center	1.11	1.43	1.31
All Towers Departures	26.61	25.94	26.95
Medical Center – Walnut	1.81	2.11	2.14
Medical Center – Beechurst	4.41	4.59	4.98
Medical Center – Engineering	1.51	1.58	1.88
Medical Center – Towers	1.17	1.33	1.41
All Medical Center Departures	8.90	9.61	10.41

Source: Reference 7

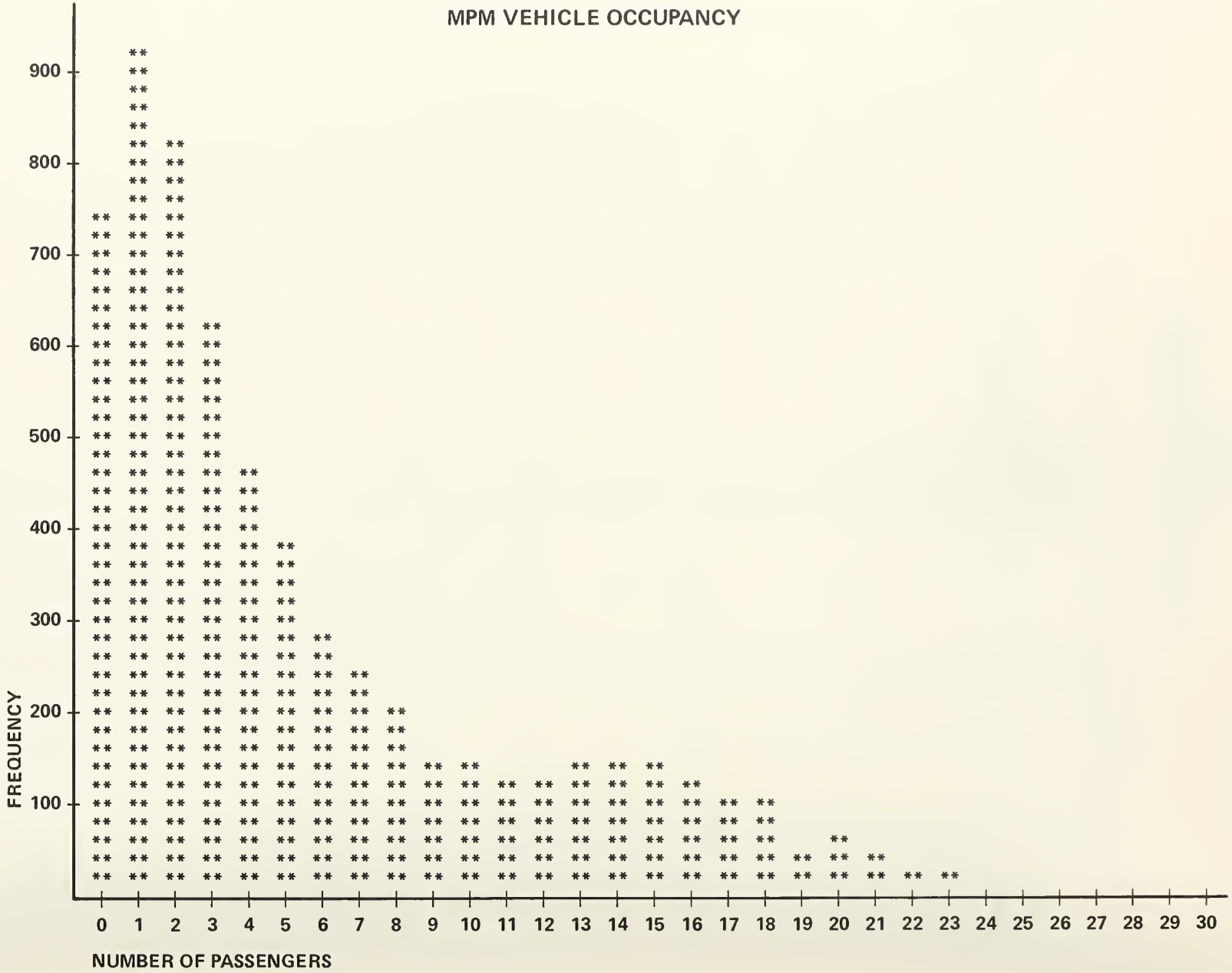
Exhibit 27
MONTHLY MPM PATRONAGE

	Monthly Patronage	Maximum Day Patronage	
September, 1979	404,151	(Tues. 9/4)	26,989
October, 1979	414,055	(Mon. 10/1)	18,209
November, 1979	292,114	(Mon. 11/12)	17,702
December, 1979	201,061	(Mon. 12/10)	17,594
January, 1980	286,191	(Wed. 1/16)	23,418
February, 1980	323,440	(Wed. 2/6)	18,305
March, 1980	250,424	(Wed. 3/19)	16,633
April, 1980	243,481	(Wed. 4/9)	15,467
May, 1980	115,348	(Thurs. 5/1)	12,911
June, 1980	77,102	(Mon 6/16)	4,385
July, 1980	119,144	(Mon 7/7)	7,138
August, 1980	176,984	(Mon. 8/25)	27,431

Source: MPM Staff

Exhibit 28

MPM VEHICLE OCCUPANCY



Vehicle load factor appears to be influenced by station activity. For example, the average load factors and the number of vehicle departures at the different MPM stations were:

	Loaded Vehicle Departures per day	Average Passengers per load
Walnut	367	3.65
Beechurst	761	8.27
Engineering	527	5.57
Towers	603	7.27
Medical Center	411	4.04

These data fit the equation:

$$\frac{\text{Mean Passengers}}{\text{vehicle}} = -0.898 + 0.0125 \left(\frac{\text{Vehicles departing}}{\text{day}}\right)$$

with a correlation coefficient (r) of 0.98.[7] Similar results were obtained for individual station pairs. Exhibit 29 lists mean passenger loads for the different station pairs. Exhibit 30 shows these data plotted in terms of vehicle departures and mean load factors. These data are also highly correlated, fitting the logarithmic curve:

$$\frac{\text{Mean Passengers}}{\text{vehicle}} = -26.54 + 5.64 \ln \left(\frac{\text{vehicle departures}}{\text{day}}\right)$$

with a correlation coefficient (r) of 0.97.

If service were restricted to the high volume Beechurst-Towers route, vehicle productivity could be substantially enhanced. Successful efforts to increase demand for low volume services would also be rewarded.

One might argue that scheduled service could be better tailored to demand than the demand responsive service. This argument is not necessarily correct. Non-stop scheduled service between station pairs would result in very long waiting times for low volume services. These waits would tend to discourage those trips that are made, rather than encourage more trips.

---

[7] $$r = \frac{n\Sigma xy - \Sigma x \Sigma y}{\sqrt{(n\Sigma x^2 - [\Sigma x]^2)\,(n\Sigma y^2 - [\Sigma y]^2)}}$$

Exhibit 29

MEAN LOAD FACTORS BY STATION PAIRS

TO / FROM	WALNUT	BEECHURST	ENGINEERING	TOWERS	MEDICAL CENTER	TOTAL
WALNUT		1.93	3.64	3.35	3.53	3.09
BEECHURST	2.17		8.43	9.31	5.76	7.38
ENGINEERING	3.42	7.44		3.32	2.94	4.92
TOWERS	2.68	9.47	4.09		2.39	6.19
MEDICAL CENTER	3.25	5.65	3.01	2.19		3.70
TOTAL	**2.83**	**7.22**	**5.59**	**5.94**	**3.91**	**5.47**

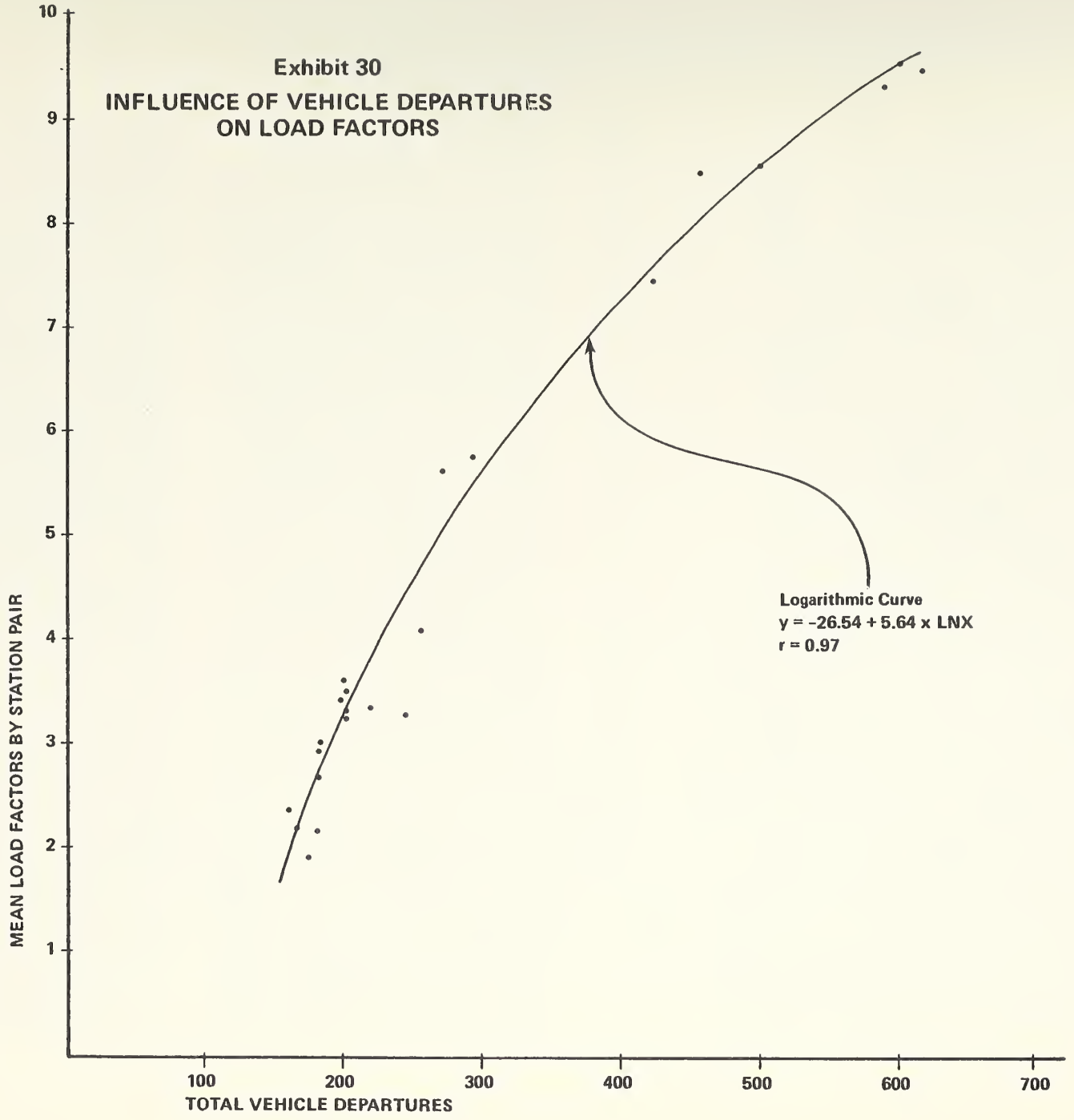


Exhibit 30
INFLUENCE OF VEHICLE DEPARTURES
ON LOAD FACTORS
MEAN LOAD FACTORS BY STATION PAIR
TOTAL VEHICLE DEPARTURES
Logarithmic Curve
y = -26.54 + 5.64 x LNX
r = 0.97
10
9
8
7
6
5
4
3
2
1
100
200
300
400
500
600
700

4.6 EMPTY VEHICLE MOVEMENTS

The operating procedures used in the MPM system require that some vehicles be stored at each station to meet the needs of passengers who request service. If the demands for service were balanced throughout the day, there would always be vehicles available at all stations. Unfortunately, demand is not always balanced -- some vehicles need to be moved empty throughout the day. Empty vehicles need to be shifted from stations where large number of passengers are discharged to stations where large numbers of passengers board. Peak demands can be and are anticipated. Vehicles are stored at Towers and Medical Center stations to meet early demands for travel from Towers to Beechurst. Exhibit 31 lists the number of empty vehicle movements for each station pair that occurred between 7:00 AM and midnight on November 5, 1980. When one considers a full day's activity, empty movements into and out of each station are balanced. The differences between the row sums (empty departures) and the column sums (empty arrivals) are very small for each of the five stations. Furthermore, total daily movements are symmetrical. The empty movements from Towers to Engineering are the same as the empty movements from Engineering to Towers. The same is approximately true for other station pairs. The largest of the empty movements fall into two categories:

1. Empty movements to balance or correct for heavy one way travel; and

2. Empty movements associated with pre-positioning vehicles to meet heavy demands.

Empty movements between Beechurst and Engineering and between Beechurst and Towers fall into the first category. When traffic is heavy in one direction, empty vehicles need to be moved in the opposite direction to provide vehicles to support demand and to remove surplus empties from the destination station. Empty movements of the second category are best illustrated by movements between Beechurst and Walnut and between Towers and Medical Center. Walnut provides backup support for heavy movements into and out of Beechurst. As surplus vehicles accumulate at Beechurst, some are shifted to Walnut and held to meet future demands for originations at Beechurst. Medical Center supports Towers in the same way. From its central position, the Engineering station provides backup support in both directions in addition to experiencing heavy periodic demands of its own.

If one examines only a portion of a day's movements, the picture is different. Exhibit 32 lists empty movements between the hours of 7:00 AM and 8:00 PM on November 6, 1980. Over this time period, flow into and out of stations is not balanced. Station pairs do not exchange equal numbers of empty vehicles with one another. The total number of empty movements is just over half of the movements that occur in a full day. The partial result clearly indicates that evening traffic is unbalanced and that the pre-staging for the early morning rush is performed in the late evening. There were also a large number of phantom demands in the evening that were due to passengers making erroneous entries or "playing with the system."

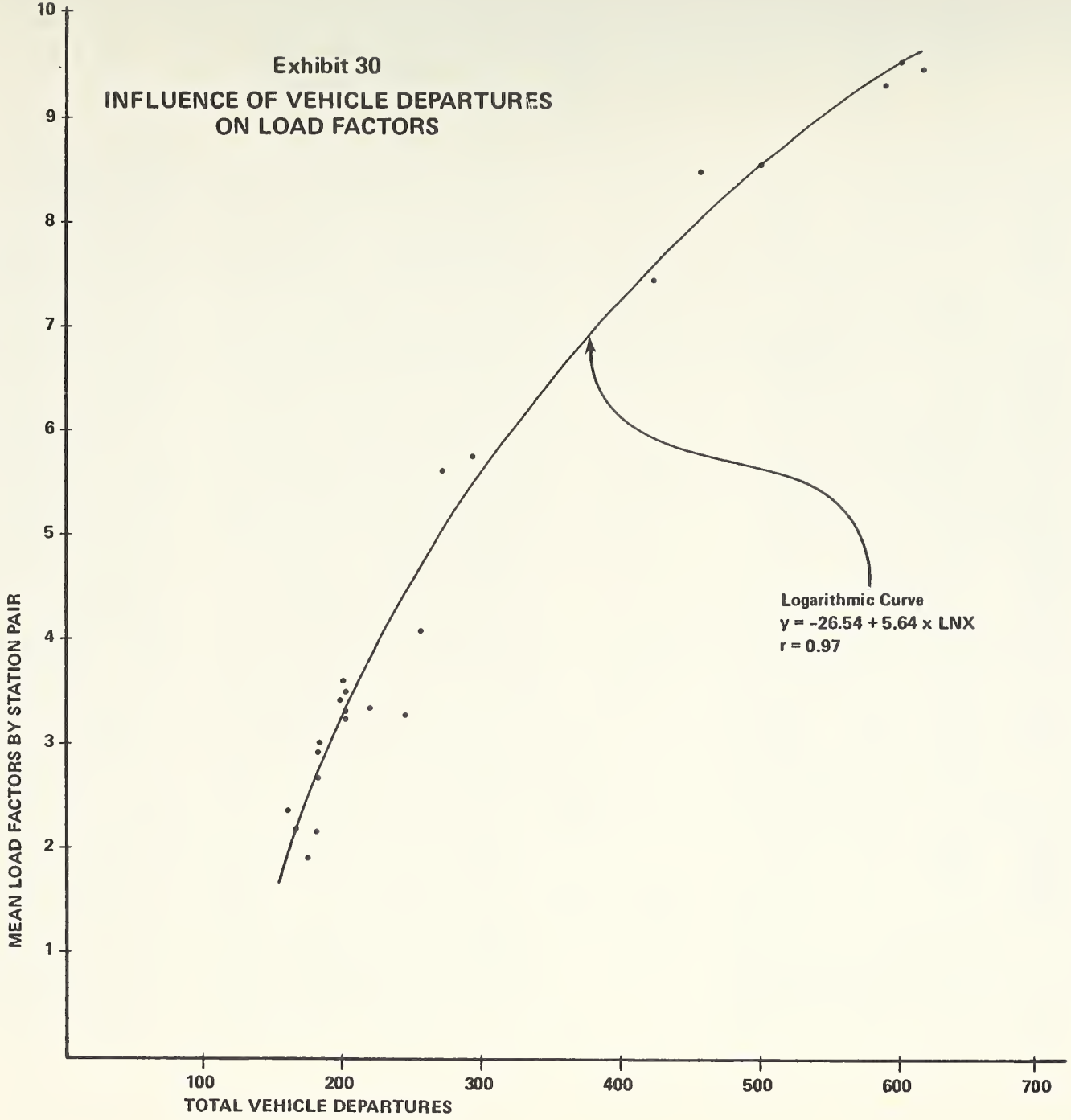


Exhibit 30
INFLUENCE OF VEHICLE DEPARTURES ON LOAD FACTORS
MEAN LOAD FACTORS BY STATION PAIR
TOTAL VEHICLE DEPARTURES
Logarithmic Curve
y = -26.54 + 5.64 x LNX
r = 0.97
10
9
8
7
6
5
4
3
2
1
100
200
300
400
500
600
700

4.6 EMPTY VEHICLE MOVEMENTS

The operating procedures used in the MPM system require that some vehicles be stored at each station to meet the needs of passengers who request service. If the demands for service were balanced throughout the day, there would always be vehicles available at all stations. Unfortunately, demand is not always balanced -- some vehicles need to be moved empty throughout the day. Empty vehicles need to be shifted from stations where large number of passengers are discharged to stations where large numbers of passengers board. Peak demands can be and are anticipated. Vehicles are stored at Towers and Medical Center stations to meet early demands for travel from Towers to Beechurst. Exhibit 31 lists the number of empty vehicle movements for each station pair that occurred between 7:00 AM and midnight on November 5, 1980. When one considers a full day's activity, empty movements into and out of each station are balanced. The differences between the row sums (empty departures) and the column sums (empty arrivals) are very small for each of the five stations. Furthermore, total daily movements are symmetrical. The empty movements from Towers to Engineering are the same as the empty movements from Engineering to Towers. The same is approximately true for other station pairs. The largest of the empty movements fall into two categories:

1. Empty movements to balance or correct for heavy one way travel; and

2. Empty movements associated with pre-positioning vehicles to meet heavy demands.

Empty movements between Beechurst and Engineering and between Beechurst and Towers fall into the first category. When traffic is heavy in one direction, empty vehicles need to be moved in the opposite direction to provide vehicles to support demand and to remove surplus empties from the destination station. Empty movements of the second category are best illustrated by movements between Beechurst and Walnut and between Towers and Medical Center. Walnut provides backup support for heavy movements into and out of Beechurst. As surplus vehicles accumulate at Beechurst, some are shifted to Walnut and held to meet future demands for originations at Beechurst. Medical Center supports Towers in the same way. From its central position, the Engineering station provides backup support in both directions in addition to experiencing heavy periodic demands of its own.

If one examines only a portion of a day's movements, the picture is different. Exhibit 32 lists empty movements between the hours of 7:00 AM and 8:00 PM on November 6, 1980. Over this time period, flow into and out of stations is not balanced. Station pairs do not exchange equal numbers of empty vehicles with one another. The total number of empty movements is just over half of the movements that occur in a full day. The partial result clearly indicates that evening traffic is unbalanced and that the pre-staging for the early morning rush is performed in the late evening. There were also a large number of phantom demands in the evening that were due to passengers making erroneous entries or "playing with the system."

Exhibit 31

EMPTY VEHICLE MOVEMENTS

November 5, 1980 – 7:00 a.m. to 12:00 midnight

TO / FROM	WALNUT	BEECHURST	ENGINEERING	TOWERS	MEDICAL CENTER	TOTAL
WALNUT		36	11	13	11	71
BEECHURST	41		37	37	5	120
ENGINEERING	4	44		52	7	107
TOWERS	15	36	52		27	130
MEDICAL CENTER	7	6	9	33		55
TOTAL	**67**	**122**	**109**	**135**	**50**	**483**

Exhibit 32

EMPTY VEHICLE MOVEMENTS
November 6, 1980 – 7:00 a.m. to 8:00 p.m.

TO / FROM	WALNUT	BEECHURST	ENGINEERING	TOWERS	MEDICAL CENTER	TOTAL
WALNUT		9	0	0	2	11
BEECHURST	25		5	37	13	80
ENGINEERING	7	18		25	3	53
TOWERS	24	25	23		7	79
MEDICAL CENTER	10	9	3	14		36
TOTAL	**66**	**61**	**31**	**76**	**25**	**259**

4.7 SYSTEM RELIABILITY

The MPM system performed reliably throughout the period that the impact assessment team took its measurements. There was one major stoppage when a metal chair was thrown onto the guideway between the Towers and Medical Center stations. Fortunately this incident occurred at about 8:15 PM when demand was low. Service was restored by morning. Several minor problems occurred afterward that involved stopping portions of the system for short periods of time. All of these problems were attributable to the chair incident.

The MPM operator keeps records on both system availability -- the probability that the system is operating when service is needed -- and system dependability -- the probability of a successful trip. These terms are defined as follows:

$$\text{Availability} = \frac{\text{Actual Operating Hours}}{\text{Scheduled Operating Hours}}$$

$$\text{Reliability} = \frac{\text{Vehicle Miles Operated}}{\text{Normal Vehicle Miles for the Operating Period}}$$

$$\text{Dependability} = \text{Availability} * \text{Reliability}$$

These terms do not take into account the frequency of failures nor do they reflect all subsystem failures. Nonetheless, they do provide a good picture of how well the MPM system functioned during any particular time period. Exhibit 33 lists availability and dependability values for the first year of Phase II operation. A 98 percent availability would mean that the system is out of service for 2-2/3 hours per week -- enough to be a nuisance if the timing is bad, but certainly a good performance record. The "chair incident" alone reduced availability for November below 98 percent. Ninety seven percent dependability in conjunction with 98 percent availability would mean that, when available, 98.8 percent of normal vehicle miles would be generated. Exhibit 34 is a graph of monthly dependability measures for the first year of Phase II operation and for the last year of Phase I operation. Except in February, Phase II performance lagged behind Phase I for every month; however, Phase II performance did show an improvement over the first year. The linear regression line on Exhibit 34 indicates a mean monthly dependability improvement of 0.49 percent. As Phase II matures, continued improvement can be expected.

The inconvenience imposed by a system failure depends on the time of day that the failure occurs and the length of time required to place the system back in service. For example, the chair incident caused a major failure. The MPM was down from 8:15 PM until service was initiated the next morning. Nonetheless, few persons were inconvenienced because evening traffic is light. A similar failure at noon would have caused many more problems.

Exhibit 35 lists the failure incidents by subsystem for the first year of Phase II operation. Most of the failures (58.9 percent) concern

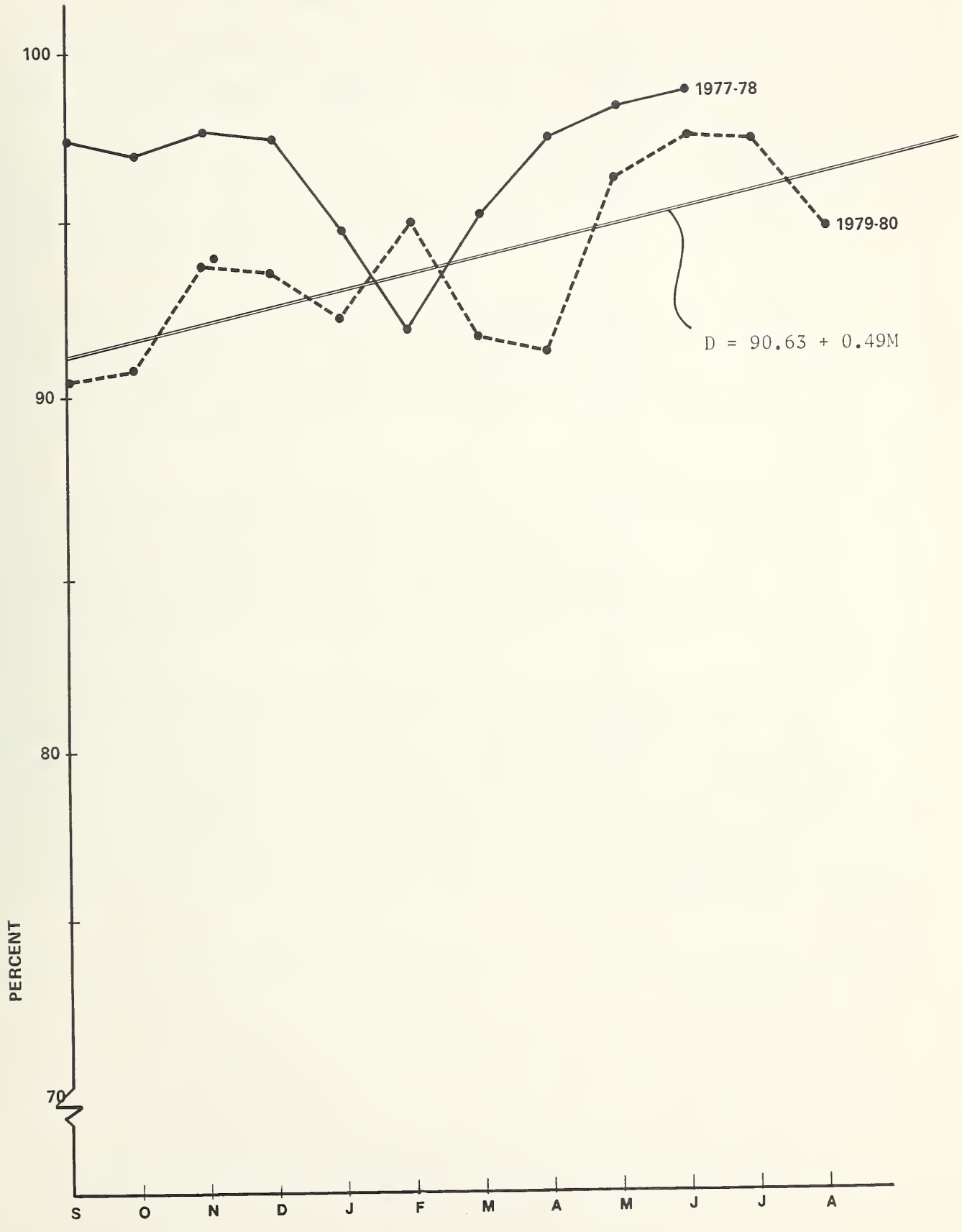
Exhibit 33
MPM RELIABILITY AND AVAILABILITY HISTORIES BY MONTH

	System Availability (%)	System Dependability (%)
September, 1979	95.6	90.6
October, 1979	96.1	90.9
November, 1979	97.1	93.9
December, 1979	97.1	93.7
January, 1980	94.5	92.2
February, 1980	97.3	95.0
March, 1980	93.9	91.8
April, 1980	96.6	91.2
May, 1980	99.3	96.4
June, 1980	98.0	97.6
July, 1980	98.0	97.5
August, 1980	95.6	94.9

Source: MPM Staff

Exhibit 34

MPM SYSTEM DEPENDABILITY



Source: MPM Staff

Exhibit 35
FAILURE INCIDENTS BY SUBSYSTEM

	Vehicles	SCCS/CCCS	Computer	S&PDS	Other	TOTAL
September, 1978	60	20	4	2	0	86
October, 1979	79	18	5	0	0	102
November, 1979	50	3	6	0	0	59
December, 1979	29	4	1	6	1	41
January, 1980	33	10	2	13	0	58
February, 1980	23	6	6	9	4	48
March, 1980	28	18	2	2	4	54
April, 1980	23	12	4	1	4	44
May, 1980	12	7	0	0	4	23
June, 1980	13	14	1	0	7	35
July, 1980	17	19	3	0	3	42
August, 1980	22	23	13	1	10	69
TOTAL	389	154	47	34	37	661
Percent of all failures	58.9	23.3	7.1	5.1	5.6	100.0

SCCS = Station Control
CCCS = Central Control
S&PDS = Structures and Power Distribution

Source: MPM Staff

vehicles. Most of these were quickly restored. The next largest category of failures is station control (SCCS) and central control (CCCS) (23.3 percent), followed by computer failures (7.1 percent). The 661 incidents experienced during the year is comparable with Phase I experience in which there were 363 incidents the last year of operation and 609 incidents the preceeding year.

Phase II vehicle failures declined steadily throughout the year at a rate of about 5 failures per year.[8] Other failures were much more erratic. By far the largest number of computer failures occurred in August. Even so, total failures declined at a monthly rate of about 3.5. As Phase II operation continues, the number of failures can be expected to continue to decline.

No data are available on down time for Phase II operations. Many system failures can be corrected from the control room. These only rarely cause delays longer than ten minutes. If maintenance personnel must be dispatched for on-site repairs, down times of 30 minutes are not uncommon. If a disabled vehicle must be towed clear of the guideway the delay may be an hour or longer. Unusual events are of unpredictable duration.

Repair data for Phase I [5] indicate that down times were generally on the order of three to 10 minutes. As Phase I experience increased the number of short repairs grew until half fell in the three to ten minute range. Operator perceptions suggest that Phase II experience is approximately the same. With an average of 55 failures per month, and an average system availability of 96.6 percent, mean down time is 18 minutes per failure. One long failure can have a substantial impact on monthly performance.

Repair times generally follow a negative exponential probability density function. Using this function, 63 percent of the repairs would take less time than the mean. Thus, a mean repair time of 18 minutes would indicate that 63 percent of the repairs would take less than 18 minutes -- substantially confirming historical evidence. Following this same density function, only five percent of the failures would last more than thirty minutes. This line of reasoning suggests that two thirds of the MPM failures are less burdensome than traffic congestion was for University bus travel. Only three times a month are MPM delays of one half hour or longer experienced.

---

[8] The linear regression curve for the vehicle failures is: No. of vehicle failures per month = 63.0 - 4.7 (months of service). The regression coefficient, r is equal to 0.83.

5. TRAVEL ALTERNATIVES

The value of the MPM to a traveler depends on his/her ability to use it to satisfy some or all of his/her travel needs. Each trip is characterized by an origin, a destination, a time of day, and a day of the week. Traveler circumstances and travel urgency vary from trip to trip. Some trips are independent; others are linked together in chains with intermediate destinations where the traveler performs some useful activity. Each traveler chooses a transportation mode for each trip that depends on the trip characteristics, the traveler's resources and encumbrances, and a set of personal feelings. Transportation mode choices are highly individual. Efforts to formulate and apply mode choice models have met with only limited success.

To gain some insight into the value of the MPM, the SYSTAN research team analyzed a set of sample trips that represent travel in the Morgantown area. The alternative modes that are available to serve each trip were identified and travel time and trip cost were estimated for each alternative mode.

5.1 SAMPLE TRIP SELECTION

Sample trips were selected on the basis of work performed by West Virginia University and presented in Reference [7]. Exhibit 36 illustrates the aggregated zone structure used by the University in some of its travel analysis. Exhibit 37 lists 1980 daily zone to zone travel as estimated by the WVU team. SYSTAN used these travel data as a basis for selecting sample trips to represent travel in Morgantown. SYSTAN sought a small set of trips that can represent daily travel. The results expected from the trip analysis were too varied and subjective to warrant the development of a carefully structured, statistically valid sample.

An examination of Exhibit 37 reveals that there are nine zone pairs that account for more than two thirds of Morgantown's daily travel. One way travel between these high traffic zone pairs varies from 3,892 daily trips (Zone 6 to Zone 7) to 1,112 daily trips (Zone 1 to Zone 7). The sample trips were limited to representations of these heavy traffic movements.

The next step was to select sample trip origins within each of the zones that generate high traffic volumes. In some instances the selection process is easy. Zone 3 includes little more than the Downtown campus of WVU. The predominant number of trips to and from

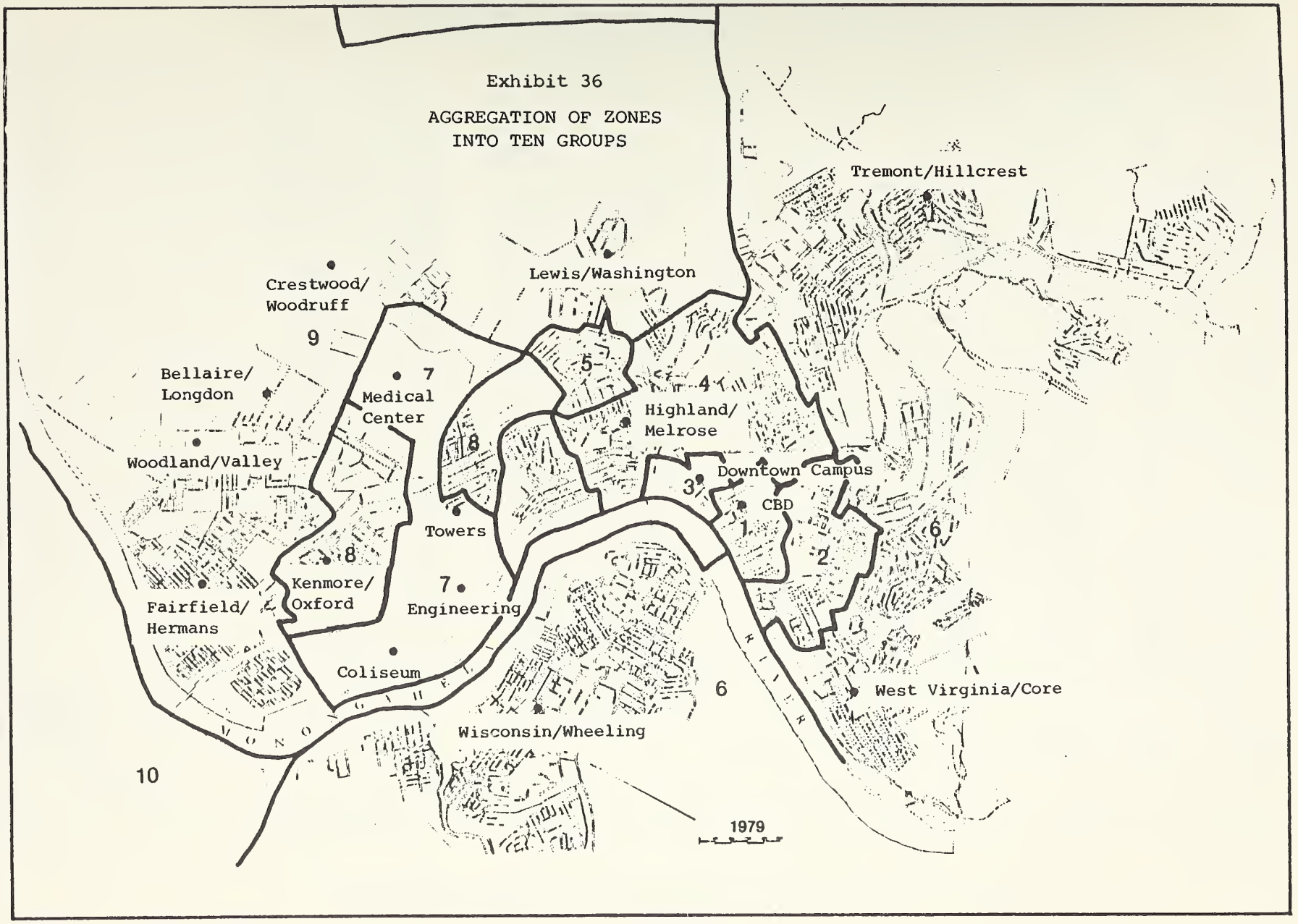


Exhibit 36
AGGREGATION OF ZONES
INTO TEN GROUPS
Tremont/Hillcrest
Crestwood/
Woodruff
Lewis/Washington
9
5
4
Bellaire/
Longdon
7
Medical
Center
Highland/
Melrose
8
Woodland/Valley
Downtown Campus
3
CBD
1
2
6
Towers
8
Kenmore/
Oxford
7
Engineering
Fairfield/
Hermans
Coliseum
6
West Virginia/Core
Wisconsin/Wheeling
10
1979

Exhibit 37

ESTIMATED 1980 WEEKDAY ZONE TO ZONE TRAVEL BY ALL MODES

FROM ZONE \ TO ZONE	1	2	3	4	5	6	7	8	9	10	TOTAL
1	0	0	93	129	113	129	1,112	391	1,231	360	3,558
2	3	0	86	33	21	76	896	272	633	81	2,051
3	92	82	0	35	40	259	3,274	565	1,481	125	5,953
4	104	31	92	21	30	207	3,416	469	1,001	114	5,485
5	144	61	44	61	0	111	654	399	371	58	1,903
6	528	97	425	117	269	1,185	3,892	1,126	3,312	675	11,626
7	1,058	574	3,842	2,331	581	3,452	1,728	824	1,052	186	15,628
8	481	85	667	272	77	1,183	554	419	1,012	20	4,770
9	1,900	675	2,144	524	343	3,397	1,341	803	266	222	11,615
10	406	128	218	106	126	549	382	122	91	16	2,144
TOTAL	4,716	1,733	7,611	3,629	1,600	10,548	17,199	5,390	10,450	1,857	64,733

Source: WVU, Reference 7

this zone originate and terminate in classrooms, offices and the student union. Precise locations for these locations were averaged to produce a single central point for Zone 3 that is approximately equal to the mean of all trip origins and destinations. Trip origins and destinations can easily be identified. The situation is similar in Zone 7 which encompasses all of the Evansdale campus. However, because of the geographic size of this campus, four separate points were selected to represent trip origins and destinations -- one in the Engineering Building, one in the Towers Dormitory, one in the Medical Center, and one at the Coliseum where there is substantial free parking, in addition to athletic and cultural events. A single point was selected to represent the Morgantown Central Business District. This point is the new center of retail trade, at the intersection of High and Fayette Streets. The other zones are predominantly residential and are represented by one or more residential locations that were selected at random. The selections were made without reference to any of the public transportation services that are available. Locations on major arterial streets were avoided because they would produce travel times that are distinctly shorter than the average. In all, sixteen separate trip ends were selected. These points are shown in Exhibit 37. Multiple points were selected in Zones 6 and 9 because of their large geographical size and heavy traffic. Some trip generators were deliberately omitted because they have little impact on the MPM. The Mountaineer Mall on Greenbag Road generates a substantial amount of traffic. Ample free parking supports automobile travel, and service to the Mall is provided by two of the six city bus routes. The Mall was not used as a sample trip end because it is so remote from the MPM. Few, if any, persons traveling to and from the Mall would find that the MPM makes the trip easier or cheaper. The one likely exception is WVU students who might travel by MPM to the CBD and then by bus to the Mall. However, similar transfer activities were included in several of the sample trips. The airport was omitted as a traffic generator because trips to and from the airport use automobiles and taxis almost exclusively. One city bus route does serve the airport, but traffic is light.

The sixteen trip ends were connected in pairs to form representative trips for each of the ten high traffic movements. Trip selection was designed to illustrate travel diversity, the impacts of different types of trip ends and alternative transportation modes as well as travel volume. Three trips each were selected for zone pairs 6-7 and 3-7. Other high volume pairs are represented by one or two trips each. The aggregate set of trips is listed in Exhibit 38 together with zone pairs, daily travel volumes and alternative transportation mode characteristics.

Exhibit 38
TRAVEL MODE COMPARISON FOR REPRESENTATIVE TRIPS

					AUTOMOBILE		AUTO–MPM		MPM		MPM–BUS		BUS	
TRIP ORIGIN	TRIP DESTINATION	TIME OF DAY	ZONE O D	DAILY TRIPS	MEAN TRIP TIME (min.)	TRIP COST	MEAN TRIP TIME (min.)	TRIP COST	MEAN TRIP TIME (min.)	TRIP COST	MEAN TRIP TIME (min.)	TRIP COST	MEAN TRIP TIME (min.)	TRIP COST
WEST VIRGINIA/CORE	ENGINEERING	3 p.m.	6-7	3,892	14.7	$0.80	26.3	$1.03			33.4	$0.65		
TREMONT/HILLCREST	MEDICAL CENTER	Noon			20.2	1.00					44.3	0.65	45.1	$0.40
WISCONSIN/WHEELING	MEDICAL CENTER	11 a.m.			22.6	1.20	30.0	1.10			37.8	0.75		
DOWNTOWN CAMPUS	ENGINEERING	11 a.m.	3-7	3,274	15.7	1.23			17.6	$0.25				
DOWNTOWN CAMPUS	TOWERS	9 a.m.			21.3	1.16			20.7	0.25			19.2	0.40
DOWNTOWN CAMPUS	MEDICAL CENTER	1 p.m.			20.7	1.23			21.0	0.25			19.7	0.40
HIGHLAND/MELROSE	ENGINEERING	3 p.m.	4-7	3,416	11.3	0.57					26.9	0.65		
WEST VIRGINIA/CORE	BELLAIRE/LONGDON	2 p.m.	6-9	3,312	15.5	0.87					64.0	0.65	64.5	0.40
TREMONT/HILLCREST	WOODLAND/VALLEY	Noon			18.7	0.93					66.4	0.65	58.2	0.40
DOWNTOWN CAMPUS	BELLAIRE/LONGDON	Noon	3-9	1,481	17.5	1.03	26.8	0.58					40.8	0.40
DOWNTOWN CAMPUS	CRESTWOOD/WOODRUFF	10 a.m.			17.1	1.01	28.8	0.72						
CBD	VALLEY/WOODLAND	Noon	1-9	1,231	19.3	1.20	29.5	0.72					33.1	0.40
CBD	FAIRFIELD/HERMANS	5 p.m.			18.8	1.18	32.3	0.72					36.8	0.40
COLISEUM	MEDICAL CENTER	1 p.m.	7-7	1,728	14.2	0.47			22.9	0.25				
ENGINEERING	LEWIS/WASHINGTON	8 p.m.	7-9	1,052	12.1	0.60					46.3	0.65		
MEDICAL CENTER	BELLAIRE/LONGDON	3 p.m.			13.0	0.52							26.4	0.40
WEST VIRGINIA/CORE	KENMORE/OXFORD	9 a.m.	6-8	1,126	16.0	0.60							53.7	0.40
HILLCREST/FREMONT	KENMORE/OXFORD	1 p.m.			19.2	0.80							53.8	0.40
CBD	MEDICAL CENTER	8 a.m.	1-7	1,112	22.3	1.37			22.0	0.25			24.1	0.40
CBD	TOWERS	Noon			23.5	1.34			21.8	0.25			24.1	0.40

5.2 ALTERNATIVE TRANSPORTATION MODES

Each of the 20 sample trips can be served by two or more transportation modes. All trips can be served by automobile. Six can be served entirely by MPM and 14 can be served entirely by city or county bus. Ten trips can be served by modal combinations with transfers -- automobile-MPM or MPM-bus.

The trip characteristics of greatest interest are trip time and trip cost. These characteristics can be determined quantitatively for easy comparison among modes. Other characteristics like comfort, ride quality, noise and aesthetics contain large subjective elements that complicate direct comparisons. Trip times include the elapsed time from the traveler decision to begin the trip until the trip is complete. The beginning of the trip is marked by the termination of a non-transportation activity, e.g. working, reading, talking, studying. The end of the trip is marked by the commencement of a non-transportation activity, e.g. attending class, shopping, working. All elapsed time between the beginning and the end of the trip is charged to the trip. Normal trip costs for typical users have been calculated for purposes of comparing modes. A simple approach has been used that reflects total costs, but does not delve into the intricacies of costs to different classes of travelers under different circumstances.

Trip times were investigated for each mode by identifying sequences of activities, and assigning an expected time to each activity. All trips originated and terminated in buildings, homes or other structures where travelers could be occupied with non-transportation activities. If, for example, a trip originated at a residence, the traveler would begin his/her trip in the kitchen, dining room, living room, or other room of the house. When all other activities ceased, the trip could begin. Travel related activities included:

- Walking to and through an outside door;
- Locking the door; and
- Walking to the transportation mode.

Trips that began in high rise buildings included elevator trips to the ground floor.

Parking spaces were identified for automobiles. In residential areas, automobiles were parked in garages or on the street in front of the residence. In the Downtown WVU campus, and the CBD, automobiles were parked in public parking structures. On the Evansdale campus, they were parked in either open public lots (e.g. at the Coliseum) or in restricted lots. Average locations were assigned to automobiles in parking structures and lots.

Travel times by automobile were measured for each sample trip by driving the route. In many cases, alternative routes were explored.

Driving time varied appreciably by time of day. Exhibit 39 illustrates variations in average speed by time of day that were recorded by West Virginia University students. Variations on Monongahela Blvd. (Beechurst) are great particularly in the afternoon. Southbound traffic on University is also congested in the afternoon. Travel on Stewart Street is slow throughout the day. To take these variations into account, a time of day was assigned to each sample trip. These times are listed in Exhibit 38.

MPM trip times were developed from the rather considerable operating data collected by the project team. Trip times included the time required to walk to the MPM station, expected waiting time for MPM service, travel time between station pairs and walking time from the destination MPM station to the trip destination. Walking times were estimated on the basis of walking distances, stairs to be climbed or descended and street intersections to be crossed. Waiting times were the expected waits calculated for the particular trip origin and destination stations. Travel times were taken from Exhibit 22. Because of the regularity of MPM service it was not necessary to differentiate among the different times of the day.

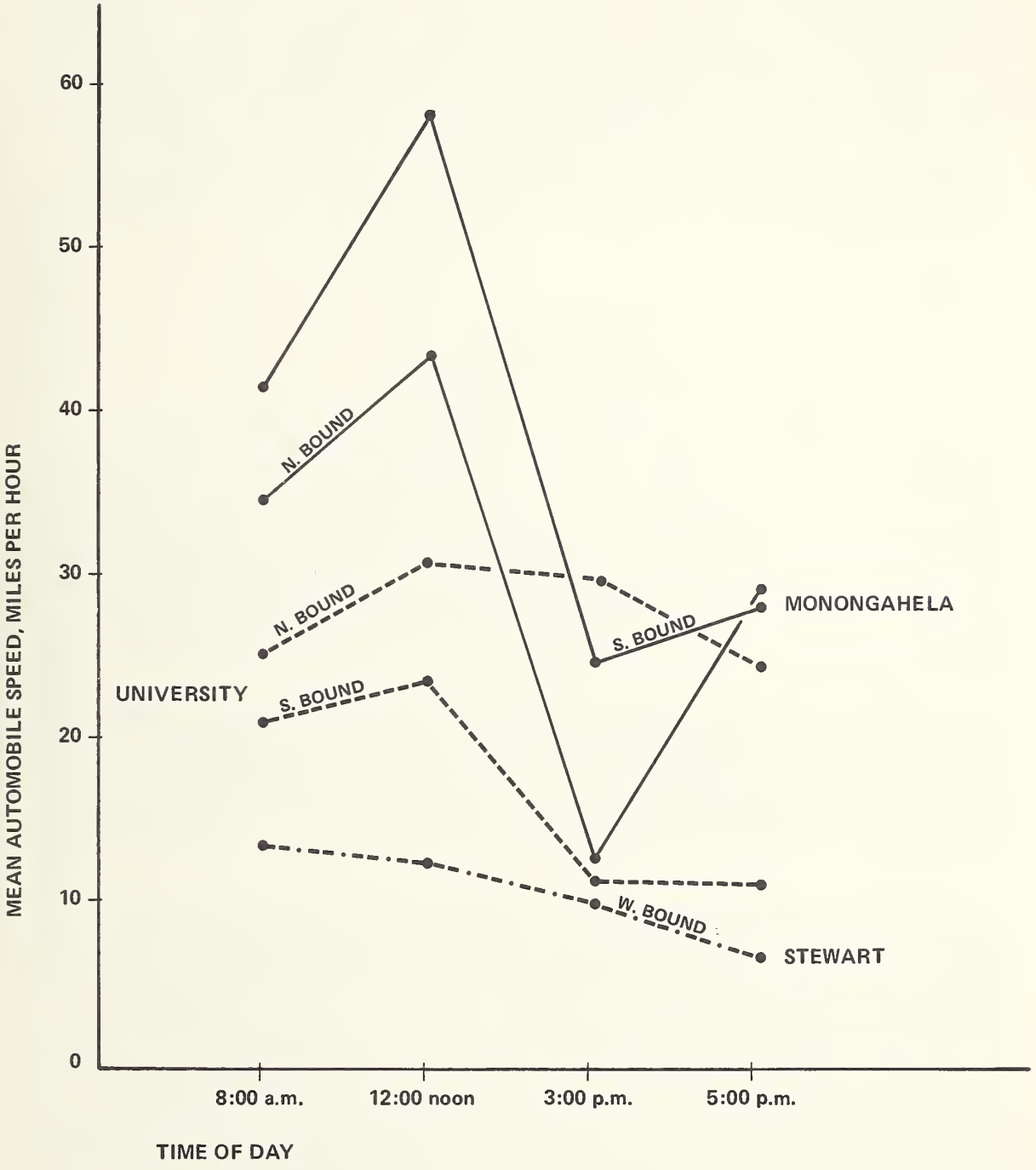
Bus travel times were estimated from the services offered and the schedules. Sample bus trips were taken by the project team to check the service, but it was not possible to personally check all of the bus trips included in the sample. Walking distances were calculated to the nearest point on the bus route, because outside of the CBD, buses stop anywhere along the routes to pick up or discharge passengers. Travelers were assumed to be familiar with bus schedules so that they would plan their trips to reach the bus route a few minutes prior to the bus' expected arrival time. An allowance of five minutes was made for waiting.[9] Bus travel times were calculated on the basis of round trip times and traffic conditions at different times of day. All bus routes are operated on regular schedules which allow one hour for each round trip throughout the day. During periods of traffic congestion, the full hour is needed to make the round trip. However, when traffic is light, considerable extra time is available. Then, buses tend to dawdle along their routes and layover at each end. These actions were taken into account. Times required to transfer between bus routes were calculated on the basis of distances to be walked and waiting times imposed by the bus schedules. Transfer times from buses to the MPM were calculated on the basis of walking times and normal waiting times for the MPM. Transfer times from the MPM to buses were more difficult to calculate because of the infrequency of bus service. Waiting times of ten to fifteen minutes were used to reflect a knowledge of the bus schedule together with the length and uncertainty of the MPM trip.

---

[9] If one assumed random arrivals at bus routes, then for all routes but the Suncrest Route, expected waiting time would be 30 minutes. Regular bus travelers do not wait this long; rather, they adjust their personal schedules to accommodate the bus schedule. One can successfully argue that this adjustment is an inconvenience, but this detail was omitted from the analysis.

Exhibit 39

MEAN AUTOMOBILE SPEED VARIATIONS BY TIME OF DAY
1979



Source: Reference 7

Trip costs were also estimated. Automobile costs include the cost of operating the automobile with a single occupant at $0.20 per mile and the cost of parking, where appropriate. In public structures, fees for two hours of parking were used. Parking charges for University spaces were spread over the year -- averaging about $0.20 per trip. No parking charges were assessed in residential areas. MPM costs were calculated on the basis of the single trip fare: $0.25. Student costs can be less. Each student pays approximately $0.25 per day for a pass. Students making more than one trip per day realize a considerable saving over the $0.25 fare. Nonetheless, the single trip fare is an acceptable standard. Bus fares were calculated on the basis of the volume fare of $0.40 (five trips for $2.00). This is the fare that is paid by regular users.

5.3 MODAL COMPARISONS FOR SAMPLE TRIPS

Exhibit 38 lists the times and costs for each mode or modal combination that can reasonably serve each of the representative trips. Automobile travel is faster than the other modes for all trips except those between the Downtown campus and Evansdale campus and between the Morgantown CBD and the Evansdale campus. In these instances, parking at the Downtown campus or CBD is inconvenient and requires a considerable walk in addition to the time needed to drive an automobile out of a parking structure. MPM service is convenient and prompt for these trips. City bus service is also convenient to Towers and to the Medical Center.

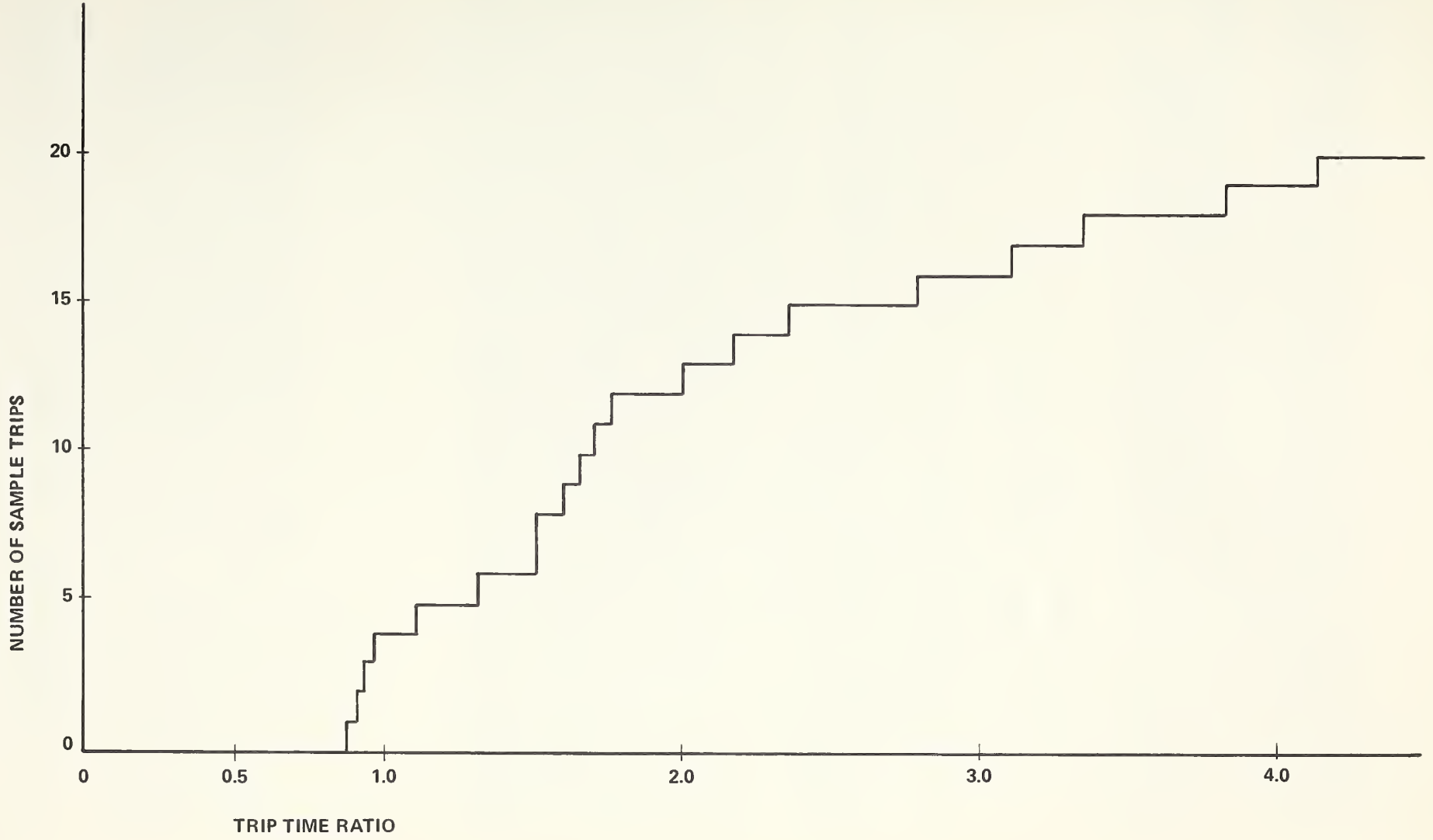
The automobile's advantage varies with trip complexity. Exhibit 40 shows the ratio of the shortest transit trip time to automobile trip time for all of the sample trips. For half of the sample trips, the best transit mode requires less than 70 percent more time than driving. The actual time penalties for using transit are short -- ten minutes or less.

Transit is unattractive for long trips -- particularly those requiring transfers between buses. The five least attractive transit trips have transit trip time penalties of 34 to 48 minutes. Three of these trips require transfers between bus routes and two require transfers between buses and the MPM. One short trip, Highland/Melrose to Engineering, is badly served by transit. Highland/Melrose is on the hill above the MPM guideway between the Beechurst and Engineering stations. The traveler has two choices: (1) take a Suncrest bus to the Downtown campus and transfer to the MPM, or (2) take a Suncrest bus to the Towers dormitories and transfer to the MPM (or walk to Engineering). The former is slightly faster than the latter, but both routes are indirect, whereas the automobile route is both short and direct.

Of the ten most attractive transit trips, four would best be served by MPM, four by MPM using the automobile as a feeder and two by bus. The latter two trips could be served by MPM almost as well as by bus.

Exhibit 40

CUMULATIVE DISTRIBUTION OF AUTO/TRANSIT TRIP TIME RATIOS



In these instances (Downtown campus to Medical Center and Downtown campus to Towers), the bus is more convenient than the MPM to both origins and destinations. Thus, the bus is prefereable for trips that fit the bus schedule; otherwise, the MPM is faster.

For six of the sample trips, the mode choice is clear. The prudent traveler will select the mode that is both fast and inexpensive. For two of these trips (Highland/Melrose to Engineering and West Virginia/Core to Engineering) the automobile is the clear choice. For the other four:

- Downtown Campus to Towers;
- Downtown Campus to Medical Center;
- CBD to Towers; and
- CBD to Medical Center.

transit is the clear choice. The MPM is the cheapest mode to serve these trips and provides the best trip times, except when the bus schedule is particularly favorable.

For seven additional trips, transit cost is lower than automobile cost and transit trip times are less than 75 percent greater than automobile trip times. In these instances, the transit time penalties are short (13 minutes or less) such that a traveler can compare the extra trip time with transit's cost advantage to arrive at an economic mode choice that suits his/her needs. For one trip (Downtown campus to Engineering), the choice clearly favors the cheaper mode. In this case, the automobile driver would pay an additional $0.98 to save 1.9 minutes -- this is equivalent to $30.95 per hour. For the other trips, the value of the time saved varies from $0.81 to $2.90 per hour. The traveler who is in a hurry and values his/her time highly would drive; the traveler who has time available that cannot be productively used may elect transit.

5.4 IMPLICATIONS

The analysis of sample trips revealed that the MPM does play an important and useful role in transportation in Morgantown. The MPM can productively contribute to 11 of the 20 sample trips that were examined. Five of the sample trips are better served by MPM than by any other transportation mode. Travelers making the other six trips would use more time but spend less money traveling by MPM than by automobile. Thus, one would expect that some travelers would select the MPM to save money while others would select their automobiles to save time.

If parking were more available and more convenient in the CBD and on the Evansdale campus, many automobile-MPM trips would be attractive.

The travelers who elect to use automobiles as feeders to MPM must park a considerable distance from the Engineering and Medical Center MPM stations or pay a reasonably high parking fee in the CBD.

The MPM can effectively serve five of the ten high volume travel movements that were examined. These include:

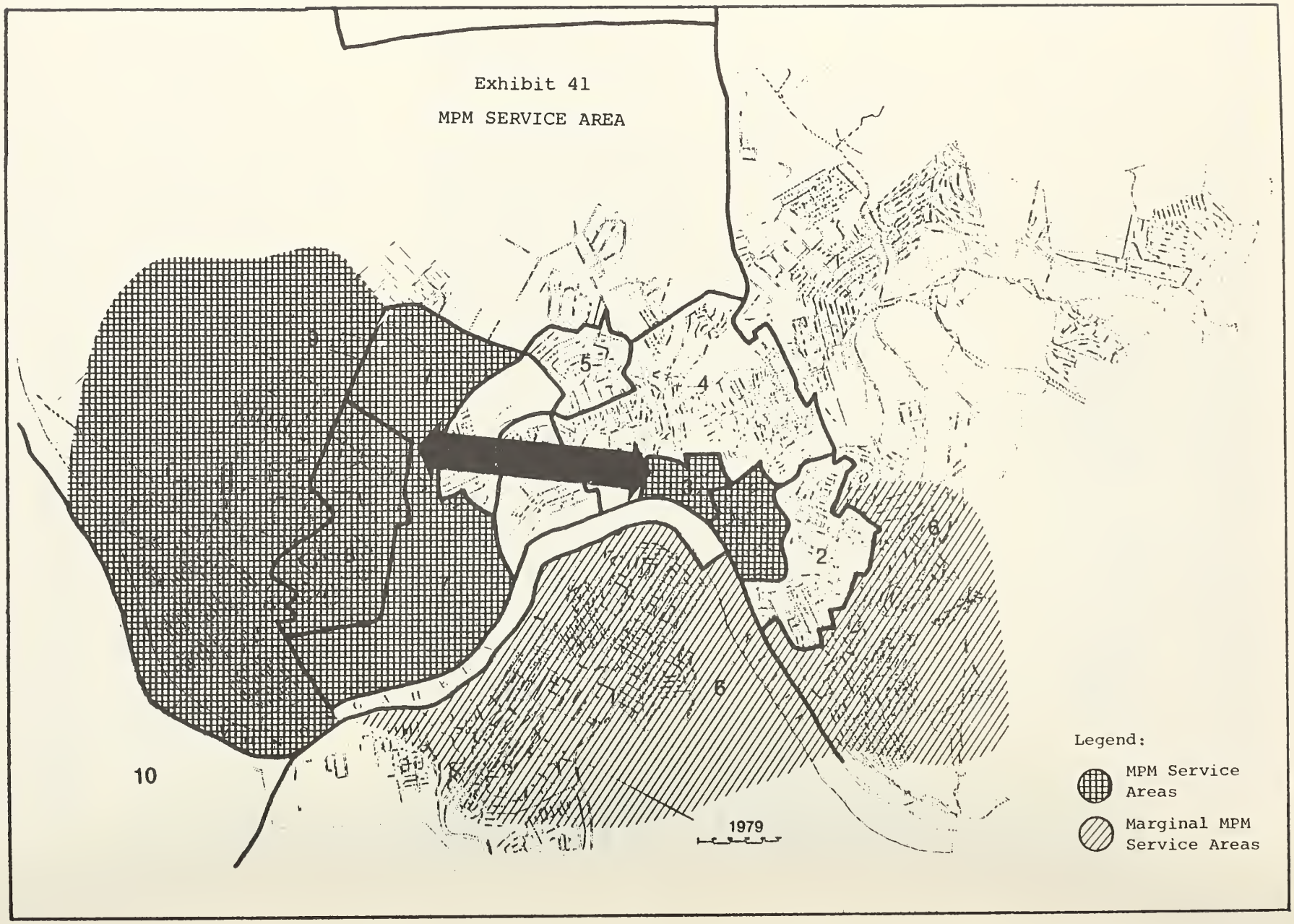
Origin Zone	Destination Zone
1	7
1	9
3	7
3	9
2	7

In all circumstances, trips between zones 1 and 3 and Zone 7 are well served by the MPM. This is to be expected because it is precisely these trips that the MPM was designed to serve. In addition, a large area north of Zone 7 can benefit from MPM service. In these instances automobile feeder service to MPM stations on the Evansdale campus (Engineering and Medical Center) complements MPM service to downtown destinations. A similar service between residences south and east of the CBD (Zone 6) is only marginally attractive because of the scarcity, inconvenience and cost of parking in the CBD area.

Exhibit 41 illustrates the MPM service area. The MPM can effectively serve a wide variety of trips that connect origins in the north with destinations in Zones 1 and 3 and origins in the south and west with destinations in Zone 7. In the aggregate, these travel patterns account for approximately 22,000 daily trips, or roughly one third of the travel in the Morgantown area. Patronage data suggest that the MPM is approaching this potential. MPM users apparently recognize its utility and use it to the extent that it is economically attractive. As a result, there are not good prospects for dramatic future increases in MPM patronage. Convenient parking on the Evansdale compus will help some. Convenient parking in the CBD would be even more helpful, but it would be costly to construct.

Exhibit 41

MPM SERVICE AREA



6. THE SURVEYS

The values expressed in the comparisons that were presented in Section 5 have some influence over the travel habits and mode selections of many persons. However, they do not tell the whole story. Mode selection is heavily subjective. Many travelers have such strong emotional ties to their automobiles that they will not even consider alternative transportation modes. Some residents of large cities shun public transit out of fear for their personal safety. Perceptions and emotions not only influence mode selection but they influence how travelers feel about the service that they have received. Therefore, no investigation of the MPM is complete until the judgments and perceptions of MPM users and non-users have been measured.

The SYSTAN research team designed and executed an investigation into the attitudes that major Morgantown groups have about the MPM and its utility. This chapter describes the design and execution of the attitude surveys. The results of the surveys are described in Section 7. The surveys were approved by the Office of Management and Budget (OMB).

6.1 POPULATION GROUPS

The Morgantown population can be divided into three groups:

1. WVU Students (20,000);
2. WVU Faculty and Staff (7,400); and
3. Morgantown area residents that are not affiliated with the University.

The size of the last group depends on the geographical boundaries that are selected. The area illustrated in Exhibit 36 has a resident population of about 45,000 persons. If one uses this value as a guide and assumes that the households of University faculty and staff average 3.5 persons, then there are approximately 19,000 persons in non-University affiliated households. This approximate breakdown was confirmed by the surveys.

As described in Section 2, each of the three population groups has a distinctly different outlook. The students are captive MPM users because they must pay for it whether or not they use it. Students, therefore, treat the MPM as though it is free and use it whenever it is even marginally convenient. Most students can be assumed to be

unfamiliar with the MPM's early development problems. Few had been in Morgantown more than four years. However, many came from homes close to Morgantown. A sample of home addresses taken from the student directory indicated that 19 percent of the students were from the Morgantown area and 46 percent were from West Virginia. Even so, most of today's students were quite young in 1973-75 when the MPM was having technical problems. Any adverse bias brought to Morgantown would have come from parents.

WVU faculty and staff have reason to be on the WVU campus and to travel between campuses. However, they are not required to buy MPM passes. They use the MPM when it is convenient and they can secure a pass or when the MPM service is judged to be worth the $0.25 fare. Approximately 75% of the faculty and staff live in Morgantown. The balance generally live a few miles away in suburbs and small towns such as Cheat Lake, Van Voorhes, Mount Morris, and Point Marion, PA. The small fraction of WVU employees who work outside of Morgantown (e.g. in Charleston) did not respond to the survey.

Non-University affiliates have little need to visit the campus and tend to view the MPM as an exclusive university facility. Many have ridden the MPM out of curiosity; others have used it for trips to the Medical Center. The views of the three groups are so different that each needed to be treated separately. Therefore, three different surveys were planned.

Reaching the different groups posed problems. The best time to ascertain perceptions about MPM service is when a person is using or has just used the MPM. At these times feelings are fresh and meaningful. Later reflection tends to change the perceptions. Therefore, at least one survey needed to be directed toward MPM users when they were using the MPM. Because most students use the MPM, it was reasonable to assume that a representative sample of students could be selected from among the MPM users. This statement is not true for the other two groups. It is quite possible that faculty and staff do not uniformly use the MPM. It is almost certain that a substantial number of non-University affiliates have never used the MPM. Therefore, the three surveys were directed to:

1. MPM users;

2. WVU faculty and staff; and

3. Non-University affiliates.

MPM users could later be broken down into three groups: students, faculty/staff, and non-University affiliates.

6.2 SAMPLING PLAN

A separate sampling plan was prepared for each of the three surveys. Each plan contained a method for identifying the universe and for extracting a sample from it. It also addressed procedures for administering the survey.

MPM Users

To secure the most accurate user perceptions of MPM service, the user survey was administered on the MPM site. Survey days were selected carefully to enhance the chance of addressing a representative sample of MPM users. Six criteria were established for the survey design:

1. The survey must be conducted when WVU is in regular session -- during a normal part of the academic term characterized by regular classroom activity;

2. The survey needed to be conducted on several days to span irregularities in daily class schedules;

3. The survey needed to cover the entire operating day so that persons using the MPM for late afternoon and evening activities would be included;

4. Special events should be avoided to eliminate biases;

5. The sample selection should be balanced with system use; and

6. The sample should be selected in a random fashion that avoids bias.

Two options were available for administering the survey instruments: personal interviews could be conducted, or respondents could be asked to complete the instrument and return it. Neither option presents an ideal environment for collecting accurate perceptional information. However, on balance, the second option has more advantages and presents fewer problems than the first. Using the second option, respondents could fill out a questionnaire during an MPM trip or just after the trip was completed when perceptions were clear in their minds. Their perceptions would not be influenced by the presence of an interviewer. The respondent would feel free to express his/her views in complete anonymity; respondents would not be intimidated by interviewers. More information could be secured from respondents willing to take the time for detailed remarks. Finally, fewer surveyors would be needed to pass out questionnaires than to conduct interviews; and they would require less extensive training. The principal risk was one of bias. Regardless of the method selected to distribute questionnaires, interested respondents would complete them; disinterested respondents would not. Some questionnaires would be filled out facetiously -- some of these could be identified; others could not.

An unbiased method was needed to distribute questionnaires. Daily MPM traffic was expected to vary from 12,000 to 20,000 persons. Weekly traffic would be in excess of 60,000 persons, many of whom would make repeat trips. The research team decided to distribute questionnaires on three days: Monday, Wednesday, and Thursday. This schedule would cover students attending Monday-Wednesday-Friday classes and those attending Tuesday-Thursday classes. It would expose surveyors to 36,000 to 60,000 MPM passengers, including many repeat trips, particularly on Wednesday. The schedule would allow Tuesday to correct errors and make adjustments identified on Monday so that Wednesday and Thursday results could be enhanced.

Exact sample sizes could not be determined in advance because the different sub-populations could not be determined. Instead, it was necessary to make approximate comparisons between the cost of data collection and the risk of losing valuable results. The project team estimated that between 1,000 and 2,000 user responses would be needed to support useful conclusions. If one expected 25 percent of the questionnaires to be returned, then it would be necessary to distribute between 4,000 and 8,000 questionnaires. These numbers of questionnaires could be distributed to one in ten MPM passengers during the three day survey period.

Random, unbiased distribution was achieved by distributing a questionnaire to each tenth person to enter each of the seven station platforms.[10] Surveyors were assigned to stations in sufficient numbers to handle the expected station volumes. To reduce bias in respondent selection, surveyors were positioned on each platform so that they could see the persons passing through the turnstiles, but could not see persons approaching them. Each surveyor was instructed to approach each tenth person to enter the station and ask if he/she would cooperate by filling out a survey instrument. If rebuffed, the surveyor would approach the next passenger to enter the station. This procedure worked well. There were few refusals the first day. On subsequent days, many passengers claimed to have already filled out a questionnaire. These claims were accepted at face value and the next passenger was approached.

Questionnaires could be returned by placing them in drop boxes that were located on all station platforms, or by mailing them to SYSTAN, using the franked panel at the bottom of the questionnaire.

Ample surveyors were recruited to assure that the sample could be drawn as planned. Exhibit 42 lists platform assignments throughout the day for Wednesday, November 5. For the most part, the surveyors were divided into teams of three -- two persons passed out questionnaires while the third recorded data on vehicle departures and passenger loads. One surveyor passed out questionnaires at each end of the platform. The

---

[10] There are two platforms each at Towers and Beechurst and one each at Walnut, Engineering and Medical Center. The "A" platform at Engineering was not in service during the survey.

Exhibit 42

STATION AND PLATFORM ASSIGNMENTS FOR NOVEMBER 5

TIME	WALNUT	BEECHURST		ENGINEERING	TOWERS		MEDICAL CENTER
		PLATFORM A	PLATFORM B		PLATFORM A	PLATFORM B	
7:00 to 9:00	3	3	3	4	3	3	3
9:00 to 11:00	3	3	3	3	3	3	3
11:00 to 1:00	3	2	3	4	3	3	3
1:00 to 3:00	2	2	3	3	3	3	2
3:00 to 5:00	2	2	3	3	2	3	2
5:00 to 8:00	2	2	3	3	2	3	2
8:00 to 10:00	2		3	3		3	2
10:00 to 12:00	2		3	3		3	2

data collector had to move back and forth. Jobs were rotated to relieve the tedium. Surveyors were assigned to two hour shifts (except 5:00 to 8:00 PM) to avoid monotony. In only a few instances were surveyors allowed to work two successive shifts. After the early morning rush, it was possible to work the simple platforms at Walnut and Medical Center and the "A" platforms at Beechurst and Towers with only two surveyors. Service at the "A" platforms of Beechurst and Towers was discontinued at 6:00 PM. The two SYSTAN supervisors circulated among the stations throughout the day to assure that the survey was properly conducted and to handle problems promptly as they arose.

WVU Faculty and Staff

WVU officials cooperated with SYSTAN by making a complete set of faculty/staff address labels available. These were affixed to envelopes that each contained one faculty/staff questionnaire and a letter that briefly explained the purpose of the survey. The survey packets were distributed through the campus mail. Because of the generous University support, it was possible to distribute questionnaires to all 7,400 WVU faculty and staff. Questionnaires were returned by mail using the franked panel at the bottom of the questionnaire.

Non-University Affiliates

A representative sample of non-University affiliates could not be contacted on the MPM or at any other central location. Respondents needed to be contacted at their homes by personal visit or by telephone. Telephone interviews were selected because they are faster and considerably less costly than home interviews. Also it was easier to gain access to individuals by telephone than by personal call. Telephone interviews have two major disadvantages:

1. Some households do not have telephones; and

2. Some households have unlisted telephone numbers.

Some unlisted numbers can be reached by systematically trying blind numbers; for example, adding one digit to a number listed in the directory. After giving the matter some thought, the project team concluded that an adequate sample of non-University affiliates could be extracted from the telephone directory.

Each interviewer was given two pages of the Morgantown telephone directory and a set of random numbers to be used in selecting names from the list. The interviewer was instructed to call numbers in the order prescribed by the random number list until 14 interviews had been completed on each page of the telephone directory. Interviewers were also instructed to call at different times of the day and different days of the week. The goal was to complete 1,000 telephone interviews.

The SYSTAN supervisors made spot checks to assure that persons were actually interviewed as reported.

6.3 THE SURVEY INSTRUMENTS

The survey questionnaires were designed to learn as much as possible about the respondents' perceptions and attitudes toward the MPM while retaining the respondents' anonymity and avoiding overly personal and potentially embarrassing questions. Particular care was taken to preserve neutral tones to questions. For sensitive issues like concerns for security and safety, written answers were requested to avoid suggesting feelings that may not have been felt. The SYSTAN team felt very strongly that additional processing time was preferable to leading questions. Each survey used a separate questionnaire that was designed for the particular population group. There were, however, some common questions. The three surveys were printed on different colored paper for ease of separation. The survey documents are presented in Appendix A. The following paragraphs describe the contents of each.

User Survey

The user questionnaire was directed toward soliciting specific information about the trip that was in process when the user was approached by a surveyor. The questions were divided into four blocks or categories. The first block addressed the user's past experience with the MPM and his/her attitude toward it. Questions concerned frequency of use, trip purposes for which the MPM was used and changes in the MPM that were considered desirable. The second block addressed the specific trip in progress, requesting origin, destination, MPM boarding and leaving stations, and perceived waiting and trip times. The user was asked whether a seat was available in the MPM vehicle, whether he/she carried parcels and whether the parcels presented problems. Perceptional information was requested including concerns about safety and security, reasons for selecting the MPM, anxiety about reaching the user's destination on time and the best and worst features of the MPM. The user was also asked to rate different aspects of the MPM service. The third block of questions concerned the user's selected transportation modes for different trip types. The table was directed toward trips made or expected to be made on the day that the questionnaire was completed -- the last block contained demographic questions about occupation, the availability of an automobile, age and sex. Respondents contacted during pre-testing required two to five minutes to complete the questionnaire.

Faculty/Staff Survey

The faculty/staff survey focused on the respondent's trip to work on the survey day and on his/her last MPM ride. The first block of questions identified the respondent's approximate residence location and work location. The nature of the survey day trip was explored, including transportation mode choice, departure and arrival time, reasons for mode choice and reasons for rejecting public transit. The next block of questions concerned experience with the MPM. These questions were similar to the ones asked of users. The next block of questions concerned the respondent's last MPM ride. It included date, origin, destination, trip time, and the perceptions asked of users.

This questionnaire also included the block for mode choice by trip purpose and a block of demographic information.

Non-University Affiliate Survey

The format of the questionnaire used for non-University affiliates was different from the other two because it was designed to be administered over the telephone. The interviewer began by writing the date and time of the telephone call. The questions began by determining whether the respondent was an adult who was not affiliated with the University. When this had been established, the interview proceeded. The first questions concerned the respondent's experience with the MPM. If he/she had ridden the MPM, questions were asked about the date, nature and quality of the last ride. All respondents were asked about the nature of their mode choices for different trip types. The interview closed with a set of demographic questions.

6.4 CONDUCT OF THE SURVEYS

The three surveys were conducted in late October and early November, 1980. Faculty/staff questionnaires were mailed during the week of October 27. Telephone interviews were held between October 30 and November 21. The user survey was conducted on November 3, 5 and 6. All of the surveys were executed as planned. The surveyors and interviewers were dependable, prompt and thorough. Almost all of the users who were approached, accepted the questionnaires. Over the three day period only a dozen questionnaires were found littering vehicles and stations. Most eligible persons who were contacted by telephone responded by granting interviews.

The overall response was good. Of the 4,300 user questionnaires distributed, 1,350 (31.4 percent) were responsibly completed and returned. Only a handful contained facetious answers. Of the 7,400 faculty/staff questionnaires distributed, 1,800 (24.3 percent) were responsibly completed and returned. Nine hundred telephone interviews were completed. The SYSTAN staff is indebted to all respondents who gave their time so willingly and to the surveyors and interviewers who performed in such a responsible manner.

7. SURVEY RESULTS

The surveys of MPM users, WVU faculty and staff, and non-University affiliates were directed toward identifying information about MPM use and perceptions about the MPM. Data on MPM use were compared with other evidence to expand and improve judgments about MPM utility. The analyses of the different perceptions and the nature of the information that could be extracted varied from subject to subject. Some, like waiting time and travel time, were direct and quantitative and could be subjected to quantitative analyses. Others, like opinions about the aesthetic beauty of the MPM were subjective, but useful when summarized by group. Others, such as the likelihood of increasing MPM use as a result of suggested changes, were speculative and therefore treated with care. Nonetheless, the perceptions sum to group impressions of the MPM and of its utility.

This chapter focuses first on the characteristics of the different respondent groups and the pattern of MPM use of each. Next, each group's trip characteristics are examined and explanations are sought for the extent of MPM use. Finally, the different group perceptions are explored and related to group behavior. The survey results are used throughout this development. The reader who would like to see the results of the surveys in a simple, tabular form is referred to Appendix B.

A key question about the surveys is whether or not the survey respondents are representative of the universes from which they were drawn. This question is addressed in detail in Appendix C. Let it suffice at this point to assert that the samples of faculty and staff and of non-University affiliates are representative of their universes and that one can therefore accept the perceptions and judgments of the samples as representing their groups. The sample of student MPM users is not representative of the WVU student body as a whole. Students are not uniform in their use of the MPM. As a result, the sample contains a larger portion of students who use the MPM regularly than of students who do not. A study of student residences revealed that the student MPM users are those whose trips are best served by the MPM. Students who live near the MPM, particularly those who live in the Towers Dormitory, are over represented; while students who have easy walking access to the Downtown campus and those who live considerable distances north or south of the campus are under represented. This finding is consistent with the analysis presented in Section 5.

7.1 RESPONDENT GROUPS

Three respondent groups were identified for the analysis:

1. Students who use the MPM;
2. WVU faculty and staff; and
3. Non-University affiliates.

The last two groups are represented by the respondents to the faculty/staff and non-University affilate surveys. The first group is a subset of the respondents to the user survey. In all, there were 1,358 responses to the user survey. These can be broken down as follows:

Students	1,168	86.0%
WVU Faculty/Staff	86	6.3
Non-University Affiliates	77	5.7
Not identified	27	2.0
		100.00

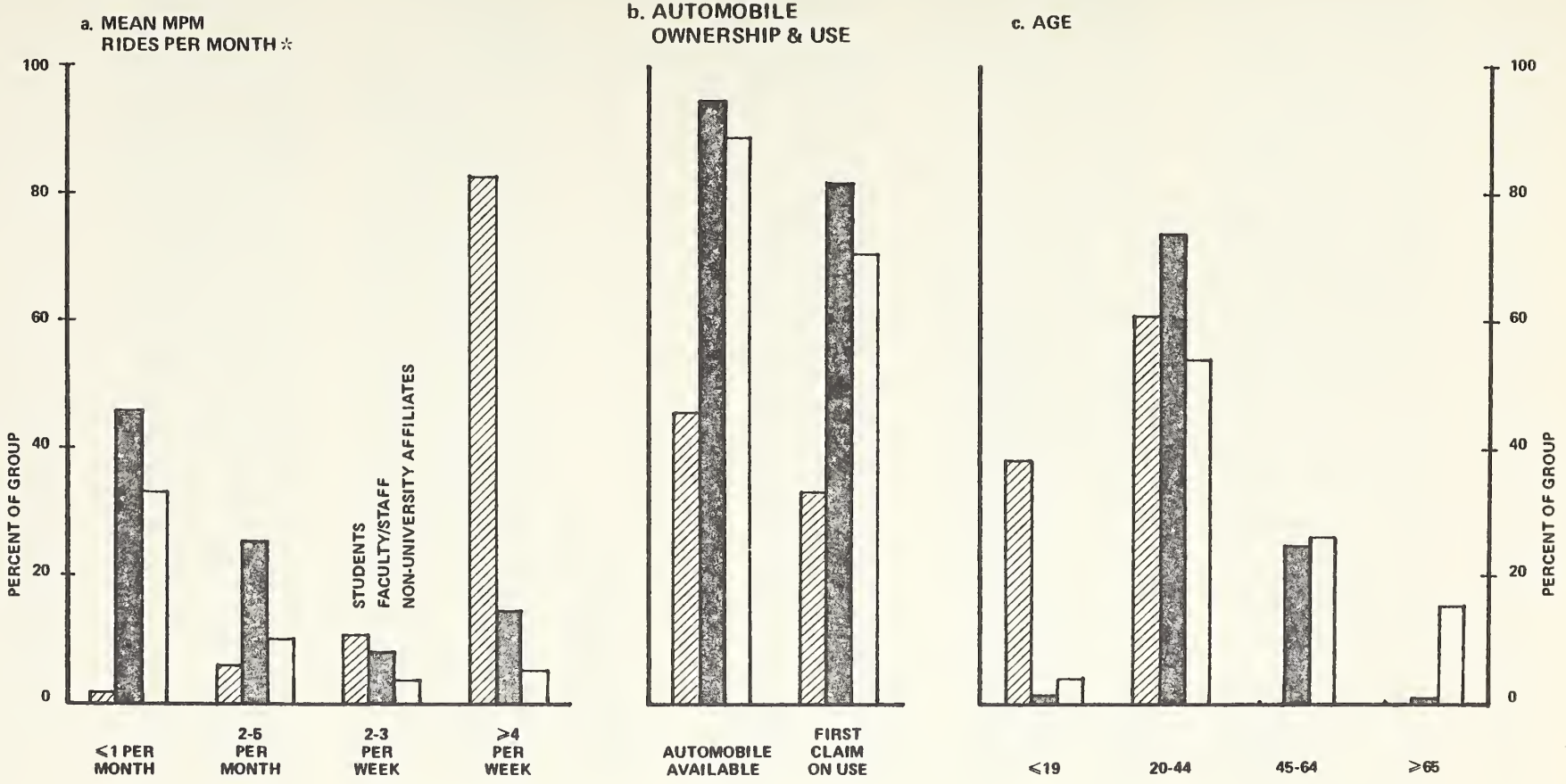
As expected, most respondents were students. Because there were so few responses from faculty/staff and non-University affiliates the responses from these groups were not separately analyzed. User responses by faculty/staff and by non-University affiliates were compared with responses to the surveys directed at each of those groups. The User responses came from persons who use the MPM more frequently than the average for each group; however, the opinions and perceptions expressed by the users were not significantly different from the corresponding strata of the larger surveys. The user analysis, therefore, represents only the perceptions of student users. The perceptions of the other two groups were taken from their separate surveys.

7.2 MPM USE BY RESPONDENT GROUP

The characteristics of the different respondent groups influence their ability and willingness to use the MPM for some or all of their travel in and about the Morgantown area. Exhibit 43 illustrates the differences in MPM ridership among groups. Students use the MPM extensively, with 82.6 percent using it four or more times per week. The average student respondent uses the MPM 24 times per month. Faculty and staff MPM use is substantially less than student use. Some faculty/staff (6.2 percent) have never used the MPM; almost half (45.9 percent) use it less than once per month; only a small fraction (14.8 percent) use the MPM regularly. Average faculty/staff use is only 4.8 rides per month. Non-University affiliates use the MPM much less often than faculty and staff. Almost half of the non-University group (48.9 percent) have never used the MPM. An additional 33.2 percent have used it once per month or less. Only 4.8 percent have used the MPM

Exhibit 43

DIFFERENCES AMONG GROUPS



*These results do not include persons who have never used the MPM:

Students	0 percent
Faculty/Staff	6.2
Non-University Affiliates	48.9

regularly. The average non-University affiliate rides the MPM 1.4 times per month.

Differences in MPM use among groups can be explained by economic, mobility and travel factors. Students are required to pay for MPM passes whether they use them or not. Therefore, to the student there is no marginal cost for each additional MPM ride. Faculty rides are often free, using MPM passes borrowed from University departments or individuals. A few faculty members purchase passes; others pay the $.25 fare. Non-University affiliates pay full fare unless offered a free ride by a student waiting in the originating station.[11]

The majority of students are dependent on transit, or on others for their transportation (Exhibit 43). Fewer than half of the students (45.2 percent) have access to automobiles, vans, motorcycles or mopeds. Only a third (33.6 percent) have first claim on the use of motorized vehicles. In sharp contrast, the faculty/staff and non-University affiliates generally have automobiles available (94.2 and 89.0 percent, respectively) and most have first claim on automobiles (81.2 and 71.0 percent, respectively). Thus part of the students' MPM use is born of necessity.

The age distribution of the groups (Exhibit 43) offers no surprises. With one exception, students fall in the two lowest age groups -- almost all are under 25. As a professional group, the faculty and staff are young -- 74.9 percent are 44 or younger. The non-University affiliates are older than the faculty and staff, with a substantial number (15.6 percent) 65 and older.[12]

7.3 MPM TRIP CHARACTERISTICS

Each survey respondent was asked to describe his/her latest MPM trip, including origin, destination, trip purpose, boarding MPM station, departing MPM station, mode of access to the MPM and other information. Analysis of these data give useful insights into the characteristics of trips that are served by the MPM. It is for these trips that respondents considered the MPM sufficiently attractive to select it over other means of transportation.

The sample trip analysis presented in Section 5 suggests that the MPM has its greatest utility for trips between a northern area of Morgantown that includes the Evansdale campus and adjacent residential areas and a southern area that includes the Morgantown CBD and the Dowtown WVU campus. This conclusion is substantiated by the survey respondents. Exhibit 44 shows the distribution of trip origins by zone

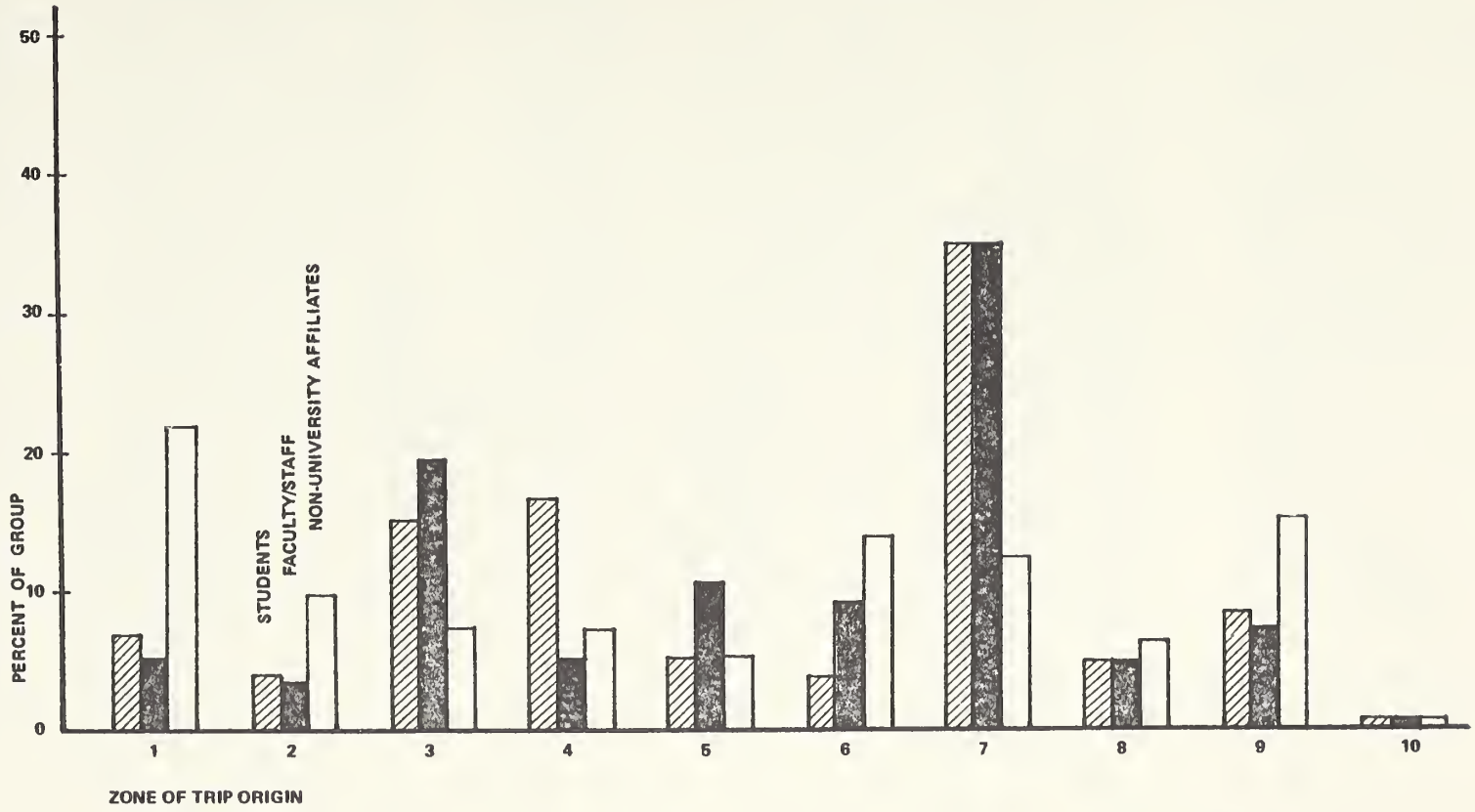
---

[11] This is not an infrequent occurrence.

[12] No interviews were conducted with persons less than 18 years old.

Exhibit 44

DISTRIBUTION OF MPM TRIP ORIGINS AMONG ZONES



for each of the three groups: students, faculty/staff, and non-University affiliates. Most student trips originated in Zone 7, the Evansdale campus. Most of these trips began at the Towers Dormitories. The next largest source of trip origins was Zone 4, particularly the area immediately adjacent to the Downtown campus; next came Zone 3, the Downtown campus. Student trips focused on two destinations (Exhibit 45); 35.7 percent of the trips terminated on the Evansdale campus (predominantly at the Engineering building and adjacent buildings) and 32.6 percent terminated at the Downtown campus. There were also a large number of destinations in Zone 5 which includes the Law School and the Computer Center.

Most faculty and staff trips originated at the two campuses (Evansdale, 34.8 percent and Downtown, 19.6 percent). The highest concentrations of trips on the Evansdale campus occurred at the Medical Center; however, there were a substantial number of originations at Engineering. Faculty and staff MPM trip destinations are concentrated at the two campuses and at the CBD. Faculty and staff take the MPM to the CBD much more frequently than students do. It is noteworthy that the faculty/staff MPM trips were substantially different from their trips to work. Exhibit 46 shows a comparison between the origins of two trip types. The large number of trips to work that began at residences north of Evansdale (Zone 9) and south of the CBD (Zone 6) were not mirrored in MPM trips. This pattern suggests that faculty and staff members use the MPM for work-related trips between classes, for trips to the Medical Center, and for shopping trips to the CBD. Relatively few faculty/staff use the MPM as part of their trips to work.

Non-University affiliates began most of their trips in the CBD, at the Medical Center, or in residential areas north of the Evansdale campus or south of the CBD. Their most popular destinations, by far, were also the CBD and the Medical Center. This suggests that non-University affiliates were either using the MPM for medical trips, for sightseeing, or for joy-riding.

Exhibit 47 lists MPM trip destinations by trip purpose and group. This result reflects the characteristics of the different groups. More than half of the student trips were for school purposes. Faculty and staff trip purposes were consistent with the analysis of MPM trip origins and destinations. The largest number of trips were work-related, but not trips to work. The 20 percent shopping trips corresponded very closely with the 23.8 percent trips destinations in the CBD. School trips may have involved faculty study or they may have been confused with work trips. At least some of the social recreational trips were luncheon trips from the Evansdale campus to the student union. Most trips by non-University affiliates were for medical or social-recreational purposes.

Travel modes used for access to the MPM also provide interesting insights into the nature of the MPM trips. Exhibit 48 shows the distribution of access and egress modes for the student, faculty/staff and non-University affiliate groups. Walking is by far the predominant

Exhibit 45

DISTRIBUTION OF MPM DESTINATIONS AMONG ZONES

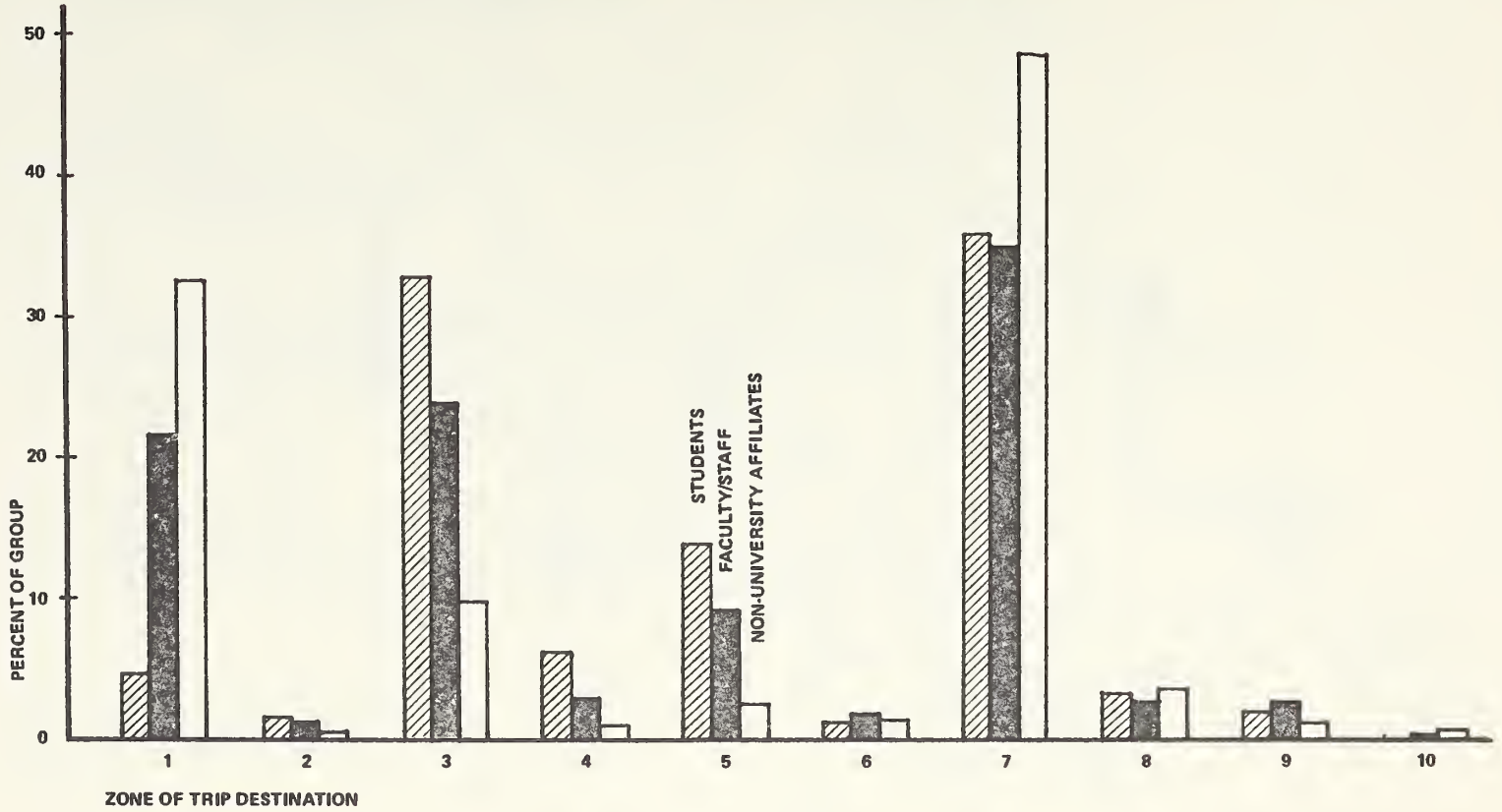


Exhibit 46

COMPARISON BETWEEN FACULTY/STAFF
MPM AND TRIP TO WORK ORIGINS

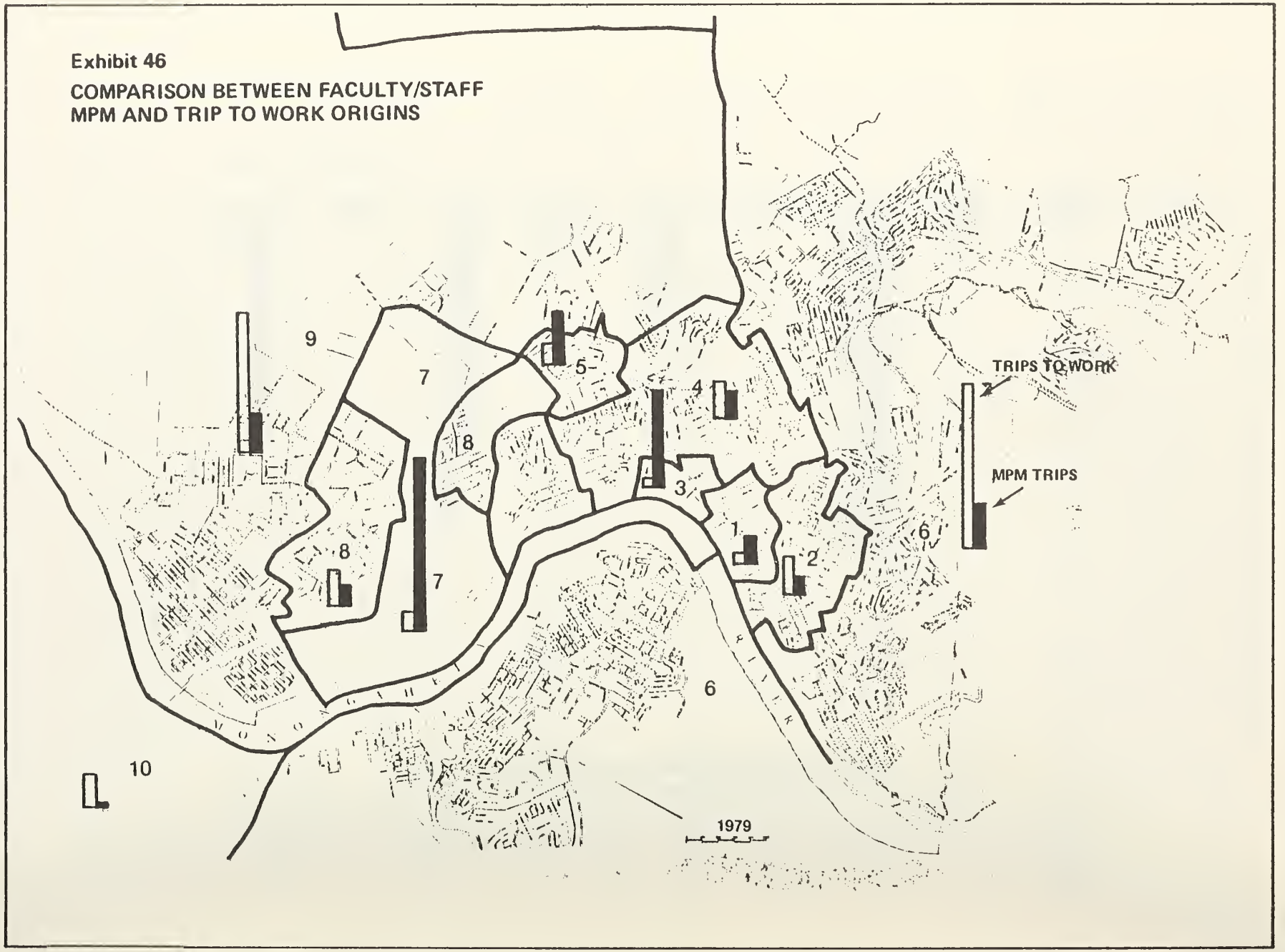


Exhibit 47
MPM TRIP PURPOSES

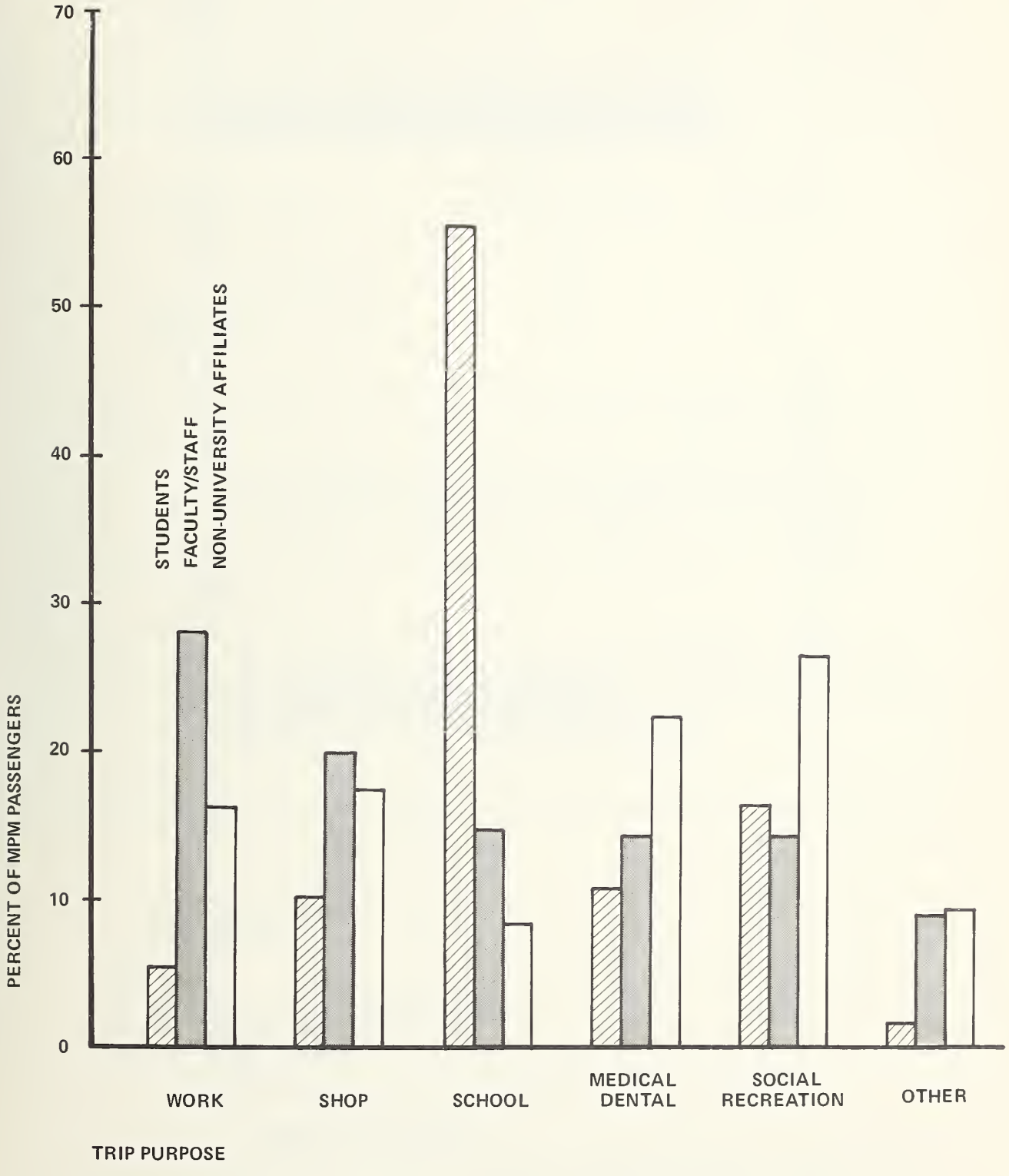
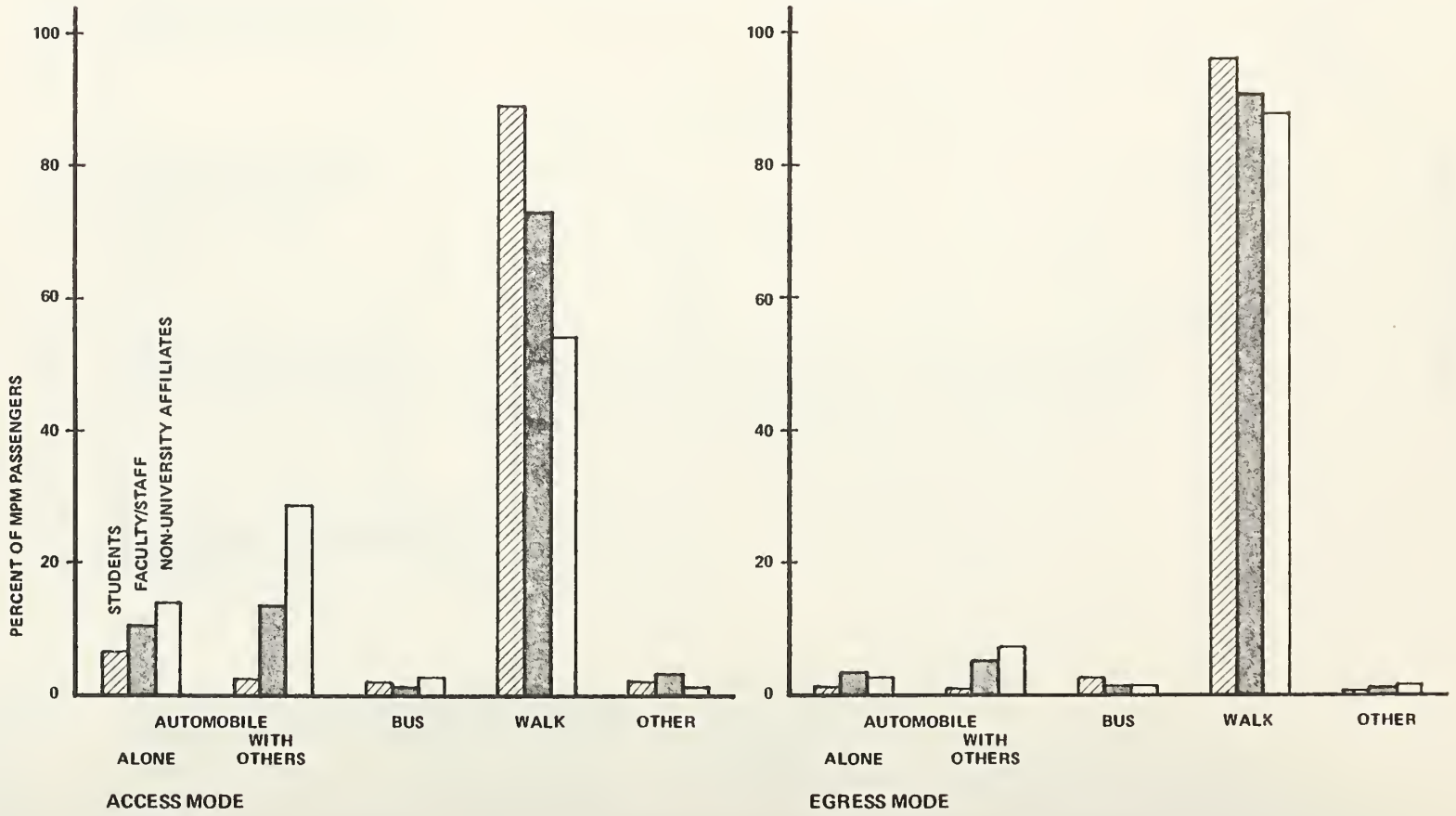


Exhibit 48
ACCESS TO AND EGRESS FROM MPM



mode for both access and egress. It is overwhelmingly for egress.[13]

The intuitive conclusions drawn from the relationships among residence location and access mode were confirmed by statistical analysis of the faculty/staff survey results. Respondents were divided into two categories according to whether or not their residences were located within one-half mile of an MPM station. Respondents who live close to the MPM used it significantly more often than respondents who do not. Using a Chi-square test, the following results are significant at the 0.001 level:

Frequency of use	Faculty/Staff living within 1/2 mile of MPM	Faculty/Staff living further from MPM
4 or more times per week	28%	12%
2 to 3 times per week	9	8
2 to 5 times per month	23	28
less than once per month	40	52

Some faculty/staff members who live close to MPM stations use the MPM for their work trips. In fact, for faculty/staff respondents who did use the MPM for their trips to work, there was a significant correlation between frequency of MPM use and the distance of residence from an MPM station. For faculty/staff who did not use the MPM for their trips to work, there was not a significant correlation between residence location and frequency of MPM use. This strongly suggests that the MPM is selected for trips to work within a narrow service territory around the MPM stations.

Almost one-fourth of the faculty/staff trips used automobiles for access to the MPM. The majority of the automobile access trips were by persons who were riding with others. Some of these may be persons who ride with others to a parking place on one campus and then take the MPM to the other campus.

Some walking access by students may be borne of necessity because many students do not have access to motorized vehicles. Residence locations may also be a factor.

---

[13] The respondent answers may be biased by over emphasis on the inbound leg of the last trip. Many respondents thought of their homes as trip origins regardless of whether the actual trip was inbound or outbound.

7.4 REASONS FOR USING THE MPM

Respondents to all three surveys were asked to cite their reasons for selecting the MPM for their last MPM trip. Several categories of reasons were offered, and respondents were encouraged to add additional reasons of their own. Most respondents (52 percent) expressed more than one reason for selecting the MPM. The majority of these cited two reasons, but sufficient numbers selected three or more reasons that on the average, almost two reasons were cited by members of each group.

	Number of MPM Riders	Number of Reasons for Using MPM	Mean Number of Reasons per Rider
Students	1,168	2,103	1.80
Faculty/Staff	1,716	3,321	1.94
Non-University Affiliates	478	801	1.68
All Riders	3,362	6,225	1.85

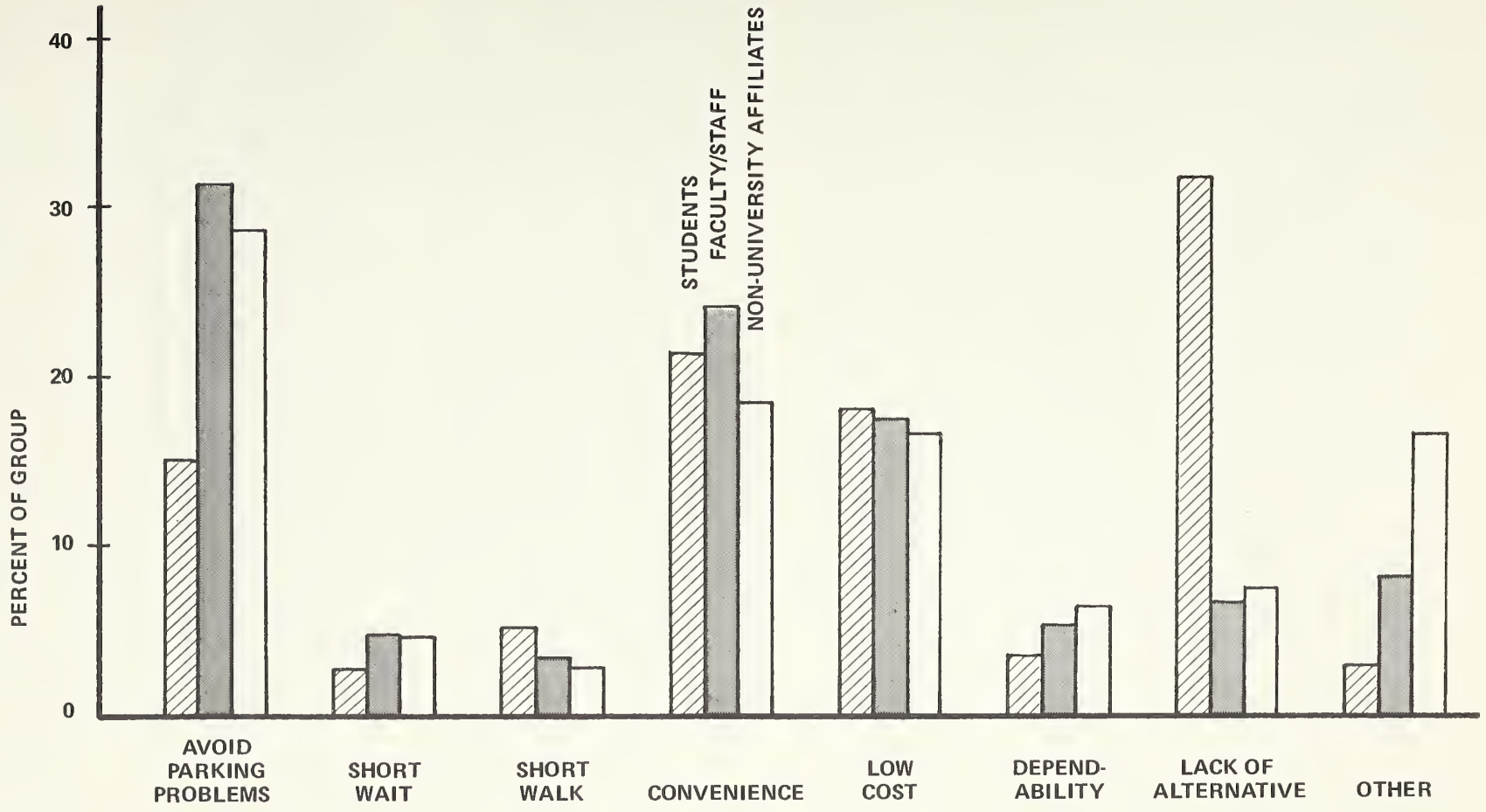
Students who cited a single reason for choosing MPM overwhelmingly (66 percent) cited lack of an automobile. Faculty/staff members citing a single reason sought to avoid parking problems (41.5 percent).

Exhibit 49 illustrates the frequency with which the most popular reasons were selected by members of the three survey groups. There was reasonable consistency among the groups, except for the large number of students who selected the MPM because they did not have alternatives. Only a small fraction of students selected the MPM to avoid parking problems because students without automobiles do not have parking problems. Parking problems were most often cited by faculty/staff and non-University respondents as the principal reason for electing to use the MPM. Convenience ranked second for all groups. It is curious that convenience was cited often, but short walking distance and short waiting time were not. This suggests that either convenience was cited as a surrogate for both walking and waiting, or travelers did not relate walking and waiting times very closely with convenience. Low cost was also cited often. The principal "other" reasons cited by non-University affiliates were: "to try it out," and "showing it to out-of-town guests." Many residents apparently consider the MPM to be an interesting local landmark worth demonstrating to visitors. The responses suggest that travelers from all groups will select the MPM for trips, if the MPM has stations that are reasonably close to the trip origin and destination. Parking problems and low cost encourage MPM use; other factors are not often considered.

To gain further insights, the reasons for selecting the MPM were examined for different subgroups of each of the three major groups: students, faculty/staff, and non-University affiliates. Subgroups were formed by dividing each major group into two subgroups according to age, sex, occupation, availability of a motorized vehicle, first claim on a motorized vehicle and frequency of MPM use. The reasons cited for selecting the MPM were then compared between subgroups of each major group. In some instances, the reasons cited by members of one subgroup were similar to those cited by members of the other subgroup. In other

Exhibit 49

REASONS FOR SELECTING THE MPM



instances, the reasons cited by members of the two subgroups were different enough to be statistically significant. Exhibit 50 lists the mode choice reasons for which significant differences were found between the different subgroups of each major group. For example, when students were divided by sex, male students stated that they selected the MPM to avoid parking problems significantly more often than did female students. The significance of differences in responses was established by means of 2 by 2 chi-square tests. All of the differences listed in Exhibit 50 were significant at a 0.05 level or better.[14]

Many of the differences identified in Exhibit 50 are self-evident. Respondents who have motorized vehicles available are more likely to select the MPM to avoid parking problems than are respondents who do not have motorized vehicles available. Similarly, persons without motorized vehicles select the MPM because they have no alternative much more often than do persons who have motorized vehicles. Nonetheless, Exhibit 50 does provide some interesting insights. Male students claim to select the MPM because of short waits and low cost, while female students more often cite lack of an available alternative. When students are divided by age, the older students are more likely to have motorized vehicles than younger students. As a result, older students select the MPM to avoid parking problems and because of the quality of its service more frequently than do younger students.

When faculty and staff are divided by sex, men more frequently have motorized vehicles available than women do. Men, therefore, select the MPM to avoid parking problems and for its convenience significantly more often than women. Women select the MPM because they have no alternative more frequently than men do. When divided by age, older faculty/staff like the MPM's frequent service and dependability, while younger faculty/staff like its convenience. Frequent MPM riders cite short waiting time, convenience, dependability and low cost more often than do infrequent riders. The technical and professional faculty and staff chose the MPM to avoid parking and because of its convenience. Clerical and maintenance staff liked the MPM's dependability. The technical and professional faculty and staff use the MPM more often than staff members with lesser skills.

When non-University affiliates were divided by age, younger persons more frequently cited both parking problems and lack of options than older persons. Frequent MPM users were attracted by the short waiting times and low cost more often than infrequent users. Employed residents selected the MPM to avoid parking problems more frequently than did unemployed residents. This choice reflects difficult parking problems, particularly at midday. Unemployed persons have more time available to contend with parking, or perhaps they are more patient.

---

[14] At the 0.05 percent, there is a 95 percent chance that there is a real difference between the two subgroups.

Exhibit 50
DIFFERENCES IN REASONS FOR SELECTING THE MPM

	STUDENTS										FACULTY/STAFF												NON-UNIVERSITY AFFILIATES									
	SEX		AGE		Vehicle AVAIL-ABLE		FIRST CLAIM		TRIP FREQ.		SEX		AGE		Vehicle AVAIL-ABLE		FIRST CLAIM		TRIP FREQ.		OCCU-PATION		AGE		Vehicle AVAIL-ABLE		FIRST CLAIM		TRIP FREQ.		EM-PLOYED	
	M	F	Yng	Old	Yes	No	Yes	No	Sel	Oft	M	F	Yng	Old	Yes	No	Yes	No	Sel	Oft	T/P	Oth	Yng	Old	Yes	No	Yes	No	Sel	Oft	Yes	No
AVOID PARKING PROBLEMS	F	I	I	F	F	I	F	I							F	I	F	I	F	I	F	I	F	I	F	I	F	I	F	I	F	I
SHORT WAIT	F	I											I	F			I	F	I	F									I	F		
SHORT WALK			I	F																												
CONVENIENT			F	I	F	I					F	I	F	I			I	F	I	F	F	I										
INEXPENSIVE	F	I	F	I	F	I									I	F	I	F	I	F									I	F		
DEPENDABLE			I	F			I	F					I	F					I	F	I	F										
ONLY MODE AVAILABLE	I	F	F	I	I	F	I	F	F	I	I	F			I	F	I	F					F	I			I	F	I	F		

I = MENTIONED INFREQUENTLY AS A REASON FOR SELECTING THE MPM
F = MENTIONED FREQUENTLY AS A REASON FOR SELECTING THE MPM

7.5 PERCEPTIONS OF MPM USERS

Respondents from the student, faculty/staff, and non-University affiliate groups were asked how they felt about their most recent MPM rides. The questions focused on their estimates of the lengths of different trip segments, their concerns about reaching their destinations on time, their feelings about different aspects of the MPM portions of their trips, the MPM features that they liked best and least and finally about their feelings of insecurity during the MPM portions of the trips.

Travel Time

Travel time is the one perception that can be analyzed in quantitative terms. Respondents were asked to estimate the total elapsed time from origin to destination for their latest trip that included use of the MPM. They were also asked to estimate the portion of that total time that was spent waiting for the MPM and the time spent aboard the MPM. Mean values and standard deviations in minutes for each of these estimates are:

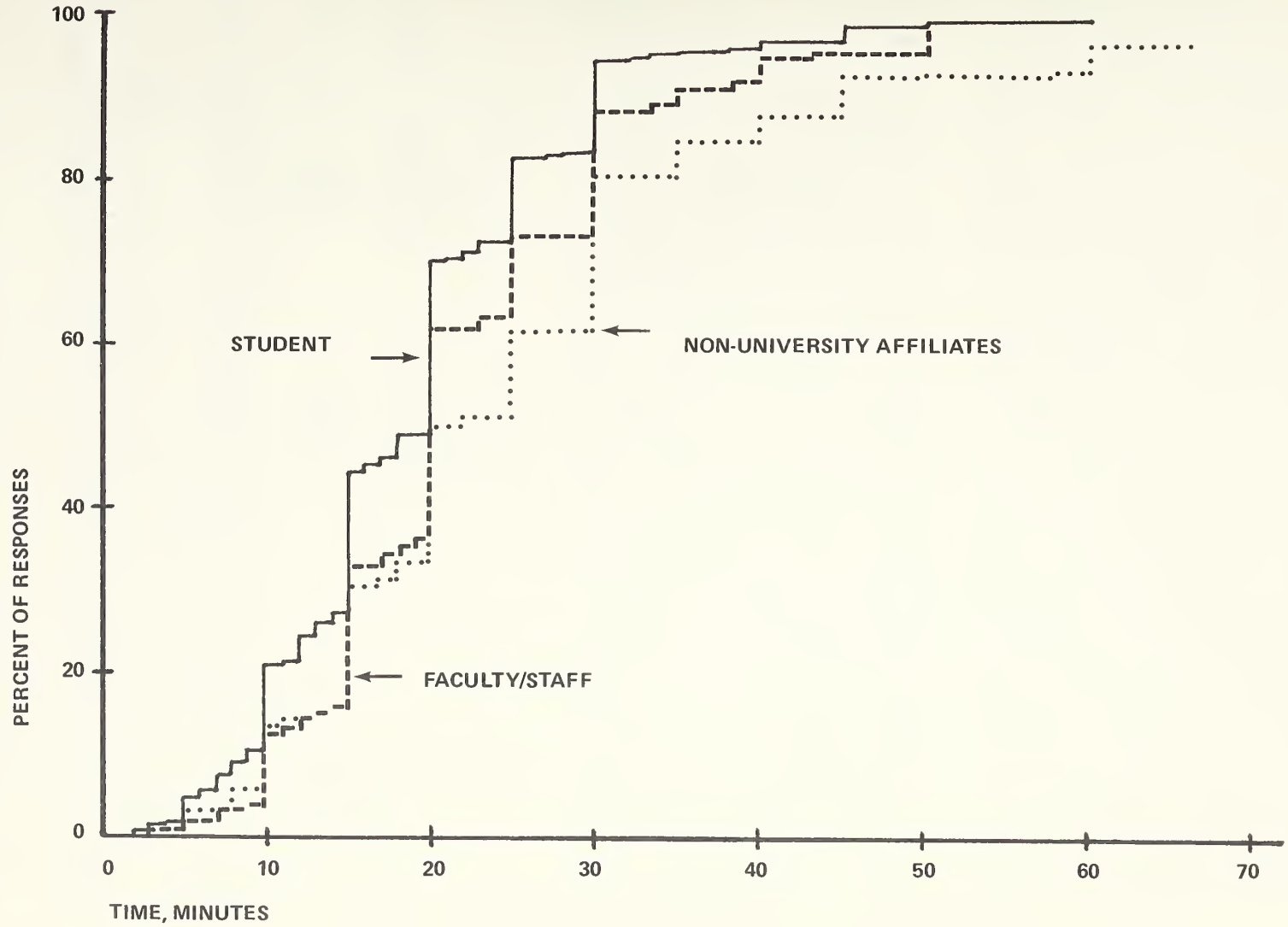
	Survey Group		
	Students	Faculty/Staff	Non-University
Trip time			
Mean	19.0	22.27	25.76
Standard deviation	9.22	11.23	15.86
Time aboard MPM			
Mean	6.80	8.50	10.68
Standard deviation	3.90	5.28	7.15
Wait time for MPM			
Mean	7.66	8.08	6.73
Standard deviation	5.23	5.30	5.83

All of the differences between groups are highly significant. When comparing the perceptions reported by the different groups, it is important to remember the circumstances under which they were made. Students were given surveys while they were waiting on MPM platforms. They were asked to report on the trip in progress. In contrast, faculty/staff and non-University affiliates were asked to report on the last MPM trip that they remember. Most of these trips (61 percent of the reported faculty/staff and 53 percent of the reported non-University affiliate trips) were made within one month of the survey date. Nonetheless, 3.9 percent of the faculty/staff trips and 7.5 percent of the non-University affiliate trips took place six months or more before the surveys were taken. Thus some of the very long trip times may be a result of faulty memories; others may be unfortunate experiences that happened a long time ago.

Trip time estimates varied widely within all three groups from as little as five minutes to one hour and even longer. Exhibit 51 shows frequency distributions of the trip time estimates made by students,

Exhibit 51

PERCEPTIONS OF TOTAL MPM TRIP TIME



faculty/staff and non-University affiliates. Throughout the distribution, students estimated shorter trip times than either of the other two groups. Faculty/staff and non-University affiliate trip time estimates were similar for trips 20 minutes duration and shorter. However, non-University affiliates reported substantially more long trips. It seems likely that, on the average, student trips were shorter than those made by faculty/staff and non-University affiliates. Most student trips took place between University campuses which are well served by the MPM. A substantial number of faculty/staff trips also took place between campuses. Faculty/staff trips to work tended to be long because of residence locations. Non-University affiliate trips that began or ended at residences also tended to be long. Sightseeing trips could begin anywhere. Thus, despite differences in travel dates, the trip time distributions shown in Exhibit 51 seem to reflect the trips that have been reported by the different respondent groups.

The MPM ride consumed only a small percentage of total trip time. Exhibit 52 shows frequency distributions for total trip time, MPM ride time, and MPM wait time for the student respondents. On the average, the MPM ride was 36 percent of the trip time. This fraction is approximately the same for all trip lengths. Differences among groups in perceived MPM ride time can be attributed to the differences in MPM travel patterns. Student travel took place predominantly between Beechurst and Engineering or Towers; Faculty/staff travel took place predominantly between the Medical Center and Walnut or Beechurst; and non-University affiliate travel took place between Walnut and the Medical Center. Thus, one would expect the differences in perceived ride time that were observed. In fact, the standard MPM travel times taken from Exhibit 22[15] for the trips made by each group can be compared with the perceived average MPM ride times as follows:

	Perceived Mean MPM Time (minutes)	Calculated Mean MPM Time (minutes)	Ratio
Students	6.80	5.75	1.18
Faculty/Staff	8.50	6.95	1.22
Non-University	10.68	7.56	1.41

All groups tended to over-estimate MPM ride time. Students were more accurate than either other group, perhaps because the rides that they were reporting were more current.

Additional insight is available by comparing perceived MPM ride times by station pairs. Exhibit 53 lists standard MPM travel times between station pairs and the mean perceived travel times between the

---

[15] These travel times are the times required by MPM vehicles to move between station pairs under normal operating conditions. Travel time commences when vehicle doors close and ends when vehicle doors open.

Exhibit 52

RELATION OF MPM COMPONENTS TO TOTAL TRIP TIME
STUDENTS

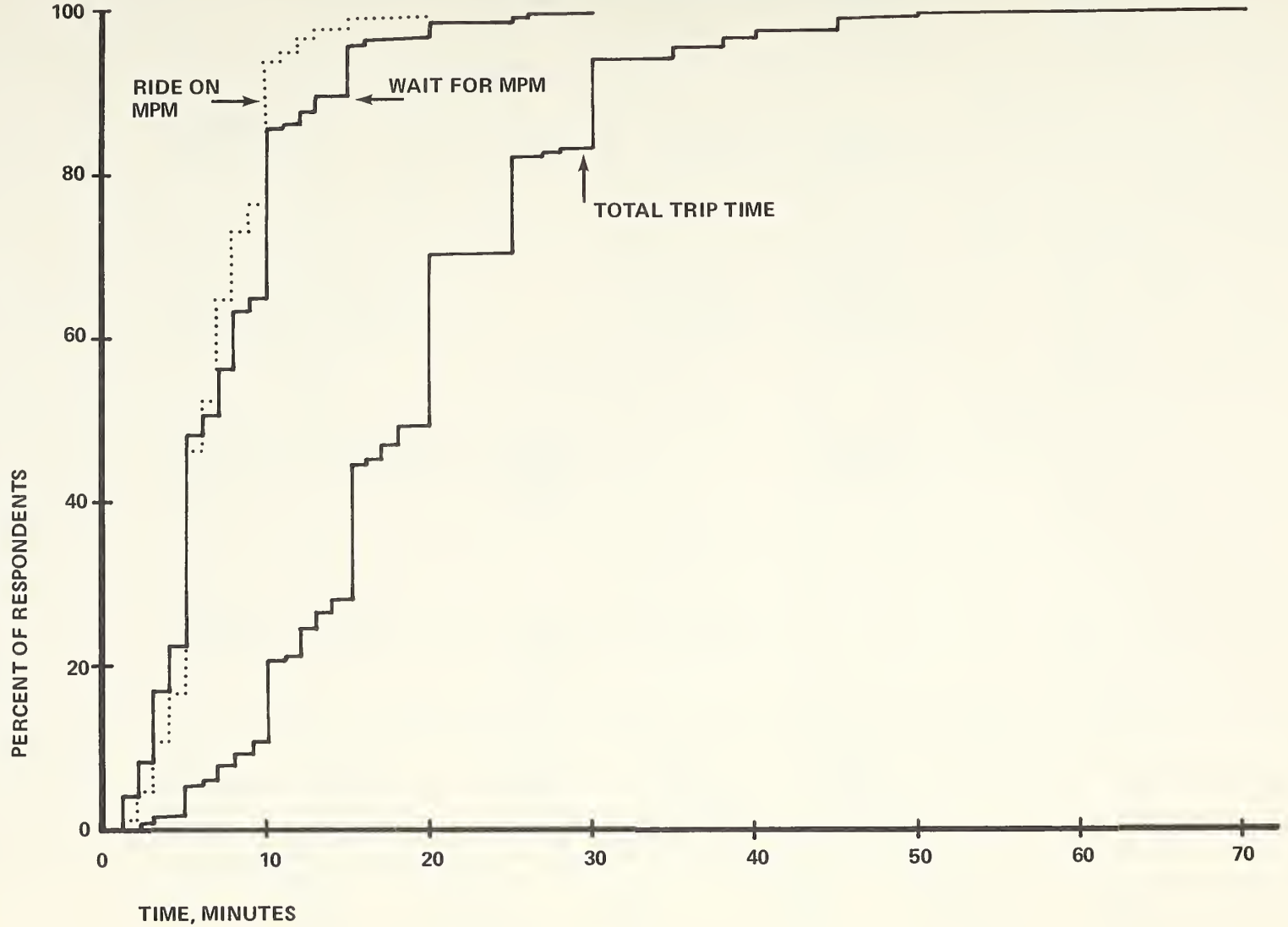


Exhibit 53

PERCEIVED vs. ACTUAL MPM RIDE TIMES

FROM \ TO	WALNUT	BEECHURST	ENGINEERING	TOWERS	MEDICAL CENTER
WALNUT					
Actual		2.17	6.57	7.17	9.07
Perceived					
Students		3.92	8.32	7.88	9.72
Faculty/Staff		4.40	7.26	8.31	10.58
Non-University		7.00	9.76	9.58	11.43
BEECHURST					
Actual	2.23		5.15	5.57	7.58
Perceived					
Students	3.42		6.22	6.88	8.59
Faculty/Staff	3.93		6.29	6.74	9.39
Non-University	5.36		6.31	6.09	9.51
ENGINEERING					
Actual	7.05	5.00		1.18	3.22
Perceived					
Students	6.80	6.51		3.00	4.57
Faculty/Staff	7.26	6.83		2.50	4.05
Non-University	9.27	10.00		--	5.50
TOWERS					
Actual	7.68	5.37	1.15		2.62
Perceived					
Students	7.79	6.40	2.26		4.47
Faculty/Staff	8.46	7.44	2.50		5.93
Non-University	7.78	7.50	2.00		5.00
MEDICAL CENTER					
Actual	9.70	7.78	3.53	2.82	
Perceived					
Students	9.67	9.06	5.10	4.00	
Faculty/Staff	10.30	8.84	5.45	4.43	
Non-University	10.94	8.63	7.00	4.75	

same station pairs that were estimated by each of the three groups. With only two exceptions (both by students), mean perceived MPM travel times were always longer than standard travel times. Student estimates were uniformly closer to standard times than either of the other groups. Faculty/staff estimates were closer than non-University affiliate estimates. Perceived travel times were closer to standard travel times for long trips than for short trips. Exhibit 54 shows the relationship between the ratio of perceived to standard travel time and standard travel time. The linear regression lines are also shown for each group. The linear fits are reasonably good yielding the following regression coefficients:

Students	0.845
Faculty/Students	0.854
Non-University	0.727

This result indicates that while all groups over-estimated the amount of time spent on the MPM, estimates became more accurate as trip length increased. Student estimates were better than estimates made by the other groups because the estimates were made when the trip was still fresh in the students' minds. Some students likely measured travel time while completing their surveys and thus reported actual time rather than perceived time.

Waiting times are typically over-estimated due to inactivity, anxiety and, at some times on a cold autumn day, physical discomfort. Typically, perceived waits are two to three times as long as actual waits. Survey respondents gave conventional opinions. Mean waiting times as measured and perceived were as follows:

	Mean Waiting Time (minutes)	Perceived Wait/ Measured Wait
Measured wait	3.13	--
Perceived wait:		
Students	7.66	2.45
Faculty/Staff	8.08	2.58
Non-University	6.73	2.15

Perceived waits for all groups were more than twice as long as measured waits. Non-University affiliates reported the shortest waits. This result may be due to the elapsed time since the trips were made, the fact that many trips were made in groups where pleasant conversation shortened perceptions, or to absence of trip urgency. Actual waiting times varied among station pairs; perceived times did also. Exhibit 55 lists measured waiting times and perceived waiting times by station pair for each group. Non-University affiliates uniformly perceived shorter waiting times than members of the other two groups. There was remarkable agreement between student and faculty/staff respondents. There seems to be no relationship between the perceived waiting times and the measured waiting times. It is interesting that students perceived long waiting times for those station pairs (Beechurst-Towers and Beechurst-Engineering) between which service was best. The large crowds traveling between these station pairs did not add significantly to the measured waiting times. It may be that the major impact on perceived waiting times was anxiety about reaching class on time.

Exhibit 54

CHANGE IN PERCEPTION WITH INCREASED MPM TRAVEL TIME

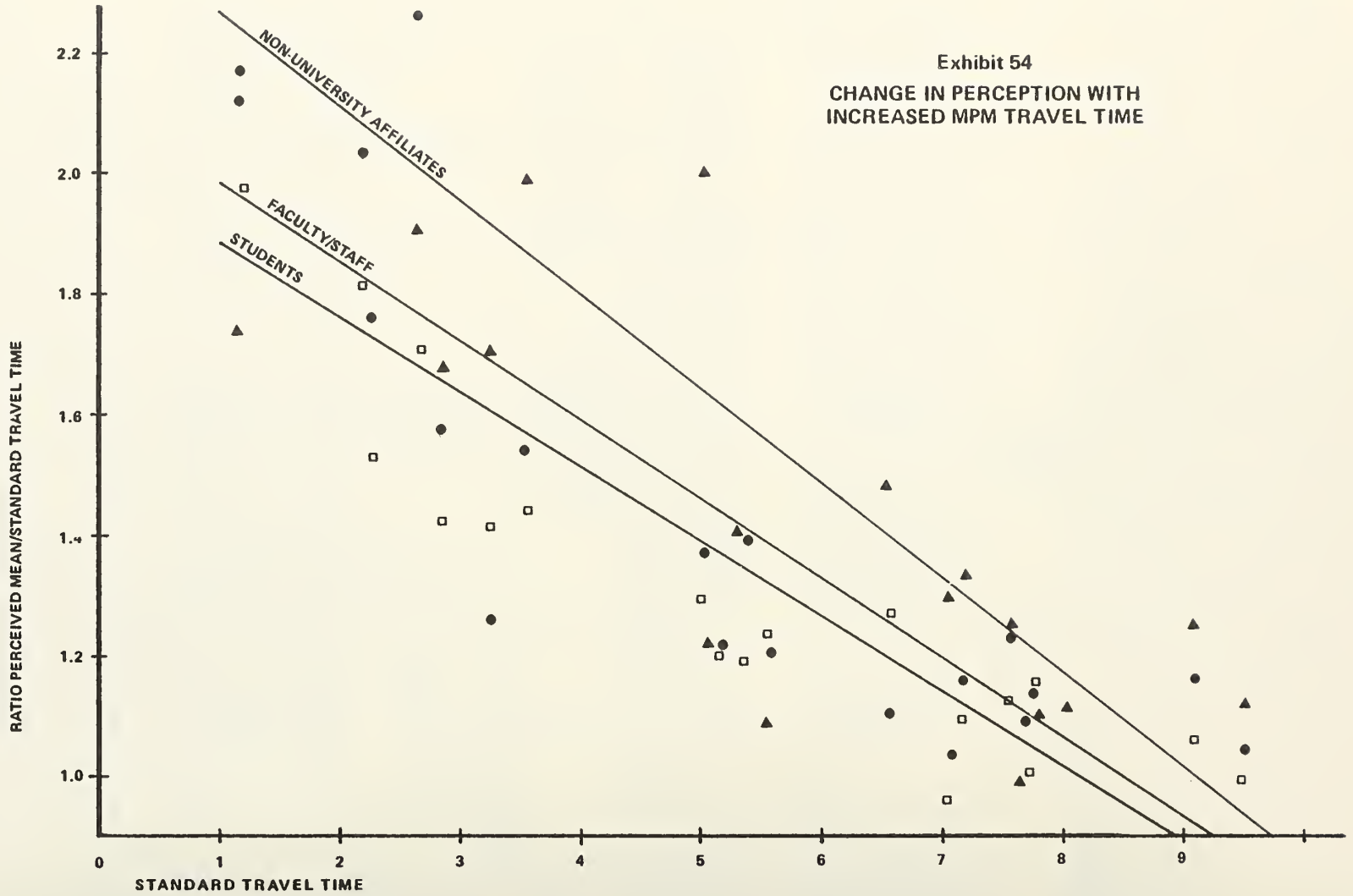


Exhibit 55

MEAN WAITING TIMES BY STATION PAIRS
(Minutes)

FROM \ TO	WALNUT	BEECHURST	ENGINEERING	TOWERS	MEDICAL CENTER
WALNUT					
Measured		2.8	3.2	2.7	2.5
Perceived by:					
Students		7.1	7.9	6.9	6.9
Faculty/Staff		6.9	7.9	7.9	7.4
Non-University		5.2	6.4	7.5	6.8
BEECHURST					
Measured	3.2		2.2	1.5	3.7
Perceived by:					
Students	8.7		7.3	6.9	8.5
Faculty/Staff	6.8		7.3	7.7	8.1
Non-University	5.1		4.4	6.7	6.6
ENGINEERING					
Measured	3.4	2.5		2.2	3.0
Perceived by:					
Students	6.2	6.7		7.6	6.0
Faculty/Staff	7.9	6.8		---	6.5
Non-University	6.4	---		---	---
TOWERS					
Measured	3.7	1.7	2.9		3.2
Perceived by:					
Students	6.9	7.3	7.9		7.4
Faculty/Staff	7.7	7.6	---		6.9
Non-University	6.1	7.4	---		---
MEDICAL CENTER					
Measured	3.4	2.2	3.5	3.7	
Perceived by:					
Students	7.9	7.8	7.3	7.8	
Faculty/Staff	8.0	6.6	7.1	7.7	
Non-University	5.5	5.2	5.0	---	

Perceived waiting times were compared for a number of subgroups: sex, age, frequency of MPM use, the availability of motor vehicles and first claim on the use of those vehicles. Motor vehicle availability and sex had no significant influence on perceived waiting times, but frequency of MPM use and age did. Infrequent riders (once per month or less) had significantly longer perceived waiting times than more frequent riders. Members of older age groups perceived shorter waiting times than members of younger age groups.

Concerns about Arriving on Time

Each survey respondent was asked whether he/she was concerned about reaching his/her destination on time. The responses varied widely by group:

	Concerned About Arriving On Time	
	Yes	No
Students	54.1%	45.9%
Faculty/Staff	40.1%	59.9%
Non-University	24.3%	75.7%

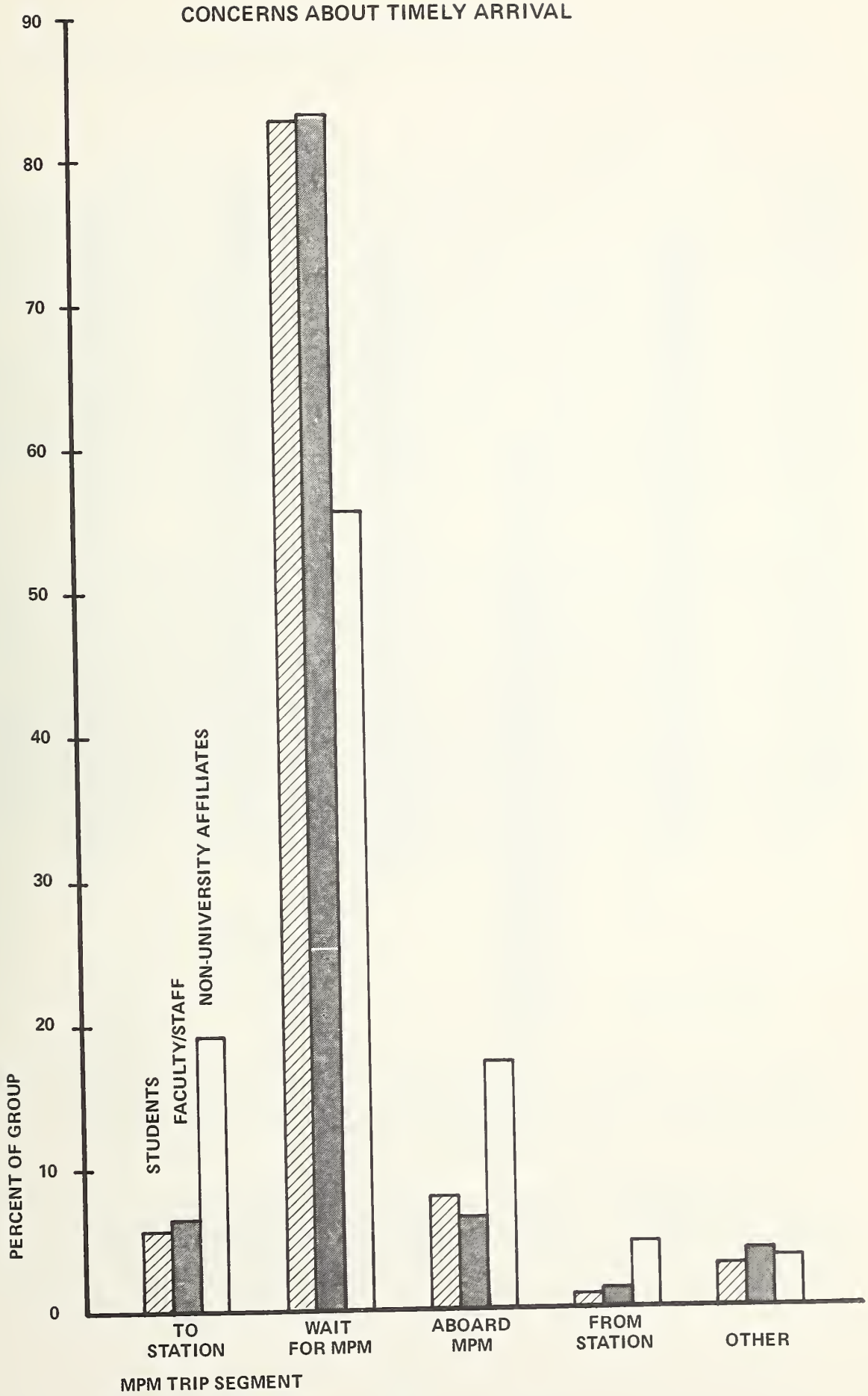
The responses reflect the reasons for using the MPM. Students traveling to class were concerned about arriving on time. They had limited time available and limited alternatives. Therefore, they took their anxieties to the MPM with them. Faculty/staff tended to follow less rigorous schedules than students. There was some anxiety but substantially less than students had. Non-University affiliates tended not to be in a hurry and were, therefore, much less concerned about timely arrival than either other group. Even persons traveling to the Medical Center for treatment had little concern because of the clinical handling of appointments.

Of those who were concerned about timely arrival, the overwhelming majority were concerned while waiting in the MPM station for a vehicle departure. Exhibit 56 shows the distribution of concerns among the different MPM trip segments for the three groups. Responses from students and faculty/staff were very similar, reflecting a more or less uniform familiarity with the system. Non-University affiliates were anxious during the trip to the station because they may have been unfamiliar with the station location or the means of reaching the platform. They were more anxious during the MPM ride because of unfamiliarity with the system and they were more anxious on leaving their destination MPM station because they were often on unfamiliar ground. It is interesting that neither students nor faculty/staff were particularly anxious about the MPM ride. This speaks well for the dependability of the Phase II system.

The concern over waiting time is curious. According to both the operating algorithm and the measurements, waiting times were short. Nonetheless, perceived waiting times are long, and waits are perceived as a major problem. The presence of empty vehicles in the stations with undesignated destinations probably was a source of frustration.

Exhibit 56

CONCERNS ABOUT TIMELY ARRIVAL



Anticipation of vehicle assignment and door opening could have been unpleasant.

Feelings about the MPM

Survey respondents from the student, faculty/staff and non-University affiliate groups were asked to rate their most recent MPM trips in terms of trip time, convenience, walking distance, waiting time, enroute delays, and comfort. The results of these questions are presented in Exhibit 57, where the upper bars represent satisfaction, the lower bars represent dissatisfaction. The two bar lengths do not add up to 100 percent because of respondents who were indifferent. Students were by far the most critical of the riders. All of their ratings were lower than those of the other two groups. This criticism is largely due to the frequency with which they use the MPM and their status as captive riders. Despite some antagonism from students, riders were generally satisfied with MPM service. The one glaring exception is waiting time. Over half of the students were dissatisfied with waiting time. Large fractions of the other two groups also expressed dissatisfaction with waiting time.

The project team was concerned with parcel handling in stations and MPM vehicles. A series of questions identified the number of respondents in each group who were traveling with parcels, whether the parcels created problems, and the nature of the problems. Exhibit 58 illustrates the responses to these questions. Most students carried parcels -- notably school books -- but only a very few had trouble carrying their parcels through the MPM. Fewer respondents from the other groups had parcels and only small fractions of these experienced difficulties. Of the 3,278 persons from all three groups who responded to these questions, only 140 had difficulties because of their parcels. The most common complaints were adequate space and difficulties standing with parcels. This complaint occurred despite the fact that most travelers of all groups had seats on the MPM vehicles:

	Fraction with Seats on MPM
Students	66.8%
Faculty/Staff	86.0
Non-University	81.8

Doubtless the parcel problems occurred on crowded vehicles. The other common complaint was difficulty passing through turnstyles while carrying parcels. The occurrence of problems is so rare that no modifications to the MPM system are indicated.

Each respondent was asked to identify the MPM features that he/she liked best and least. Both questions were open-ended to avoid suggesting answers. The most common responses are tabulated in Exhibit 59 for all three groups. Students expressed appreciation for the short vehicle travel times, convenience, the scenic view from the vehicles,

Exhibit 57

TRAVELER PERCEPTIONS OF MPM SERVICE

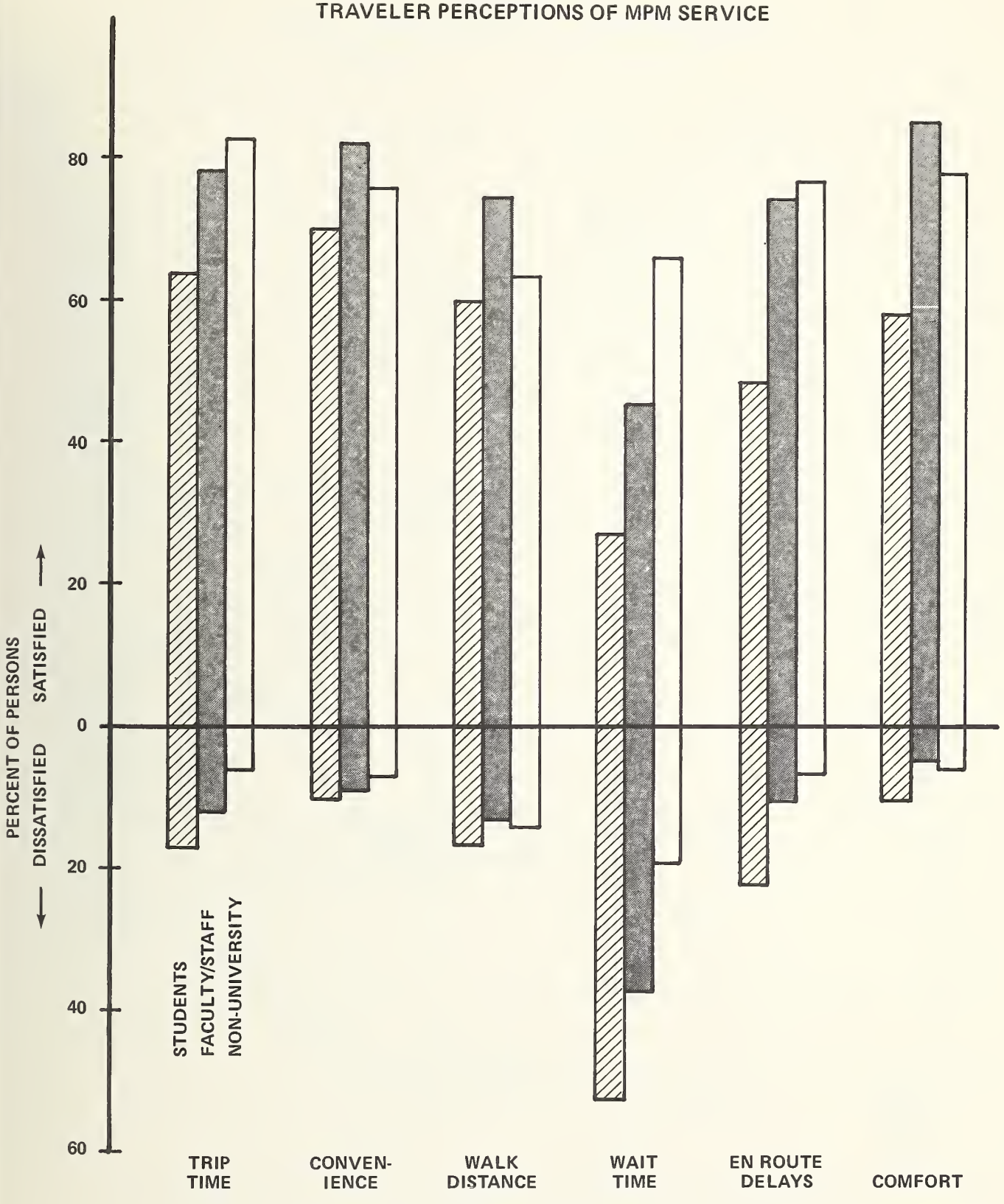


Exhibit 58

PARCELS AND PARCEL PROBLEMS ON THE MPM

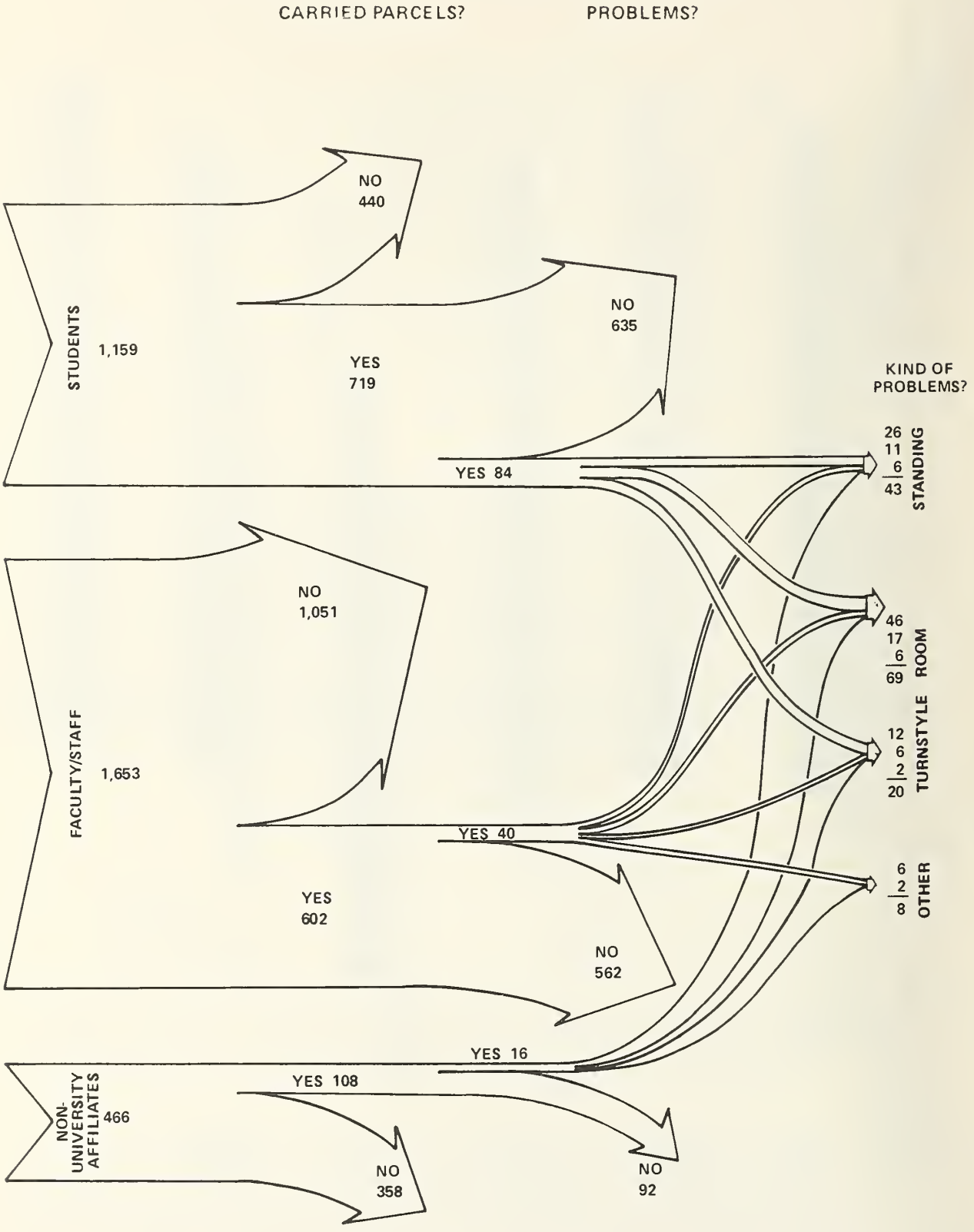


Exhibit 59

FEELINGS ABOUT MPM SERVICE

	STUDENTS	FACULTY STAFF	NON-UNIVERSITY	TOTAL
BEST MPM FEATURE:				
Convenience	111	294	41	446
Speed of Travel	121	175	71	367
Scenery, View	84	135	78	297
Avoid Traffic/Driving	46	193	25	264
Comfort	55	81	19	155
Vehicle Temperature	63	22	18	103
Direct Route	20	71	6	97
Reaching Destination	54	22	9	85
Novelty	11	43	30	84
Low Fare	31	44	6	81
Company of Others	38	10	11	59
Lack of Crowding	25	9	13	47
Quiet Ride	15	20	6	41
TOTAL	674	1,119	333	2,126
WORST MPM FEATURE:				
Waiting	298	367	65	730
Jerky, Bumpy Ride	95	64	27	186
Breakdowns	68	91	11	170
Crowding	48	39	17	104
Long Walks	11	49	16	76
Vehicle Seats	45	17	12	74
Vehicle Smell	14	44	6	64
Exposed Stations	17	34	7	58
Vehicle Temperature	32	15	2	49
General Unreliability	17	27	--	44
Station Stairs	7	21	6	34
Area Served	5	19	6	30
TOTAL	657	787	175	1,619

vehicle climate control, and a number of other features. Avoiding automobile traffic ranked seventh on their list. Student distaste was focused on waiting time which accounted for almost half of the negative comments. They also objected to the jerky ride, system breakdown, crowding, and vehicle seats. Some students objected to vehicular temperature control.

Faculty and staff members offered substantially more favorable comments than unfavorable comments. They liked the MPM's convenience, and the opportunity to avoid traffic congestion and driving. Faculty/staff also appreciated travel speed, the scenic view, ride comfort and the direct route. Faculty/staff ire was also heavily focused on waiting times. Other objections included breakdowns, the jerky ride, long walks to and from stations, the exposed stations and vehicle odors. The last objection is puzzling. In all of its rides, the SYSTAN team did not encounter any smells in vehicles.[16] It is possible that personal odors could become objectionable in crowded vehicles and other circumstances where the vehicular air circulation requires time to purge odors.

Non-University affiliates also offered more good comments than bad. They liked the scenic view from the vehicles, the speedy service, the novelty and the opportunity to avoid traffic congestion. Non-University affiliates also cited waiting time as the MPM's most objectionable feature, followed by the jerky, bumpy ride, the crowding and the long walks to and from MPM stations.

Survey respondents were also asked to comment on the architectural design of the MPM system. The most popular responses are summarized in Exhibit 60. More favorable comments were made than unfavorable ones. Vehicle design was by far the most preferred feature, followed by station design and a vague "general appearance." The largest number of negative comments were directed to the rust on the guideway structural steel.[17] The guideway design also received a large number of negative comments. Some criticized road crossings or supporting columns. Others criticized the chain link fences or merely stated that the guideway is ugly. It is significant that no respondent chastized the guideway for being elevated, and only 10 percent of the respondents made unfavorable comments about the guideway. One can conclude that the guideway location and configuration are acceptable but that some design details could bear improvement. The station design was also criticized. Exposed platforms, excessive numbers of stairs and station locations were most often mentioned. Vehicle designs drew very little criticism, and must be considered one of the MPM system's most positive design features.

---

[16] One instance was observed where someone had apparently urinated in a vehicle. This incident was reported to central control and the vehicle was promptly removed from service and cleaned.

[17] The guideways were built of "corten" steel which is designed to have a permanent protective coating of rust.

Exhibit 60
FEELINGS ABOUT MPM ARCHITECTURE

	STUDENTS	FACULTY STAFF	NON-UNIVERSITY	TOTAL
BEST FEATURES:				
Vehicle Design	290	358	170	818
Station Design	195	141	59	395
General Appearance	85	96	78	259
Guideway	12	21	6	39
Accessibility	8	21	--	29
Automation	10	12	7	29
TOTAL	600	649	320	1,569
WORST FEATURES:				
Rust on Guideway	144	170	64	378
Guideway Design	143	185	58	386
Station Design	106	138	42	286
Vehicle Design	73	25	22	120
TOTAL	466	518	186	1,170

Respondents to the faculty/staff and non-University affiliate surveys were asked to identify MPM system changes that would cause them to use the MPM more frequently. Of the 862 responses, 437 (50.7 percent) suggested adding new routes. It is undoubtedly correct to say that route extensions would increase patronage. Nonetheless, high capital costs preclude such a change. Adding stations, another fiscal impossibility, was second in popularity. The operating changes that were suggested include shorter waits for service, increased reliability and longer operating hours. The latter two have already been accomplished. Some respondents also suggested more public parking near stations -- a subject that is under study.

Security

Security is a major concern for the developers and operators of automated guideway systems. Passengers enter stations that are unattended. Although stations are monitored by closed circuit television, instant response to problems appears impossible. When passengers leave stations, they board vehicles that operate automatically without manual intervention. A number of passenger anxieties can be envisioned that range from vehicle mishaps to personal attacks. The SYSTAN team sought to identify anxieties felt by MPM passengers and the categories of passengers who were most anxious. When preparing the survey instruments, the team was careful to avoid suggesting sources of insecurity to the respondents. Instead, the surveys merely asked, "Did you feel insecure or uneasy riding the MPM or while standing or walking in the stations?" If the respondent answered yes, he/she was asked to explain. These "open-ended" answers were analyzed to gain an assessment of insecurity among MPM passengers.

An overwhelming majority of the respondents who had ridden the MPM felt no insecurity at all:

	Students		Faculty/Staff		Non-University		Total	
Felt Insecure?	No.	Percent	No.	Percent	No.	Percent	No.	Percent
NO	991	86.2%	1423	87.9%	404	88.0%	2818	87.4%
YES	158	13.8	195	12.1	55	12.0	408	12.6

It is interesting that a larger fraction of students felt insecure than of the other groups, since they are the most frequent users and are most familiar with the MPM. This feeling of insecurity is a direct result of the large number of students, especially female students, who use the

MPM at night.

The principal sources of anxiety as identified by each group were:

	Students	Faculty/ Staff	Non-University	Total
Fear of breakdown	39	65	12	116
Danger at night	37	16	7	60
Concern about time	15	22	--	37
Concern about other passengers	8	22	6	36
Crowding at stations	3	6	7	16
MPM too bumpy	5	9	2	16
Unsure of procedure	--	6	5	11
Hard to stand in vehicles	9	--	--	9
Claustrophobic	2	6	--	8
Open station gates	--	3	3	6
MPM too fast	--	--	2	2
Annoying children	--	--	2	2
TOTAL	118	155	46	319

Faculty/staff were proportionally more concerned about breakdowns than either other group. As a group, faculty/staff had more experience with the Phase I MPM for which breakdowns were more common. Memories of these occasions could linger in many minds. Students were most concerned about nightime dangers for the reasons cited above. Anxiety about time is listed with the other sources of insecurity because it is often hard to differentiate among emotions. Time anxiety affected both students and faculty/staff. Concern about other passengers caused problems for faculty/staff and non-University affiliates more often than for students. This lack of concern among students suggests that nightime concerns may not have been associated with potential attacks from other passengers,[18] but from unknown sources.

Prevalence of insecurity was investigated for subgroups of each of the three major survey groups. Significant differences were attributed to sex, age, and frequency of MPM use. Differences in feelings of insecurity between subgroups were tested using the Student's t-test.

The initial hypotheses concerned the influence of sex on insecurity. As expected, female respondents were significantly more insecure than males ($t = 4.73$, $p < 0.01$). Sources of female insecurity were concentrated in concerns about other passengers and danger at night. No significant differences were found among female students,

---

[18] Vagrants who congregated at the Courthouse across from the Walnut station caused SYSTAN some concern for female surveyors. A "character" who frequented the Walnut station was also viewed as a potential problem.

faculty/staff or non-University affiliates; nor were significant differences found among male students, faculty/staff or non-University affiliates.

The investigation of insecurity related to age was complicated by the different age distributions for the three major groups. No significant difference in insecurity was identified for the two student age groups (less than or equal to 19 and 20 to 44) or for the middle age categories of non-University affiliates (20 to 44 and 45 to 64); however, younger faculty staff (20 to 44) were significantly more insecure than older faculty/staff (45 to 64). Further investigation revealed a larger fraction of women in the younger group than the older group. Thus the age difference was simply a manifestation of the sex difference.

Frequency of MPM use did not have a significant impact on the insecurity felt by any of the major groups. However, there were changes in sources of insecurity with frequency of use. Increased familiarity with the MPM bred concern over breakdowns and about arrival time:

Frequency of MPM Use	Percent of Respondents Citing Breakdown and Time Insecurity
4 or more trips/week	41%
Fewer than 4 trips/week	6%

A similar result was found for insecure faculty/staff respondents. Increased familiarity with the MPM also caused increased concern about other passengers and waiting at night. Increased anxiety in these areas was balanced by reduced anxiety about crowds, stations and bumpy rides.

7.6 SUMMARY

The most emphatic result of the survey was to emphasize that all MPM users dislike the uncertain waiting times for service. These times are perceived to be much longer than they really are. Nonetheless, anxiety about arriving on time and many feelings of insecurity are focused on these waiting periods. Long waiting times are the overwhelming leader among adverse MPM features. It appears worthwhile to give serious attention to means for shortening the real or perceived waiting times.

There is good acceptance of the service and architectural features of the MPM. The design and operation of the small vehicles are especially appreciated. There is residual concern over system failures, but the principal criticism concerns the jerky ride. Most architectural criticisms focus on design features that were selected to minimize cost. There seems to be little if any objection to the concept of elevated guideway.

MPM users accept the automated guideway transit concept with very few exceptions. Principal feelings of insecurity concern breakdowns, nightime trips and other passengers. The latter two are largely derived from unattended stations and vehicles. As expected, women are more concerned about safety than men.

8. COMMUNITY IMPACTS

A project with the size, complexity, visibility and notoriety of the MPM could not be constructed and operated in a city the size of Morgantown without having an impact on many individuals and groups within the community. Some persons became fully engaged in developing the MPM as early as 1969. During peak Phase I construction, about 500 persons in Morgantown were engaged in the project. The Phase II system which now operates with a staff of 72, has daily impacts on large numbers of students, faculty and staff members, and Morgantown residents.

The purpose of this chapter is to assess the impact that the MPM has had and is having on persons and life in Morgantown. Some impacts can be measured quantitatively; others subjectively and still others only emotionally. Nonetheless all of these impacts are part of community life in Morgantown. Exhibit 61 lists the impact areas that have been explored. Some impacts were combined; others were omitted for lack of tangible evidence. For example, there was no reasonable way to directly assess the MPM's impact on noise or pollutants. The MPM is quiet, and non-polluting. Therefore, its impact on noise and pollution depends on the amount of automotive traffic that it has been able to divert from city streets. Accordingly, traffic was used as a surrogate for noise and pollution, without any attempt to convert traffic levels to noise or pollutants.

8.1 SOURCES OF DATA

Three principal sources of data were used:

1. The research of the WVU Engineering Department into traffic on the major streets in the MPM corridor [7];

2. The community acceptance study conducted by Professor Roger B. Trent of WVU's Department of Sociology and Anthropology [8]; and

3. A series of interviews conducted by the SYSTAN team.

Where possible, two or more sources were used to corroborate a finding. More often, only a single source was available.

Exhibit 61
MPM IMPACT AREAS

Construction

- Labor Force
- Disruption

Displacement

- Business
- Residence

Traffic

Public Transportation

Retail Business

- Changes in Shopping Patterns
- New Business

Aesthetic

Civic Pride

Institutional

8.2 CONSTRUCTION IMPACTS

Two types of construction impacts were examined:

1. The impact of the project budget and work force on the Morgantown economy; and

2. Disruption to normal activities caused by construction work.

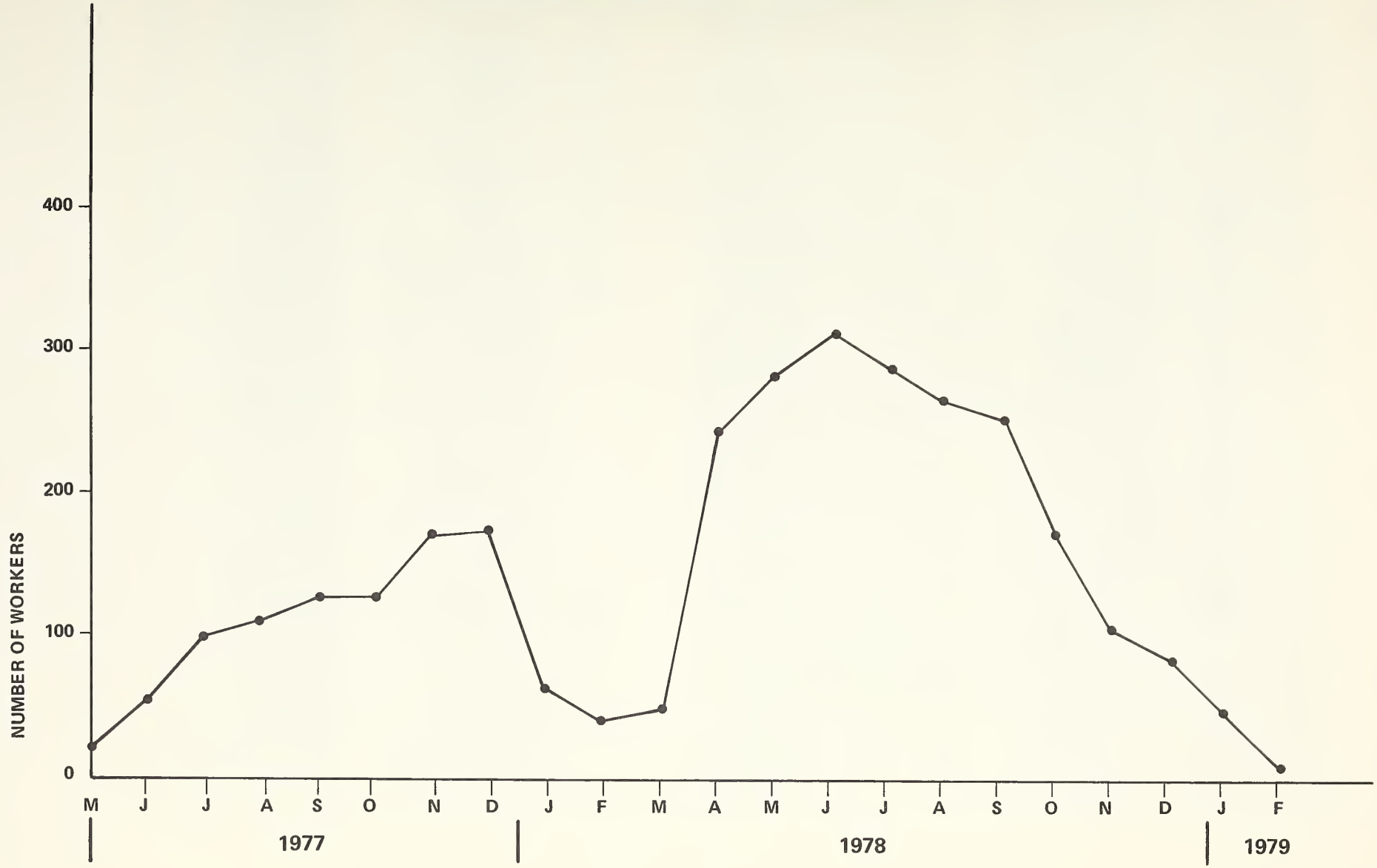
The construction impacts were influenced by the nature of the Morgantown economy. With approximately 40 percent of Morgantown's labor force employed by the University, employment in Morgantown is very stable. There are only a few workers that are available to support large construction projects. Most of these have been employed by contractors engaged in building new homes north and east of the city. Large Morgantown construction projects tend to draw their labor force from out-of-town -- generally from southwestern Pennsylvania, sometimes reaching as far as Pittsburgh. These workers typically commute to their jobs in preference to moving to Morgantown.

The size and cost of the MPM project were such that its construction could very well have had an impact on the Morgantown economy. In 1980 dollars, it has been estimated that the total capital cost of the MPM was $141 million [9]. About sixty percent of this amount was spent on the Phase I system with the balance on Phase II. This is a substantial capital investment for a community the size of Morgantown where the gross annual product is on the order of $300 million. The size of the undertaking is particularly impressive when one recognizes that the Phase I heavy construction was completed in approximately one year (October 1971 to October 1972) and the Phase II heavy construction was completed in about 18 months (June 1977 to December 1978). Thus, if executed entirely in Morgantown, the MPM would have had an enormous impact on the economy, increasing the gross local product by ten to thirty percent. However, most of the MPM investment was spent elsewhere for equipment, material, supplies, engineering and labor. Expenditures in Morgantown were limited to about $15 million spent for construction of the guideway and stations and installation of the equipment. Spread over the construction period, this investment represents an annual expenditure rate of $4 to $8 million or one to three percent of the community's gross product. While important, the project did not have a significant impact.

Further insights are gained by examining the size of the construction labor force. Exhibit 62 is a graph of the on-site labor force over the Phase II construction period. Maximum employment amounted to 313 persons during June 1978. There were six months during which employment exceeded 200. Average employment over the 18 months of peak activity was 165. The total employment represented in Exhibit 62 is equivalent to about $6 million in wages or an annual wage expenditure of $4 million. Wages of this magnitude could have an impact on the Morgantown economy if they were largely spent in Morgantown. Unfortunately, a large fraction of the construction workers were brought

Exhibit 62

PHASE II WORK FORCE IN MORGANTOWN



Source: Frederick R. Harris Co.

from outside the Morgantown area -- mostly from nearby Pennsylvania. As a result, the impact of the construction payroll was greatly reduced -- to a level of $1 to $2 million per year. This impact is no more than that of other Morgantown area projects, like the new football stadium, the Law School, and the Morgantown Energy Technology Center.

Disruption of community life during MPM construction was not great. Four of the five stations were located on University property. The fifth, Walnut, was built over the County Bus Terminal, which consisted of a bus parking area with only a small structure. The guideway traversed University property for the most part. There were five critical street crossings:

1. University Avenue near the Walnut station;

2. Beechurst (twice) near the Beechurst station;

3. Monongahelia Boulevard near the Engineering station; and

4. University Avenue between the Towers and Medical Center stations.

These crossings were handled with minimal disruption to street traffic. Curb lanes were sometimes closed to build columns and to facilitate material handling. Traffic slowed down while motorists inspected construction progress. Nonetheless, traffic proceeded more or less as usual without creating major bottlenecks.

8.3 DISPLACEMENT

The MPM did not cause serious displacement of residences or businesses. No residences were displaced by stations or guideways. The only residence that was impacted by the MPM is a house on the west side of Beechurst near the Beechurst station. The MPM guideway passes near this house but does not encroach on its property. The University would like to acquire the property for other purposes.

One commercial property, a scrap dealer, was taken to provide a site for the MPM maintenance facility. Columns and guideway were placed near other properties, but care was taken to avoid blocking entrances or influencing customer or employee access. Representatives of several firms were interviewed. None expressed an objection to the construction or operation of the MPM near their businesses.

8.4 TRAFFIC

The traffic analysis presented in Chapter III concluded that the MPM has not had a significant impact on automotive traffic along Beechurst and University Avenues. There may have been some diversion of traffic from automobiles to the MPM, but this hypothesis cannot be supported from available evidence. During the construction and operation of Phase I and Phase II of the MPM, automobile traffic has grown. On Beechurst northbound traffic has increased substantially while southbound traffic has grown little. The situation on University is the opposite. Most or all of the increased traffic can be attributed to residential growth beyond the Evansdale campus and to the development of the Morgantown Energy Technology Center.

Local interviews are more favorable to the MPM than traffic counts. Morgantown officials believe that the MPM has diverted an appreciable amount of traffic from University Avenue. Some University Avenue business persons blame the MPM for lost business; others credit the MPM with improving access for their customers. Removal of the University buses from University Avenue is cited as a definite improvement. Despite their small number, the buses were perceived as disrupting traffic -- particularly at traffic signals where low bus accelerations limited the number of automobiles that could pass through on a green phase. On balance, the MPM should be credited with a small contribution toward reduced traffic congestion on University Avenue.

8.5 PASSENGER TRANSPORTATION

The impact that the MPM has had on personal travel can be described in terms of:

1. Changes in mode choice by different travel groups for different trip types; and

2. Changes in transportation patterns and habits by different groups for different trips.

These changes are difficult to measure because of the dominance of automobile travel. Daily and weekly changes in automobile traffic more than mask any direct measurements that could identify MPM impacts. Therefore, one needs to take an indirect approach to measuring MPM impacts.

First, it is useful to consider the modal distribution of typical weekday travel in Morgantown.

	Daily Trips	Percent of All Daily Trips
Automobile (drivers & passengers)	53,620	81.6%
City Bus	1,150	1.8
County Bus	580	0.9
Taxi	350	0.5
MPM	10,000	15.2
TOTAL	65,700	100.0

The analysis presented in Section 3 indicated that the patronage of both City and County bus systems is stable or growing and that little, if any, MPM impact has been noted on routes that roughly parallel the MPM guideway. This insensitivity has been attributed to:

1. Differences in route detail including directional differences that render the services non-competitive in important respects;

2. The large number of enroute stops made by City and County buses; and

3. The good service provided by the buses within their service frequency limitations.

The sample trip analysis of Section 5 confirms that City and County buses do provide MPM competitive service for a number of trips.

In contrast, taxi patronage has been declining, particularly for trips to the Medical Center and to the Mountaineer Mall. The supposition is that the MPM has attracted Medical Center trips away from taxis, and City buses have attracted Mall trips from taxis.

The distribution of travel modes reveals that the MPM is by far the largest non-automotive mode. Nonetheless, it would be wrong to claim a transportation impact for the MPM that is as large as its mode share. Most, if not all, of the students carried by the MPM were carried by University buses in pre-MPM days, however, the route structure and convenience of the MPM have doubtlessly induced student trips that were not made when bus service was available. Many faculty also rode on the University buses. There are, however, persons who ride the MPM but did not ride the University buses. These include non-University affiliates and some faculty/staff members.

Unfortunately, accurate estimates of the number of student trips before and after implementation of the MPM are not available because regular counts were not kept of the number of persons who used the University buses. Such bus counts as are available suggest that there may be between ten and twenty percent more MPM trips than there were bus trips. These additional MPM trips include the following categories:

1. Trips by students who park in the public garage in the Morgantown CBD and then take the MPM to the campus;

2. Shopping trips downtown from the Evansdale campus;

3. Trips to evening functions at the Student Union and Cultural Arts Center;

4. Trips to athletic events; and

5. Spontaneous trips that are only feasible because of the MPM.

These trips could amount to between 800 and 1,600 trips per day. Some of these trips were diverted from other transportation modes.

MPM rides by non-University affiliates can be divided into two categories -- those which serve work or personal business purposes, and those which are recreational.[19] The distribution of non-University affiliate trips suggests that roughly two thirds of the trips are for some business purpose and one third are recreational:

Trip Purpose	Percentage Daily Trips	
Medical	22.1%	
Shopping	17.5	64.2%
Work-related	16.2	
School-related	8.4	
Social/recreational	26.5	35.8%
Other	9.3	

The non-University affiliate attitude survey revealed that this group accounts for 5.7 percent of all MPM trips -- equivalent to about 550 trips per day. Of these 353 are for medical, shopping, work or school purposes and 197 are for social/recreational and other purposes. One can argue that many, if not all of the 353 trips were diverted to the MPM from other travel modes. The 197 represent trips that are made only because the MPM exists and are therefore new trips.

Some faculty/staff trips have likely been diverted from other modes. In addition, at least three new trip types can be attributed to the MPM:

1. Trips from the Evansdale campus to the Downtown campus for meals and other purposes;

2. Trips from the Evansdale campus to the Morgantown CBD for shopping; and

---

[19] These include trips to, "see what the MPM is like," and trips to show the MPM to out-of-town visitors and guests.

3. Trips between the Downtown campus and the Medical Center.

Easy access between the Evansdale campus and the Student Union has stimulated faculty interests that did not exist when the journey between the two points was a chore. Downtown merchants report that more faculty and staff (particularly from the Medical Center) come downtown than did prior to the MPM.

The impact of the MPM on faculty/staff travel cannot be estimated with precision, but rough guidelines are available. Based on the surveys, faculty and staff members make about 600 MPM rides per typical weekday. These are distributed by purpose approximately as follows:

Trip Purpose	Percent of Trips	Estimated Daily Trips
Work related	28.0%	168
Shopping	19.8	119
School	14.7	88
Medical	14.3	86
Social/recreational	14.2	85
Other	9.0	54
	100.0	600

Most work-related, school and medical trips were likely to be made regardless of the transportation modes that were available. Therefore, most of these trips were diverted from other modes to the MPM. Few, if any, were induced by the MPM. Of these trips which aggregate 342 trips per day, as many as 80 percent may have been diverted from other modes. New shopping and social/recreational trips may have been stimulated by the MPM. Perhaps as many as half of these 204 daily trips are new.

The MPM's aggregate impact on personal transportation is approximately the following:

	Daily Trips Diverted From Other Modes	Daily Trips Induced by MPM	Total Daily Trips
Students	400	800	1,200
Non-University	350	200	550
Faculty/Staff	380	170	550
TOTAL	1,130	1,170	2,300

New trips induced by the MPM amount to about 13 percent of the MPM traffic, while diversions, except from the University buses, comprise about 12 percent of the MPM traffic. From the viewpoint of total travel in Morgantown, the impact of the MPM has been limited. There has been a two percent growth in trip making attributable to the MPM, and a 1.6 percent diversion of traffic to the MPM. While neither of these numbers

is overwhelming, it is very difficult for any public transportation service to have a significant impact on automobile travel. The analysis presented in Section 5 indicates that the MPM is approaching its attainable market share. Additional patronage would require costly route extensions.

8.6 RETAIL BUSINESS

The business impacts of the MPM are limited to retail businesses. Neither the construction of the MPM nor its continued operation has a measurable impact on commercial or industrial activity in the Morgantown area. There has been no perceptable business relocation that can be attributed to the MPM. This is due in part to property control by the University and to the limited industry and commerce in the city.

Retail business impacts are of two types:

1. Changes in buying practices; and

2. New business.

Retail businesses accessible from the MPM include those in the Morgantown CBD and the businesses on University Avenue and Patteson Drive that are reasonably close to the Towers Station. Retail buying in these areas has been influenced by changes in mobility for access, visual exposure and changes in traffic congestion. The impacts of the MPM have been both positive and negative.

There is no evidence that the MPM has had an impact on commercial business in the Morgantown CBD. The problem is considerably more complex than assessing differences between pre- and post-MPM. The retail businesses in the CBD are in a turmoil and have been for several years. In 1979 the only department store in the CBD was closed. This closure has been blamed on bad management rather than poor sales, but the true facts are not known. No new department store has been located in the CBD as yet. The Morgantown Mall, 3.2 km (2 miles) from the CBD has attracted some retail customers. It is argued that the high quality stores that remained in the CBD are not competing with the Penney's and Montgomery Ward stores in the Mall. Nonetheless, downtown merchants are plagued with indecision and inconsistency as well as traffic and parking problems. Indecision concerns operating hours, decor, exchange policy and other factors. Most downtown businesses close at 5:00 or 5:30 p.m. The merchants have not been able to agree on either days or hours for late opening. Policies on window displays vary. Many stores pay scant attention to window displays with the result that store fronts are not attractive. At one time, there was a move to close a portion of High Street and make it into a Mall. This effort failed for lack of agreement and unwillingness to invest. Although some downtown merchants continue to prosper, there are vacant stores along High Street and particularly on the side streets.

CBD traffic is a problem during a considerable part of the day because several traffic arteries pass through the CBD via University Avenue, Willey, Walnut and Pleasant Streets. Re-routing this traffic around High Street was examined as part of the High Street Mall proposal but no good solution was uncovered. Traffic bypasses would be difficult to implement without major redevelopment to support street widening.

Despite conflicting opinions,[20] parking remains a problem. Several spot checks during the middle of weekdays revealed that most, if not all, parking spaces were occupied. The MPM both accentuates the parking problem and relieves it. By occupying half of the 421 spaces in the municipal garage, student vehicles deny CBD access to many shoppers. Conversely, shoppers can park free at the Coliseum, CAC or Natatorium lots on the Evansdale campus and ride the MPM to the CBD at a total cost comparable to the CBD parking fees.

On balance, it appears that the MPM has done more harm than good for retail shopping in the CBD. MPM shopping trips to the CBD by students, faculty/staff and non-University affiliates are likely to total 300 to 500 trips per day. Some, perhaps half, of these are new trips that were not made prior to initiating MPM service. Against these are balanced the shoppers who are not able to park in the City garage because it is half full of student vehicles. These 210 parking spaces could support as many as 600 shopping trips per day. The CBD is likely to benefit more from new parking in conjunction with the development of the Junior High School site than it has from the implementation of the MPM. If downtown merchants were able to agree on an agressive promotional plan that would attract more customers to the CBD, the MPM could play a significant role in delivering those customers.

Retail business outside of the CBD also views the MPM as a mixed blessing. Businesses along University Avenue are divided as to whether the MPM has helped or hurt. There is little doubt that students traveling along University Avenue in University buses were influenced by signs, displays, and advertising along the route. When using the MPM, students do not see these stimulants and are likely to avoid University Avenue businesses through ignorance or oversight. Therefore, it would appear likely that there has been a net loss of business along University Avenue due to the MPM.

Discussions with merchants along Patteson and on University near Patteson indicate little, if any, impact from the MPM. This indifference appears logical. There is adequate parking in and around these businesses. Furthermore, they are so far from the Towers station that few persons would readily undertake the 1/3 to 1/2 mile walk if an automobile option were available.

---

[20] The downtown merchants who were interviewed all complained of parking problems, but local officials said that merchant concerns were exaggerated.

The MPM has definitely boosted Morgantown's tourist business. The Chamber of Commerce reports that it receives over 12,000 requests per year for information that include questions about the MPM. If only a small fraction of these people actually visit Morgantown, the MPM will still have benefitted the local economy. Convention business in Morgantown has grown as a result of the MPM. Many more people throughout the United States have heard about Morgantown than had in the pre-MPM days.

The residents of Morgantown sense that the MPM has been good for the city. In 1980, members of Dr. Trent's panel [9] reported favorably on the following questions:

	Yes	Not Sure	No	No. of Responses
Did the MPM:				
Increase tourism?	82%	8%	10%	237
Increase business downtown?	45	20	35	237
Decrease traffic congestion downtown?	55	8	36	237
Decrease parking problems?	40	14	47	235

There was considerable agreement about the MPM's impact on tourism. Responses about business, traffic and parking impacts were mixed. These opinions are consistent with the analytical results reported here.

8.7 AESTHETIC IMPACTS

The aesthetic impact of the MPM is positive. As indicated in Section 7, substantially more persons from student, faculty/staff and non-University affiliate groups commented favorably about the MPM than unfavorably. Only 386 (10 percent) of 3,800 persons criticized the MPM guideway; and only 286 (7.5 percent) criticized the design of the stations. Many of these criticisms were directed toward features dictated by the terrain rather than the architectural design.

The survey findings were confirmed by Dr. Trent's panel [9]. Only 18 percent of the panel members felt that the MPM is an eyesore. This question is rather negative. Perhaps if it had been asked in a more neutral way the fraction objecting to the MPM would be even smaller. Nonetheless, 82 percent of the respondents thought that the MPM definitely is not an eyesore.

8.8 CIVIC PRIDE

The MPM has had an impact on the consciousness of every resident of the Morgantown area. No survey respondent was unaware of the MPM's existence. The SYSTAN surveys did not explore feelings of civic pride in the MPM, but Dr. Trent's panel did. Panel members were asked the following questions with the 1980 results indicated:

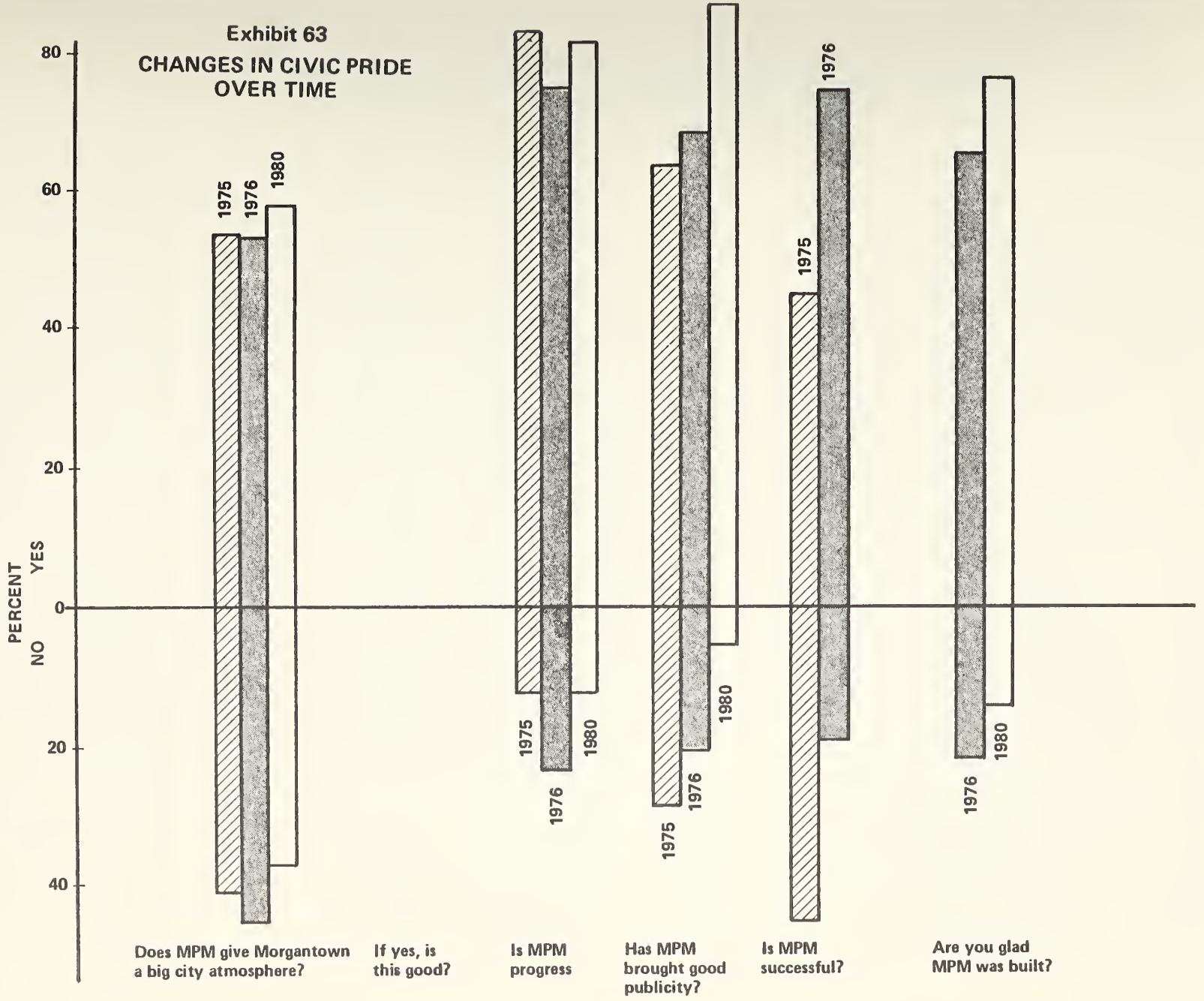
	Yes	Not Sure	No	No. of Responses
Does the MPM give Morgantown a "Big City" atmosphere?	60%	4%	35%	237
If yes, is this good?	80	8	12	138
Is MPM progress for Morgantown?	81	6	13	236
Has MPM brought good publicity for Morgantown?	87	7	6	237
Is the MPM a successful transportation system?	75	8	17	237
Are you glad it was built in Morgantown?	76	11	12	237

These responses clearly indicate a civic pride in the MPM. However, this pride was not completely blind. The number of persons who responded favorably to these questions changed over the life of the MPM as indicated in Exhibit 63. In 1975 a much smaller fraction of the respondents thought that the MPM had brought good publicity than in 1980. In 1975 less than half of the respondents thought that the MPM was successful. By 1976 when its success had been demonstrated, over 70 percent thought the system successful. The most stable question over time concerned the contribution of the MPM toward a "Big City" atmosphere, because this question had little to do with the success or value of the MPM. Despite fluctuations in responses, the pattern of answers illustrated in Exhibit 63 reflects considerable civic pride in the MPM system.

8.9 INSTITUTIONAL IMPACTS

The MPM's institutional impacts are affected by the "town vs. gown" conflict that exists in Morgantown as well as most other small university cities. Both merchants and local officials volunteered the opinion that the MPM is a University project executed by and for the University community, and had little impact on the non-University community. This attitude suggests a hint of conflict. It is supported by local government decisions not to build facilities or to make changes that would enhance non-University use of the MPM. For example, public action directed toward cleaning up the area around the Walnut station would make the MPM much more appealing to persons downtown.

In its turn, the University has not made an effort to make the MPM available to non-University people. There are large, vacant land areas



Source: Reference 9

adjacent to the Engineering, Towers, and Medical Center stations that could be made into public parking. To date, they have not. Some public parking is now available at the Medical Center close to the MPM station.

City and County transit officials are indifferent to the MPM and can be expected to continue their indifference until such time as their subsidies are threatened. Then they can be expected to strongly oppose the MPM. The MPM operator is in a difficult position. As federal operating subsidies are decreased and eliminated, new sources of revenue will be needed. It may be that a cooperative effort among the University, City and transit officials could solve the MPM's operating cost problem, but it is unlikely to happen because of institutional barriers.

9. CONCLUSIONS

The Morgantown People Mover is a unique automated guideway transportation system that effectively meets needs for transportation between the two campuses of West Virginia University. The MPM is a technical success. It efficiently performs the functions for which it was designed. Vehicles closely follow the operating algorithm.

The purpose of this report has been to assess the service that the MPM provides to its passengers and to travelers in the Morgantown community, and to assess the MPM's impact on community life. This purpose overlaps work already performed by two separate WVU research teams. The quantitative findings of these three efforts are essentially consistent; however, there are some differences in interpretation and emphasis.

The MPM replaced a system of University buses that provided similar transportation between the University campuses. Although the two services are not directly comparable, some useful observations can be made:

1. The MPM provides more dependable travel time than did the University buses. In fact, passengers can estimate MPM travel times within a maximum range of five minutes. For example, consider the transit portion of a trip from Engineering to Downtown Campus (Beechurst). The average wait plus travel time is 7.88 minutes, with a maximum time of 10 minutes. By bus the average time was 12.1 minutes, with a maximum time of 25 minutes. Given 20 minutes between classes, the student using the bus could expect to be late 26 percent of the time.

2. The average MPM load of 6.2 passengers is less than the seating capacity (of 8 passengers) while the average bus load was greater than the seating capacity (more than three-fourths of the bus loads included standees).

3. The MPM provides a smoother and more scenic ride than the University buses.

4. Contrary to expectations the MPM requires passengers to wait longer at stations than was necessary for University buses. Student passengers object to the wait.

5. Passengers must stand in relatively exposed stations while waiting for the MPM service in contrast to waiting while seated in a standing bus at two of the seven bus stops. On the other hand, the MPM stations have roofs while the exposed bus stops did not.

6. The MPM is more than twice as expensive to operate as the University bus system.[21]

Three classes of MPM users were identified: students, University faculty and staff, and Morgantown residents who are not affiliated with the University. Of these groups, students are by far the most frequent users, averaging 24 rides per month, compared with 4.8 rides per month for faculty and staff and 1.4 rides per month for non-University affiliates. Almost half of the non-University affiliates have never ridden the MPM.

Members of the three groups elect to use the MPM for a variety of reasons. Students predominantly select the MPM because they have no alternative. Faculty/staff and non-University affiliates select the MPM to avoid parking problems. Convenience and low cost are also important factors for all groups.

All three groups have excellent perceptions of the MPM and of the service that it provides. In particular, the MPM vehicles are perceived to be attractive. Only ten percent of the survey respondents object to the guideway, indicating that an elevated, or at-grade guideway is generally acceptable. The strongest architectural objection is to the protective rust coating on guideway structural members.

Concerns about safety and security while riding the MPM are few -- less than ten percent of the passengers reported any feelings of insecurity. Women passengers are more concerned than men. Principle concerns are system malfunctions, riding the MPM at night, and concern about other passengers. Although many MPM passengers carry parcels, parcels do not pose a problem.

Passenger perceptions of MPM service are good. The one strong objection is to time spent standing in stations waiting for vehicles. Passengers are more concerned about reaching their destinations on time while waiting in stations. They perceive waiting time to be about 2.5 times as long as it actually is. This time cannot be spent either constructively or comfortably. The fact that passengers can observe empty, undesignated vehicles standing in the station while they wait is particularly galling.

The effective MPM service territory is restricted to the two campuses, the Morgantown CBD and residential areas to the north of the Evansdale campus. Access to the MPM is principally by walking. The MPM effectively serves its territory, carrying about half of the estimated daily travelers. There seems little opportunity for increasing the MPM's mode share within its present territory. Any patronage growth

---

[21] The MPM employs 72 persons as opposed to about 20 for the university bus system. Although MPM vehicles are energy efficient, the system uses large quantities of natural gas in the winter to melt ice and snow from the guideway.

must come from expanding the MPM's service area. This growth could be most effectively accomplished by providing convenient parking adjacent to MPM stations that is accessible to the public.

The MPM has had a substantial impact on the consciousness of Morgantown and of its residents. Most residents believe that the MPM has a favorable impact on the life of the city. Most residents view the MPM with civic pride and most are glad that it was built.

Tangible MPM impacts are difficult to measure. Construction of the MPM had little impact on the economy of the city. Although residents perceive that the MPM has reduced traffic congestion along Beechurst and University Avenues, there is no quantitative evidence to support this opinion. The MPM has diverted about 1,100 daily trips from other modes, mostly automobiles, and it has induced about 1,200 daily trips that were not previously made. As a result, the MPM carries about 2,300 more passengers than were carried by University buses. Actual traffic varies widely from day-to-day and from week-to-week. The MPM has not adversely affected either City or County transit services but it has attracted some traffic from taxis.

Local business has felt little impact from the MPM. It has not helped the city and its merchants to revitalize the CBD. In fact, student parking in downtown garages restricts CBD access of potential shoppers. The Downtown campus is a much stronger commercial force than the MPM. The MPM has attracted considerable tourist interest and is likely helping convention bookings. Even so, local officials and merchants view the MPM as a University project. Neither the University nor the community seems disposed to join hands to integrate the MPM into the community.

Without question, the construction and operation of the MPM is a technical and operational success. However, the service that the MPM performs is not sufficiently better than the bus service that it replaced to justify either the capital investment or the operating cost. The cost per trip is high. The operating cost plus equivalent annual capital cost per trip is about $4.60.[22] Operating costs alone are $0.70 per trip or almost twice the operating costs of the university bus system. On the other hand, since the MPM was known from the start to be a demonstration, it was not expected to necessarily justify its costs.

---

[22] Using interest cost at 8 percent.

E HAS BEEN APPROVED BY THE OFFICE OF MANPOWER AND BUDGET
IN ACCORDANCE WITH THE FEDERAL REPORTS ACT OF 1942
OMB No 004-580012
APPROVAL EXPIRES MAY 1981

MORGANTOWN PRT USER SURVEY

SYSTAN, Inc. under the sponsorship of the Urban Mass Transportation Administration, is conducting a survey of the quality of service that the Morgantown PRT provides to its riders. Your anonymous participation in this important survey is entirely voluntary. Furthermore, your answers will remain confidential. Please be kind enough to answer the following questions about **the trip you are about to make**. There is a box at your destination station where you can leave this questionnaire (or you may mail it to us at the address on this form).

THE FIRST QUESTIONS CONCERN YOUR EXPERIENCE WITH PRT AND YOUR FEELINGS TOWARD IT.

1. Is this your first ride on PRT? Today's Date ____/____/____ (MO DAY YEAR)
   ( ) Yes
   ( ) No ... How often do you ride the PRT?
   ( ) Once a **month** or less ( ) 2 or 3 times a **week**
   ( ) 2 to 5 times a **month** ( ) 4 or more times a **week**
2. Would you ride PRT more frequently if changes were made to its design, schedule, route, fares, etc.?
   ( ) No
   ( ) Yes ... What **one** major change? _____
   _____
3. For which of the following types of trips do you find PRT to be most convenient? Place an 'x' in the appropiate box(es).
   ( ) Work ( ) School ( ) Social/Recreational
   ( ) Shopping ( ) Medical/Dental ( ) Other _____
4. What design or architectural aspect of PRT do you consider to be the
   Most attractive? _____
   Least attractive? _____

THE FOLLOWING QUESTIONS CONCERN *THIS* RIDE ON THE PRT.

1. Where do you start your trip to this PRT station?
   ( ) Home, location: _____ (NEAREST CROSS STREETS)
   ( ) Other, location: _____ (NEAREST CROSS STREETS)
2. At what station did you **board** the PRT?
   ( ) Walnut ( ) Engineering ( ) Medical Center
   ( ) Beechhurst ( ) Towers
3. How did you travel **to** this PRT station? Place an 'x' in the appropriate box(es)
   ( ) Automobile, drove alone ( ) Walk ( ) Other:
   ( ) Automobile, drove with others ( ) Bicycle
   ( ) Bus ( ) Motorcycle/Motorbike _____
4. At what station will you **leave** the PRT?
   ( ) Walnut ( ) Engineering ( ) Medical Center
   ( ) Beechhurst ( ) Towers
5. How **will** you travel **from** the PRT station to your destination?
   ( ) Automobile, drive alone ( ) Walk ( ) Other:
   ( ) Automobile, drive with others ( ) Bicycle
   ( ) Bus ( ) Motorcycle/Motorbike _____
6. Where is your destination located?
   Building: _____ (or)
   Campus: _____ (or)
   Nearest cross-streets: _____ and _____
7. How long do you estimate your trip takes from your origin to destination? _____ minutes. Of this time:
   a. How much was spent **waiting** for PRT service? _____ minutes
   b. How much was spent **aboard** the PRT vehicle? _____ minutes
8. Was there room for you to sit down on the PRT?
   ( ) No
   ( ) Yes

OVER

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 341 MORGANTOWN W. VIRGINIA

POSTAGE WILL BE PAID BY—

SYSTAN INC.
P.O. BOX 496
MORGANTOWN, WEST VIRGINIA 26505

9. Did you have parcels with you?
   ( ) No
   ( ) Yes ... Did you have any problems with your parcels?
      ( ) No
      ( ) Yes ... What was the **main** problem?

      _____

10. During the PRT trip, were you concerned about reaching your destination on time?
   ( ) No
   ( ) Yes ... At what point were you **most** concerned?
      ( ) While going to the PRT station.
      ( ) While waiting for the PRT.
      ( ) While riding on the PRT.
      ( ) While coming from the PRT station.
      ( ) Other: _____

11. Please rate the following aspects of your PRT trip. Place an 'x' in the appropriate box(es).

	Satisfied	Indifferent	Unsatisfied
Total trip time			
Convenience of PRT			
Walking distance (to and from station)			
Waiting time			
Delays in route			
Comfort of PRT ride			

12. What were your **most important** reason(s) for selecting PRT for this trip?
   ( ) Avoid parking problems
   ( ) Shorter wait than other transit
   ( ) Shorter walk than other modes (Other mode: _____)
   ( ) Convenient (physically close to your origin or destination)
   ( ) Inexpensive
   ( ) Dependable (arrives on time)
   ( ) Only transportation available
   ( ) Other: _____

13. What **one** feature of your PRT ride did you like the
   Best? _____
   Least? _____

14. Did you feel insecure or uneasy riding PRT or while standing or walking in the stations?
   ( ) No
   ( ) Yes ... Please explain: _____

THIS QUESTION CONCERNS TRIPS THAT YOU HAVE MADE OR EXPECT TO MAKE TODAY.

1. What mode(s) did you use or plan to use for each of the one-way trips (going **to** a place) you made or expect to make today? In the appropriate boxes, place a "1" for your first trip, place a "2" for your second trip, etc.

Trip Purpose	Auto, drive alone	Auto, drive with others	PRT	Bus	Walk	Bicycle	Motorcycle/ Motorbike	Other: (specify)
a. Work								
b. Shopping								
c. School								
d. Medical/Dental								
e. Social/Recreation								
f. Home								
g. Other: (specify)								
_____								
_____								

THE FOLLOWING INFORMATION WILL ASSIST US IN TABULATING THE SURVEY RESULTS.

1. Are you affiliated with the University?
   ( ) No
   ( ) Yes ... Are you a student?
      ( ) Yes
      ( ) No

2. If you are not affiliated with the University, are you employed?
   ( ) No
   ( ) Yes ... What is your occupation? _____

3. Is there an automobile, truck, van, motorcycle or motorbike available for your use?
   ( ) No
   ( ) Yes ... a. Please indicate which: _____
      b. Do you have 'first claim' on the use of one of these vehicles?
         ( ) Yes
         ( ) No

4. What is your age?
   ( ) 19 years or younger
   ( ) 20 to 44 years
   ( ) 45 to 64 years
   ( ) 65 years or older

5. Are you: ( ) Male? ( ) Female?

THANK YOU FOR YOUR TIME AND COOPERATION. PLEASE FOLD TWICE, STAPLE, AND MAIL (NO STAMP REQUIRED).

THIS QUESTIONNAIRE HAS BEEN APPROVED BY THE OFFICE OF MANPOWER AND BUDGET
IN ACCORDANCE WITH THE FEDERAL REPORTS ACT OF 1942
OMB No. 004-580012
APPROVAL EXPIRES MAY 1981

WEST VIRGINIA UNIVERSITY FACULTY/STAFF SURVEY

THE FIRST QUESTIONS CONCERN YOUR TRIP TO WORK TODAY.

Today's Date ____ / ____ / ____
MO DAY YEAR

1. Where did you start your trip to work?
   ( ) Home, location: _____
   NEAREST CROSS STREETS
   ( ) Other, location: _____
   NEAREST CROSS STREETS
2. What building, campus **or** street intersection is near your work destination this morning?
   Building _____ (or) Campus _____
   (or) Street Intersection _____
3. How did you travel **to** work this morning? Place an 'x' in the appropriate box(es).
   ( ) Automobile, drove alone ( ) Morgantown PRT ( ) Walk ( ) Motorcycle/Motorbike
   ( ) Automobile, drove with others ( ) Bus ( ) Bicycle ( ) Other: _____
4. If you rode in an automobile, where did you park? (Please specify)
   Street _____ (or) Parking Lot _____
5. What features of your method of transportation to work are **most important** to you?
   _____
6. What time did you **leave** home? _____ ( ) AM ( ) PM
   What time did you **arrive** at work? _____ ( ) AM ( ) PM
7. **If you did not** use public transportation for your trip to work, have you ever considered using it?
   ( ) No
   ( ) Yes ... If yes, what was your **primary** reason for rejecting public transit?
   _____

THE FOLLOWING QUESTIONS CONCERN THE MORGANTOWN PRT

1. Have you ever ridden on the PRT?
   ( ) No
   ( ) Yes ... How often do you ride the PRT?
   ( ) Once a **month** or less ( ) 2 or 3 times a **week**
   ( ) 2 to 5 times a **month** ( ) 4 or more times a **week**
2. Would you ride PRT more frequently if changes were made to its design, schedule, route, fares, etc.?
   ( ) No
   ( ) Yes ... What **one** major change? _____
   _____
3. For which of the following types of trips do you find PRT to be most convenient? Place an 'x' in the appropiate box(es).
   ( ) Work ( ) School ( ) Social/Recreational
   ( ) Shopping ( ) Medical/Dental ( ) Other _____
4. What design or architectural aspect of PRT do you consider to be the
   Most attractive? _____
   Least attractive? _____

THE FOLLOWING QUESTIONS CONCERN YOUR *LAST* RIDE ON THE PRT.

If you have not ridden on PRT, please skip to the next section.

1. What was the last date on which you rode the PRT? ____ / ____ / ____
   MONTH DAY YEAR
2. Where do you start your trip to this PRT station?
   ( ) Home, location: _____
   NEAREST CROSS STREETS
   ( ) Other, location: _____
   NEAREST CROSS STREETS
3. At what station did you **board** the PRT?
   ( ) Walnut ( ) Engineering ( ) Medical Center
   ( ) Beechhurst ( ) Towers
4. How did you travel **to** this PRT station? Place an 'x' in the appropriate box(es)
   ( ) Automobile, drove alone ( ) Walk ( ) Other:
   ( ) Automobile, drove with others ( ) Bicycle
   ( ) Bus ( ) Motorcycle/Motorbike _____
5. At what station will you **leave** the PRT?
   ( ) Walnut ( ) Engineering ( ) Medical Center
   ( ) Beechhurst ( ) Towers

OVER

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 341 MORGANTOWN W. VIRGINIA

POSTAGE WILL BE PAID BY—

SYSTAN INC.
P.O. BOX 496
MORGANTOWN, WEST VIRGINIA 26505

6. How will you travel **from** the PRT station to your destination?

( ) Automobile, drive alone ( ) Walk ( ) Other:
( ) Automobile, drive with others ( ) Bicycle
( ) Bus ( ) Motorcycle/Motorbike _____

7. Where is your destination located?

( ) Work, location: _____
NEAREST CROSS STREETS OR BUILDING

( ) Other, location: _____
NEAREST CROSS STREETS OR BUILDING

8. How long do you estimate your trip takes from your origin to destination? _____ minutes. Of this time:

a. How much was spent **waiting** for PRT service? _____ minutes
b. How much was spent **aboard** the PRT vehicle? _____ minutes

9. When you rode the PRT was there room for you to sit down?

( ) No
( ) Yes

10. Did you have parcels with you?

( ) No
( ) Yes ... Did you have any problems with your parcels?
( ) No
( ) Yes ... What was the **main** problem?
_____

11. During the PRT trip, were you concerned about reaching your destination on time?

( ) No
( ) Yes ... At what point were you **most** concerned?
( ) While going to the PRT station.
( ) While waiting for the PRT.
( ) While riding on the PRT.
( ) While coming from the PRT station.
( ) Other: _____

12. Please rate the following aspects of your PRT trip.
Place an 'x' in the appropriate box(es).

	Satisfied	Indifferent	Unsatisfied
Total trip time			
Convenience of PRT			
Walking distance (to and from station)			
Waiting time			
Delays in route			
Comfort of PRT ride			

13. What were your **most important** reason(s) for selecting PRT for this trip?

( ) Avoid parking problems
( ) Shorter wait than other transit
( ) Shorter walk than other modes (Other mode: _____)
( ) Convenient (physically close to your origin or destination)
( ) Inexpensive
( ) Dependable (arrives on time)
( ) No other service available
( ) Other: _____

14. What **one** feature of your PRT ride did you like the

Best? _____

Least? _____

15. Did you feel insecure or uneasy riding PRT or while standing or walking in the stations?

( ) No
( ) Yes ... Please explain: _____

THIS QUESTION CONCERNS TRIPS THAT YOU HAVE MADE OR EXPECT TO MAKE TODAY.

1. What mode(s) did you use or plan to use for each of the one-way trips (going **to** a place) you made or expect to make today? In the appropriate boxes, place a "1" for your first trip, place a "2" for your second trip, etc.

Trip Purpose	Auto, drive alone	Auto, drive with others	PRT	Bus	Walk	Bicycle	Motorcycle/ Motorbike	Other: (specify)
a. Work								
b. Shopping								
c. School								
d. Medical/Dental								
e. Social/Recreation								
f. Home								
g. Other: (specify) _____								
_____								

THE FOLLOWING INFORMATION WILL ASSIST US IN TABULATING THE SURVEY RESULTS.

1. Are there any vehicles (automobiles, trucks, vans, motorcycles or motorbikes) available to members of your household?

( ) No
( ) Yes ... a. How many _____ vehicles?
b. Do you have 'first claim' on the use of one of these vehicles?
( ) Yes
( ) No

2. What is your age?

( ) 19 years or younger ( ) 45 to 64 years
( ) 20 to 44 years ( ) 65 years or older

3. What is your occupation?

( ) WVU Faculty ( ) Administrative staff ( ) Maintenance staff
( ) Academic unit staff ( ) Administrator ( ) Other: _____
( ) Research or Technical staff ( ) Medical Center staff

4. Are you: ( ) Male? ( ) Female?

THANK YOU FOR YOUR TIME AND COOPERATION. PLEASE FOLD TWICE, STAPLE AND MAIL. (NO STAMP REQUIRED.)

THIS QUESTIONNAIRE HAS BEEN APPROVED BY THE OFFICE OF MANPOWER AND BUDGET
IN ACCORDANCE WITH THE FEDERAL REPORTS ACT OF 1942
OMB No. 004-580012
APPROVAL EXPIRES MAY 1981

MORGANTOWN TELEPHONE SURVEY OF NON-UNIVERSITY AFFILIATES

DATE: _____ / _____ / _____
MONTH DAY YEAR

TIME: _____ [ ] AM [ ] PM

ANY INFORMATION IN ITALICS SHOULD NOT BE READ TO RESPONDENT.
PLEASE CIRCLE THE RESPONSE NUMBER FOR EACH QUESTION.

Hello, my name is _____ with SYSTAN, Inc. We are taking a survey for the Urban Mass Transportation Administration on public attitudes toward the Morgantown PRT. Your participation is entirely voluntary. We will not record your name or telephone number, and we will keep all of your answers confidential. Would you be kind enough to answer a few questions for me?

THE FIRST QUESTIONS ESTABLISH THE SUITABILITY OF THE RESPONDENT.

How many adults (18 years or older) are living at your residence? _____ Are you one of these adults?

1. Yes
2. No ... May I speak with one of the adults who is not a WVU student and does not work for the University?

Are you a WVU student or a member of the WVU faculty or staff?

1. Yes ... May I speak to an adult who is not a WVU student or employee?
2. No ... *(Continue the interview.)*

THE FOLLOWING QUESTIONS CONCERN THE MORGANTOWN PRT

1. Have you ever ridden on the Morgantown Personal Rapid Transit (PRT)?
   1. No
   2. Yes ... How often do you ride the PRT?
      1. Once a **month** or less
      2. 2 to 5 times a **month**
      3. 2 or 3 times a **week**
      4. 4 or more times a **week**
2. Would you ride PRT more frequently if changes were made to its design, schedule, route, fares, etc.?
   1. No
   2. Yes ... What **one** major change? _____
3. For which of the following types of trips do you find PRT to be most convenient? ***(MULTIPLE RESPONSES OKAY)***
   1. Work
   2. Shopping
   3. School
   4. Medical/Dental
   5. Social/Recreational
   6. Other _____
4. What design or architectural aspect of PRT do you consider to be the
   Most attractive? _____
   Least attractive? _____

THE FOLLOWING QUESTIONS CONCERN YOUR LAST RIDE ON THE PRT.
(IF THE RESPONDENT HAS NEVER RIDDEN ON PRT, SKIP TO THE NEXT PART.)

1. What is the most recent date on which you rode the PRT? _____ / _____ / _____
   MONTH DAY YEAR
2. Where did you start your trip to the PRT station?
   1. Home ... What are the nearest cross-streets?
      _____ (and) _____
   2. Other ... What were the nearest cross-streets?
      _____ (and) _____
3. At what station did you **board** the PRT?
   1. Walnut
   2. Beechhurst
   3. Engineering
   4. Towers
   5. Medical Center
4. How did you travel **to** this PRT station? ***(MULTIPLE RESPONSES OKAY)***
   1. Automobile, drove alone
   2. Automobile, drove with others
   3. Bus
   4. Walk
   5. Bicycle
   6. Motorcycle/Motorbike
   7. Other: _____
5. At what station will you **leave** the PRT?
   1. Walnut
   2. Beechhurst
   3. Engineering
   4. Towers
   5. Medical Center
6. What were the nearest cross-streets to your destination?
   _____ (and) _____
7. How did you travel **from** the PRT station to your destination? ***(MULTIPLE RESPONSES OKAY)***
   1. Automobile, drove alone
   2. Automobile, drove with others
   3. Bus
   4. Walk
   5. Bicycle
   6. Motorcycle/Motorbike
   7. Other: _____
8. How long do you estimate your trip took from your origin to destination? _____ minutes. Of this time:
   1. How much was spent **waiting** for PRT service? _____ minutes
   2. How much was spent **aboard** for PRT vehicle? _____ minutes
9. When you rode the PRT was there room for you to sit down?
   1. No
   2. Yes

OVER

10. Did you have parcels with you?

    1. No
    2. Yes .. Did you have any problems with your parcels?
        1. No
        2. Yes ... What was the **main** problem?

        _____

11. During the PRT trip, were you concerned about reaching your destination on time?

    1. No
    2. Yes ... At what point were you **most** concerned? *(MULTIPLE RESPONSES OKAY)*
        1. While going to the PRT station.
        2. While waiting for the PRT.
        3. While riding on the PRT.
        4. While coming from the PRT station.
        5. Other: _____

12. Please rate the following aspects of your PRT trip. Were you satisfied, indifferent or unsatisfied about:
    (PLACE CHECK IN APPROPRIATE BOX)

	Satisfied	Indifferent	Unsatisfied
Total trip time			
Convenience of PRT			
Walking distance (to and from station)			
Waiting time			
Delays in route			
Comfort of PRT ride			

13. From the following list, what were your **most important** reason(s) for selecting PRT for this trip?
    (MULTIPLE RESPONSES OKAY)

    1. Avoid parking problems
    2. Shorter wait than other transit
    3. Shorter walk than other modes (What other mode?) _____
    4. Convenient (physically close to your origin or destination)
    5. Inexpensive
    6. Dependable (arrives on time)
    7. No other service available
    8. Other: _____

14. What **one** feature of your last PRT ride did you like the

    Best? _____

    Least? _____

15. Did you feel insecure or uneasy while riding PRT or while standing or walking in the stations?

    1. No
    2. Yes ... Please explain: _____

    _____

THESE QUESTIONS CONCERN THE TYPES OF TRIPS THAT YOU HAVE MADE OR EXPECT TO MAKE TODAY.

1. Which of these trips are you going to make today?

    1. Work
    2. Shopping
    3. School
    4. Medical/Dental
    5. Social/Recreational
    6. Other _____

2. *(USE ONLY THE TRIP TYPES FROM PREVIOUS QUESTION)*

What transportation will you use on your:	*MODE(S)*
1. Work trip	
2. Shopping trip	
3. Medical/Dental trip	
4. School trip	
5. Social/Recreational trip	
6. Other: _____	

(MULTIPLE RESPONSES OKAY)
FILL IN NUMBER(S) FROM LIST

1. *Automobile, drive alone*
2. *Automobile, drive with others*
3. *Bus*
4. *PRT*
5. *Walk*
6. *Bicycle*
7. *Other ... (please specify)*

THE FOLLOWING INFORMATION WILL ASSIST US IN TABULATING THE SURVEY RESULTS.

1. Are there any vehicles (automobiles, trucks, vans, motorcycles or motorbikes) available to members of your household?

    1. No
    2. Yes ... a. How many _____ vehicles?
        b. Do you have 'first claim' on the use of one of these vehicles?
            1. Yes
            2. No

2. Which of the following categories includes your age?

    1. 19 years or younger
    2. 20 to 44 years
    3. 45 to 64 years
    4. 65 years or older
    5. *(Refused)*

3. Are you employed?

    1. No
    2. Yes ... What is your occupation? _____

4. *Is the respondent 1. Male? 2. Female?*

THANK YOU VERY MUCH FOR YOUR TIME AND COOPERATION.

APPENDIX B
TABULATION OF SURVEY RESULTS

I USER SURVEY

QUESTION		RESPONSES Number	Percent
EXPERIENCE WITH THE MPM:			
1. Is this your first MPM ride?	Yes	8	0.6%
	No	1,326	99.4
	Total	1,334	100.0%
How often do you ride the MPM?	≤Once/Month	27	2.0%
	2 to 5 times/Month	94	7.0
	2 or 3 times/Week	162	12.1
	≥4 times/Week	1,058	78.9
	Total	1,341	100.0%
2. Would you ride MPM more often if it were changed?	No	841	64.0%
	Yes	474	36.0
	Total	1,315	100.0%
What one major change?	More Routes	109	24.2%
	Shorter Waits	105	23.3
	Longer hours	53	11.8
	Increase reliability	48	10.6
	Fewer breakdowns	47	10.4
	More stops	33	7.3
	Stations nearer building	10	2.2
	Other	46	10.2
	Total	451	100.0%
3. For which trip types is MPM most convenient?	Work	191	8.5%
	Shopping	248	11.0
	School	1,151	51.0
	Medical/Dental	255	11.3
	Social/Recreational	364	16.1
	Other	48	2.1
	Total	2,257	100.0%
4. What design or architectural feature of MPM is most attractive?	Vehicle design	309	34.2%
	Station design	214	23.7
	Modern appearance	41	4.5
	Visibility from vehicle windows	32	3.5
	Phase II design	24	2.7
	Vehicle temperature	18	2.0
	Night lighting	17	1.9
	Guideway	12	1.3
	Accessibility	12	1.3
	Automation	11	1.2
	Other	213	23.7
	Total	903	100.0%

Least attractive?	Rust on Guideway	158	19.5%
	Guideway	137	16.9
	Stations	54	6.7
	Exposed platform	51	6.3
	Frequent Breakdowns	37	4.6
	Vehicles	35	4.4
	Vehicle seats	32	3.9
	Colors	19	2.3
	Vehicle odor	19	2.3
	Landscaping	13	1.6
	Vehicle size	12	1.5
	Jerky ride	14	1.7
	Station Stairs	19	2.3
	Other	211	26.0
	Total	812	100.0%

THIS MPM RIDE:

1. Where did you start your trip to the MPM station?	Home	884	67.8%
	Other	419	32.2
	Total	1,303	100.0%
	Zone 1	92	7.7%
	Zone 2	54	4.5
	Zone 3	167	13.9
	Zone 4	190	15.8
	Zone 5	62	5.2
	Zone 6	60	5.0
	Zone 7	398	33.2
	Zone 8	64	5.3
	Zone 9	104	8.7
	Zone 10	9	0.7
	Total	1,200	100.0%
2. At what station did you board MPM?	Walnut	199	14.8%
	Beechurst	453	33.6
	Engineering	173	12.8
	Towers	332	24.7
	Medical Center	190	14.1
	Total	1,347	100.0%
3. How did you reach the MPM station?	Automobile (alone)	91	6.6%
	Automobile (with others)	57	4.1
	Bus	29	2.1
	Walk	1,186	86.1
	Bicycle	3	0.2
	Motorcycle/Moped	1	0.1
	Other	11	0.8
	Total	1,378	100.0%

4. At what station will you leave the MPM?

Walnut	145	10.8%
Beechurst	497	37.0
Engineering	304	22.7
Towers	226	16.8
Medical Center	170	12.7
Total	1,342	100.0%

5. How will you travel from MPM to destination?

Automobile (alone)	19	1.4%
Automobile (with others)	22	1.6
Bus	34	2.5
Walk	1,285	94.2
Bicycle	—	—
Motorcycle/Moped	—	—
Other	4	0.3
Total	1,364	100.0%

6. Where is your destination?

Building	1,127	86.9%
Campus	31	2.4
Cross Street	139	10.7
Total	1,297	100.0%
Zone 1	84	6.5%
Zone 2	24	1.9
Zone 3	389	30.1
Zone 4	74	5.7
Zone 5	160	12.4
Zone 6	22	1.7
Zone 7	468	36.2
Zone 8	42	3.2
Zone 9	28	2.2
Zone 10	2	0.1
Total	1,293	100.0%

7. Trip length estimate?

	Total Trip		Wait for MPM		Ride MPM	
Minutes	Number	Percent	Number	Percent	Number	Percent
0 to 2	5	0.4%	103	7.8%	59	4.6%
3 to 5	55	4.3	548	41.4	512	39.7
6 to 8	53	4.2	204	15.4	327	25.4
9 to 12	190	15.0	306	23.1	338	26.3
13 to 19	311	24.6	121	9.1	39	3.0
20 to 24	275	21.8	27	2.0	6	0.5
25 to 29	142	11.2	7	0.5	4	0.3
30 to 39	178	14.1	4	0.3	—	—
40 to 49	43	3.4	3	0.2	1	0.1
50 & over	13	1.0	2	0.2	1	0.1
Total	1,265	100.0%	1,325	100.0%	1,287	100.0%

8. Was there room to sit on the MPM?

No	405	30.5%
Yes	922	69.5
Total	1,327	100.0%

9. Did you have parcels?

No	532	39.7%
Yes	807	60.3
Total	1,339	100.0%

Did you have problems with parcels?	No	700	88.7%
	Yes	89	11.3
	Total	789	100.0%
What problems?	Not enough room	46	54.8%
	Difficulty standing	26	30.9
	Passing through turnstyle	12	14.3
	Total	84	100.0%

10. During MPM trip, were you concerned about reaching destination on time?

No	618	45.9%
Yes	729	54.1
Total	1,347	100.0%
At what time were you most concerned?		
Going to MPM station	41	5.8%
Waiting for MPM	587	82.7
Riding on MPM	56	7.9
Going from MPM to destination	5	0.7
Other	21	2.9
Total	710	100.0%

11. MPM trip rating:

	Satisfied		Indifferent		Dissatisfied	
	Number	Percent	Number	Percent	Number	Percent
Total trip time	873	66.2%	229	17.3%	218	16.5%
Convenience of MPM	953	72.1	240	18.2	129	9.7
Walking distance (to & from)	817	61.6	292	22.0	217	16.4
Waiting time	396	30.0	267	20.2	659	49.8
Delays en route	654	51.5	354	27.9	262	20.6
Comfort of MPM	818	61.8	382	28.8	125	9.4

12. What were most important reason(s) for selecting the MPM?

Avoid parking problems	392	15.6%
Shorter wait than other transit	88	3.5
Shorter walk than other mode	122	4.9
Convenient	536	21.4
Inexpensive	466	18.6
Dependable	110	4.4
Only transportation available	709	28.3
Other	84	3.3
Total	2,507	100.0%

13. What one feature of the MPM did you like Best?

Travel speed	142	14.9%
Convenience	135	14.2
Scenery/view	105	11.0
Vehicle temperature	68	7.1
Comfort	63	6.6
Reaching destination	57	6.0
Company of others	41	4.3
No Traffic/parking problems	40	4.2
Low fare	39	4.1

Best? (Continued)	Lack of crowding	28	2.9%
	Short wait	22	2.3
	No breakdown	21	2.2
	Reliability	20	2.1
	Seat	20	2.1
	Other	153	16.0
	Total	954	100.0%
Least?	Waiting for vehicle	335	38.3%
	Jerky, bumpy ride	110	12.6
	Breakdowns	74	8.5
	Crowding	49	5.6
	Vehicle seats	47	5.4
	Vehicle temperature	36	4.1
	Other	224	25.5
	Total	875	100.0%
14. Did you feel insecure while riding MPM, standing or walking in stations?	No	1,146	86.8%
	Yes	174	13.2
	Total	1,320	100.0%
Why?	Danger at night	43	26.9%
	Fear system failure	40	25.0
	Concern about time	15	9.4
	Fear other passengers	11	6.9
	Stations cold in winter	9	5.6
	Hard to stand	9	5.6
	Other	33	20.6
	Total	160	100.0%

MODE CHOICE BY TRIP PURPOSE:

	Auto, drive alone	Auto, drive with others	MPM	Bus	Walk	Bicycle	Motorcycle/ Motorbike	Other (specify)
a. Work	60	42	205	16	154	1	2	1
b. Shopping	82	60	147	14	195	3	3	2
c. School	99	56	1,069	42	429	5	3	4
d. Medical/Dental	21	11	169	9	58	1	2	1
e. Social/Recreation	65	71	203	11	153	5	4	2
f. Home	101	87	601	22	324	2	3	3
g. Other	7	7	51	4	22	1	1	1
Total	435	334	2,445	118	1,335	18	18	14

TOTAL 4,717

DEMOGRAPHIC DATA:

1. Are you affiliated with the University?	No	77	5.8%
	Yes	1,259	94.2
	Total	1,336	100.0%
Are you a student?	Yes	1,173	93.9%
	No	76	6.1
	Total	1,249	100.0%

2.	If not affiliated with the University, are you employed?	No	77	64.7%
		Yes	42	35.3
		Total	119	100.0%
	Occupation?	Professional	16	42.1%
		Clerical	7	18.4
		Sales	6	15.8
		Managerial	4	10.5
		Unskilled	3	7.9
		Skilled	2	5.3
			38	100.0%
3.	Is there a vehicle available for your use?	No	675	51.2%
		Yes	644	48.8
		Total	1,319	100.0%
	What type of vehicle?	Automobile	556	88.1%
		Truck	40	6.3
		Van	11	1.7
		Motorcycle	18	2.9
		Moped	6	1.0
		Total	631	100.0%
	Do you have first claim on vehicle use?	Yes	472	78.9%
		No	126	21.1
		Total	598	100.0%
4.	Age?	19 or younger	485	36.3%
		20 to 44	810	60.7
		45 to 65	30	2.2
		65 or older	10	0.8
		Total	1,335	100.0%
5.	Sex?	Male	723	54.6%
		Female	602	45.4
		Total	1,325	100.0%

II FACULTY/STAFF SURVEY

TRIP TO WORK:

			Responses	
			Number	**Percent**
1.	Where did you start your trip to work?	Home	1,772	98.8%
		Other	21	1.2
		Total	1,793	100.0%
		Zone 1	31	1.9%
		Zone 2	130	7.8
		Zone 3	21	1.3
		Zone 4	124	7.4
		Zone 5	56	3.4
		Zone 6	558	33.5
		Zone 7	55	3.3
		Zone 8	117	7.0
		Zone 9	470	28.2
		Zone 10	104	6.2
		Total	1,666	100.0%

2. What building or street intersection is near your work destination?	Building	1,552	90.6%
	Campus	83	4.8
	Street intersection	78	4.6
	Total	1,713	100.0%
	Zone 1	11	0.6%
	Zone 2	1	0.1
	Zone 3	565	32.3
	Zone 4	73	4.2
	Zone 5	245	14.0
	Zone 6	21	1.2
	Zone 7	789	45.2
	Zone 8	29	1.6
	Zone 9	12	0.7
	Zone 10	1	0.1
		1,747	100.0%
3. How did you travel to work this morning?	Automobile (alone)	865	35.9%
	Automobile (with others)	481	19.9
	MPM	704	29.2
	Bus	42	1.7
	Walk	288	11.9
	Bicycle	12	0.5
	Motorcycle/Moped	10	0.4
	Other	11	0.5
	Total	2,413	100.0%
4. If you rode in an automobile, where did you park?	Zone 1	41	3.6%
	Zone 2	1	0.1
	Zone 3	256	22.6
	Zone 4	43	3.8
	Zone 5	184	16.2
	Zone 6	15	1.3
	Zone 7	563	49.6
	Zone 8	25	2.2
	Zone 9	6	0.5
	Zone 10	1	0.1
	Total	1,135	100.0%
5. What features of your method of transportation to work are most important?	Convenience	381	25.7%
	Speed	315	21.2
	Flexibility	172	11.6
	Dependability	121	8.2
	Low cost	74	5.0
	Available at desired time	66	4.5
	Only means available	57	3.8
	Avoid traffic problems	42	2.8
	Exercise	40	2.7
	Near departure and arrival	24	1.6
	Other	191	12.9
	Total	1,483	100.0%

6. What time did you

	Leave Home?		Arrive at Work?	
	Number	Percent	Number	Percent
4:00 - 4:59 a.m.	7	0.4%	6	0.3%
5:00 - 5:59 a.m.	12	0.7	7	0.4
6:00 - 6:29 a.m.	26	1.4	14	0.8
6:30 - 6:59 a.m.	89	4.9	52	2.9
7:00 - 7:29 a.m.	213	11.8	117	6.6
7:30 - 7:59 a.m.	624	34.6	393	22.2
8:00 - 8:29 a.m.	443	24.5	688	38.9
8:30 - 8:59 a.m.	179	9.9	217	12.3
9:00 - 9:59 a.m.	113	6.3	177	10.0
10:00 - 10:59 a.m.	34	1.9	44	2.5
11:00 and later	65	3.6	55	3.1
Total	1,805	100.0%	1,770	100.0%

7. If you did not use public transit, have you ever considered it?

No	660	41.9%
Yes	914	58.1
Total	1,574	100.0%

Why did you reject it?

Doesn't go close to destination	257	28.4%
Unavailable at desired times	128	14.1
Takes too long	110	12.1
Inconvenient	101	11.1
Other	310	34.3
Total	906	100.0%

ABOUT THE MPM:

1. Have you ever ridden the MPM?

No	112	6.1%
Yes	1,716	93.9
Total	1,828	100.0%

How often do you ride the MPM?

Once/month or less	831	48.9%
20 to 5 times/month	456	26.8
2 or 3 times/week	144	8.5
4 or more times/week	268	15.8
Total	1,699	100.0%

2. Would you ride MPM more frequently if changes were made?

No	987	56.8%
Yes	752	43.2
Total	1,739	100.0%

What changes

More routes	291	39.3%
More stations	96	13.0
Less waiting time	67	9.1
More reliable	64	8.6
Longer hours	63	8.5
Other	159	21.5
Total	740	100.0%

3.	For which trip types is MPM most convenient?	Work	704	28.0%
		Shopping	499	19.8
		School	370	14.7
		Medical/Dental	361	14.3
		Social/Recreational	357	14.2
		Other	227	9.0
		Total	2,518	100.0%
4.	What design or architectural feature of the MPM do you consider:			
	Most attractive?	Vehicles	329	31.8%
		Stations	140	13.5
		System as a whole	77	7.4
		Site	55	5.3
		Guideways	28	2.7
		Express ride	26	2.5
		Other	380	36.8
		Total	1,035	100.0%
	Least attractive?	Rust on guideway	169	17.5%
		Guideway	154	15.9
		Exposed stations	63	6.5
		Stations	44	4.6
		Station location	27	2.8
		Station stairs	27	2.8
		Vehicle seats	27	2.8
		Other	455	47.1
		Total	966	100.0%

LAST MPM RIDE:

1.	What was the last date on which you rode the MPM?	November 15, 1980 and later	17	1.1%
		Nov. 1 to 14	180	11.2
		Oct. 16 to 31	776	48.4
		Oct. 1 to 15	140	8.7
		September	160	10.0
		August	67	4.2
		July	62	3.9
		June and before	200	12.5
		Total	1,602	100.0%
2.	Where did you start your last MPM trip?	Home	578	35.1%
		Other	1,068	64.9
		Total	1,646	100.0%
		Zone 1	79	5.1%
		Zone 2	55	3.5
		Zone 3	304	19.6
		Zone 4	80	5.1
		Zone 5	161	10.4
		Zone 6	143	9.2
		Zone 7	541	34.8
		Zone 8	69	4.4
		Zone 9	113	7.3
		Zone 10	10	0.6
		Total	1,555	100.0%

4. How did you travel to this MPM station?

Automobile (alone)	178	10.4%
Automobile (with others)	231	13.4
Bus	25	1.5
Walk	1,260	73.3
Bicycle	1	0.1
Motorcycle/Moped	4	0.2
Other	20	1.1
Total	1,719	100.0%

5. At what station did you leave the MPM?

Walnut	446	26.6%
Beechurst	427	25.5
Engineering	244	14.6
Towers	132	7.9
Medical Center	425	25.4
Total	1,674	100.0%

6. How did you travel from the MPM station to your destination?

Automobile (alone)	46	2.8%
Automobile (with others)	84	5.0
Bus	16	1.0
Walk	1,517	90.7
Bicycle	2	0.1
Motorcycle/Moped	3	0.2
Other	4	0.2
Total	1,672	100.0%

7. Where was your destination located?

Work	725	45.7%
Other	861	54.3
Total	1,586	100.0%
Zone 1	327	21.6%
Zone 2	19	1.3
Zone 3	361	23.8
Zone 4	39	2.6
Zone 5	136	9.0
Zone 6	27	1.8
Zone 7	528	34.8
Zone 8	41	2.7
Zone 9	35	2.3
Zone 10	3	0.1
Total	1,516	100.0%

8. MPM trip length estimate:

	Total Trip		Wait for MPM		Ride MPM	
Minutes	Number	Percent	Number	Percent	Number	Percent
0 to 2	1	0.1%	97	6.2%	23	1.5%
3 to 5	27	1.8	651	41.4	477	31.7
6 to 8	28	1.9	183	11.6	285	19.0
9 to 12	163	10.9	409	26.0	559	37.2
13 to 19	320	21.4	160	10.2	133	8.8
20 to 24	414	27.7	50	3.2	19	1.3
25 to 29	153	10.2	8	0.5	–	–
30 to 39	271	18.1	8	0.5	2	0.1
40 to 49	87	5.8	5	0.3	1	0.1
50 & over	31	2.1	1	0.1	4	0.3
Total	1,495	100.0%	1,572	100.0%	1,503	100.0%

9.	When you rode the MPM, was there room for you to sit down?	No	232	14.0%
		Yes	1,421	86.0
		Total	1,653	100.0%
10.	Did you have parcels with you?	No	1,059	63.6%
		Yes	605	36.4
		Total	1,664	100.0%
	Did you have problems with parcels?	No	558	93.3%
		Yes	40	6.7
			598	100.0%
	What was your principal problem?	Not enough room	15	40.5%
		Difficult holding parcel	9	24.3
		Other	13	35.2
		Total	37	100.0%
11.	During MPM trip were you concerned about reaching your destination on time?	No	995	59.9%
		Yes	665	40.1
		Total	1,660	100.0%
	At what point were you most concerned?	Going to MPM station	41	6.2%
		Waiting for MPM	551	83.0
		Riding MPM	41	6.2
		Going from MPM station	6	0.9
		Other	25	3.7
		Total	664	100.0%

12. MPM trip rating:

	Satisfied		Indifferent		Dissatisfied	
	Number	Percent	Number	Percent	Number	Percent
Total trip time	1,296	78.7%	154	9.3%	197	12.0%
Convenience of MPM	1,324	81.7	163	9.9	137	8.4
Walking distance (to and from)	1,217	74.3	199	12.2	221	13.5
Waiting time	744	45.6	273	16.7	614	37.7
Delays en route	1,149	74.2	245	15.8	154	10.0
Comfort of MPM	1,403	85.3	170	10.4	71	4.3

13. What were your most important reasons for selecting the MPM?

Avoid parking problems	1,038	31.3%
Shorter wait than other transit	146	4.4
Shorter walk than other mode	112	3.4
Convenient	793	23.9
Inexpensive	583	17.5
Dependable	169	5.1
Only transportation available	214	6.4
Other	266	8.0
Total	3,321	100.0%

14. What one feature of the MPM ride did you like:

Best?	Convenience	294	23.1%
	Speed	172	13.5
	Avoid traffic/parking	158	12.4
	Scenic view	134	10.5
	Comfort	78	6.1
	Inexpensive	44	3.5
	Novelty	42	3.3
	Express ride	35	2.8
	Reliability	34	2.7
	Direct route	34	2.7
	Avoid driving	33	2.6
	Other	214	16.8
	Total	1,272	100.0%
Least?	Waiting	367	37.3%
	Breakdowns	91	9.2
	Jerky, bumpy ride	62	6.3
	Long walk	48	4.9
	Odor in vehicles	43	4.4
	Crowding	39	4.0
	Platform exposure	34	3.5
	Reliability	24	2.4
	Stairs	21	2.1
	Other	255	25.9
	Total	984	100.0%

15. Did you feel insecure or uneasy while riding the MPM or while in the stations?

	No	1,423	87.9%
	Yes	195	12.1
	Total	1,618	100.0%
Why?	Fear of system failure	65	34.4%
	Fear of other passengers	22	11.6
	Concern about time	18	9.5
	Danger at night	16	8.5
	Other	68	36.0
	Total	189	100.0%

MODE CHOICE BY TRIP PURPOSE:

		Auto, drive alone	Auto, drive with others	MPM	Bus	Walk	Bicycle	Motorcycle/ Motorbike	Other (specify)
a.	Work	768	421	227	33	283	12	14	2
b.	Shopping	335	162	83	10	143	–	5	–
c.	School	109	49	120	4	100	–	3	2
d.	Medical/Dental	85	29	78	4	30	–	2	1
e.	Social/Recreation	203	160	41	6	67	4	4	1
f.	Home	642	343	152	30	221	10	8	4
g.	Other	94	48	38	–	20	–	–	–
	Total	2,236	1,212	739	87	864	26	36	10

TOTAL 5,210

DEMOGRAPHIC DATA:

1.	Are there vehicles available to members of your household?	No	105	5.8%
		Yes	1,695	94.2
		Total	1,800	100.0%
	How many?	1	703	41.7%
		2	733	43.5
		3	186	11.0
		4 or more	62	3.8
		Total	1,684	100.0%
	Do you have first claim on the use of a vehicle?	No	191	11.6%
		Yes	1,462	88.4
		Total	1,653	100.0%
2.	Age?	19 or younger	19	1.1%
		20 to 44	1,335	73.9
		45 to 64	440	24.3
		65 or older	13	0.7
		Total	1,807	100.0%
3.	What is your occupation?	Faculty	656	36.5%
		Academic unit staff	171	9.5
		Research or technical staff	233	13.0
		Administrative staff	248	13.8
		Administrator	52	2.9
		Medical Center staff	263	14.7
		Maintenance staff	27	1.5
		Other	145	8.1
		Total	1,795	100.0%
4.	Sex?	Male	912	51.1%
		Female	874	48.9
		Total	1,786	100.0%

III. NON-UNIVERSITY AFFILIATE SURVEY

	Question		Responses Number	Percent
EXPERIENCE WITH THE MPM:				
1.	Have you ever ridden the MPM?	No	422	46.9%
		Yes	478	53.1
		Total	900	100.0%
	How often do you ride the MPM?	Once/month or less	300	64.9%
		2 to 5 times/month	90	19.5
		2 or 3 times/week	28	6.1
		4 or more times/week	44	9.5
		Total	462	100.0%
2.	Would you ride MPM more frequently if changes were made?	No	576	67.5%
		Yes	277	32.5
		Total	853	100.0%

	What changes?	More routes	145	56.9%
		More stations	44	17.3
		More reliable	16	6.3
		Longer hours	13	5.1
		More parking at stations	10	3.9
		Reduce fare	7	2.7
		Other	20	7.8
		Total	255	100.0%
3.	For which trip types is MPM most convenient?	Work	98	16.2%
		Shopping	106	17.5
		School	51	8.4
		Medical/Dental	134	22.1
		Social/Recreational	160	26.5
		Other	56	9.3
		Total	605	100.0%
4.	What architectural feature of the MPM do you consider:			
	Most attractive?	Vehicles	170	41.1%
		System as a whole	78	18.8
		Stations	59	14.3
		Site	13	3.1
		Phase II	13	3.1
		Other	81	19.6
		Total	414	100.0%
	Lease attractive?	Rust on guideway	64	23.2%
		Guideway	49	17.8
		Vehicles	22	8.0
		Stations	21	7.6
		Station exposure	13	4.7
		Site	9	3.3
		Station stairs	5	1.8
		Other	93	33.6
		Total	276	100.0%
LAST MPM RIDE:				
1.	What is the last date on which you rode the MPM?	November 15, 1980 and later	28	6.5%
		Nov. 1 to 14	81	18.9
		Oct. 16 to 31	56	13.1
		Oct. 1 to 15	86	20.1
		September	49	11.5
		August	28	6.5
		July	39	9.1
		June and before	61	14.3
		Total	428	100.0%

2.	Where did you start your last MPM trip?	Home	301	70.3%
		Other	127	29.7
		Total	428	100.0%
		Zone 1	86	21.9%
		Zone 2	39	9.9
		Zone 3	30	7.6
		Zone 4	29	7.4
		Zone 5	21	5.3
		Zone 6	54	13.8
		Zone 7	48	12.2
		Zone 8	24	6.1
		Zone 9	60	15.3
		Zone 10	2	0.5
		Total	393	100.0%
3.	At what station did you board the MPM?	Walnut	203	43.2%
		Beechurst	97	20.6
		Engineering	25	5.3
		Towers	35	7.5
		Medical Center	110	23.4
		Total	470	100.0%
4.	How did you travel to this MPM station?	Automobile (alone)	66	14.0%
		Automobile (with others)	134	28.3
		Bus	12	2.5
		Walk	257	54.4
		Bicycle	2	0.4
		Motorcycle/Moped	1	0.2
		Other	1	0.2
		Total	473	100.0%
5.	At what station did you leave the MPM?	Walnut	133	28.2%
		Beechurst	48	10.2
		Engineering	63	13.3
		Towers	30	6.4
		Medical Center	198	41.9
		Total	472	100.0%
6.	Where was your destination located?	Zone 1	99	32.4%
		Zone 2	1	0.3
		Zone 3	30	9.8
		Zone 4	2	0.7
		Zone 5	7	2.3
		Zone 6	4	1.3
		Zone 7	148	48.3
		Zone 8	11	3.6
		Zone 9	3	1.0
		Zone 10	1	0.3
		Total	306	100.0%

7. How did you travel from the MPM station to your destination?

Automobile (alone)	11	2.4%
Automobile (with others)	33	7.4
Bus	4	0.9
Walk	393	87.5
Bicycle	1	0.2
Motorcycle/Moped	–	–
Other	7	1.6
Total	449	100.0%

8. MPM trip length estimate:

	Total Trip		Wait for MPM		Ride MPM	
Minutes	Number	Percent	Number	Percent	Number	Percent
0 to 2	1	0.2%	69	15.1%	8	1.8%
3 to 5	9	2.0	214	46.8	99	21.7
6 to 8	12	2.7	33	7.2	61	13.4
9 to 12	43	9.7	105	23.0	170	37.3
13 to 19	86	19.4	23	5.1	77	16.9
20 to 24	78	17.6	9	2.0	25	5.5
25 to 29	47	10.6	–	–	3	0.6
30 to 39	100	22.5	1	0.2	10	2.2
40 to 49	38	8.6	1	0.2	1	0.2
50 & over	30	6.7	2	0.4	2	0.4
Total	444	100.0%	457	100.0%	456	100.0%

9. When you rode the MPM, was there room for you to sit down?

No	85	18.2%
Yes	381	81.8
Total	466	100.0%

10. Did you have parcels with you?

No	361	76.8%
Yes	109	23.2
Total	470	100.0%

Did you have problems with parcels?

No	90	84.9%
Yes	16	15.1
Total	106	100.0%

What was your principal problem?

Difficult standing with parcel	6	42.9%
Not enough room	5	35.7
Problem with turnstyle	2	14.3
Problem with door	1	7.1
Total	14	100.0%

11. During MPM trip, were you concerned about reaching your destination on time?

No	358	75.7%
Yes	115	24.3
Total	473	100.0%

At what point were you most concerned?

Going to MPM station	22	19.1%
Waiting for MPM	64	55.7
Riding MPM	20	17.4
Going from MPM station	5	4.3
Other	4	3.5
Total	115	100.0%

12. MPM trip rating:

	Satisfied		Indifferent		Dissatisfied	
	Number	Percent	Number	Percent	Number	Percent
Total trip time	390	82.8%	51	10.8%	30	6.4%
Convenience of MPM	357	75.5	85	18.0	31	6.5%
Walking distance (to and from)	296	63.0	108	23.0	66	14.0
Waiting time	313	66.6	66	14.0	91	19.4
Delays en route	352	77.2	74	16.2	30	6.6
Comfort of MPM	370	78.4	75	15.9	27	5.7

13. What were your most important reasons for selecting the MPM?

Avoid parking problems	226	28.2%
Shorter wait than other transit	35	4.4
Shorter walk than other mode	21	2.6
Convenient	147	18.4
Inexpensive	132	16.5
Dependable	49	6.1
Only transportation available	57	7.1
Other	134	16.7
Total	801	100.0%

14. What one feature of the MPM did you like:

Best?	Scenery	78	20.3%
	Speed	71	18.5
	Convenience	41	10.7
	Novelty	30	7.8
	Comfortable	19	4.9
	Avoid traffic/parking	18	4.7
	Vehicle temperature	18	4.7
	Lack of crowding	13	3.4
	Smooth ride	11	2.9
	Company of others	11	2.9
	Reliability	9	2.3
	Other	65	16.9
	Total	384	100.0%
Least?	Waiting	65	26.1%
	Jerky, bumpy ride	27	10.8
	Crowding	17	6.8
	Long walk	16	6.4
	Vehicle seating	12	4.8
	Other passengers	12	4.8
	Breakdowns	11	4.4
	Exposed platforms	7	2.8
	Stairs in stations	6	2.4
	Dirty vehicles	6	2.4
	Vehicle odors	6	2.4
	Other	64	25.9
	Total	249	100.0%

15. Did you feel insecure or uneasy while riding the MPM or while in the station?

No	404	88.0%
Yes	55	12.0
Total	459	100.0%

Why?	Fear of system failure	12	22.6%
	Danger at night	7	13.2
	Crowding	7	13.2
	Fear of other passengers	6	11.3
	Unknown	5	9.4
	Open station gates	3	5.7
	Other	13	24.6
	Total	53	100.0%

MODE CHOICE BY TRIP PURPOSE:

		Auto, drive alone	Auto, drive with others	MPM	Bus	Walk	Bicycle	Other (specify)
a.	Work	278	63	15	43	32	–	1
b.	Shopping	150	90	23	17	28	–	3
c.	School	45	32	10	13	7	1	1
d.	Medical/Dental	22	13	7	11	8	–	–
e.	Social/Recreation	74	95	6	15	26	2	3
f.	Other	15	17	1	1	2	–	2
	Total	584	310	62	100	103	3	10

TOTAL 1,172

DEMOGRAPHIC DATA:

1.	Are there vehicles available to members of your household?	No	99	11.0%
		Yes	797	89.0
		Total	896	100.0%
	How many?	1	330	41.8%
		2	327	41.4
		3	90	11.4
		4 or more	42	5.4
		Total	789	100.0%
	Do you have first claim on the use of a vehicle?	No	142	18.3%
		Yes	636	81.7
		Total	778	100.0%
2.	Age?	19 or younger	35	3.9%
		20 to 44	481	54.0
		45 to 64	236	26.5
		65 or older	139	15.6
		Total	891	100.0%
3.	Are you employed?	No	383	43.1%
		Yes	505	56.9
		Total	888	100.0%

	What is your occupation?	Professional	69	14.1%
		Managerial	31	6.3
		Clerical	64	13.1
		Skilled	97	19.8
		Unskilled	59	12.0
		Blue Collar	81	16.5
		Sales	63	12.9
		Homemaker/Domestic	3	0.6
		Self-employed	6	1.2
		Other	17	3.5
		Total	490	100.0%
4.	Sex?	Male	352	40.0%
		Female	527	60.0
		Total	879	100.0%

APPENDIX C

SURVEY SAMPLE ANALYSIS

Despite the care taken in the experimental design, it is useful to check the characteristics of the different respondent groups against the available data on their universes to determine whether the survey respondents do represent their different groups. Because of the paucity of data, this step cannot be performed with any precision. Nonetheless some evidence is available for each of the three groups: (1) WVU students; (2) WVU faculty and staff; and (3) Morgantown residents who are not affiliated with the University.

WVU Students

Location of Morgantown residence is sufficient to demonstrate that the survey was biased toward student MPM users. Inasmuch as the location of the respondent's Morgantown residence was not a survey question, an indirect approach was used. All student respondents, whose MPM trips started at home (67.8 percent of all respondents) did identify the location of their Morgantown residences. In Exhibit C-1, the distribution of these respondent residences, by zone, is compared with the distribution of all student residences as estimated by WVU [7]. The differences are pronounced. The 9.3 percent of students who live in the Towers Dormitory accounted for 23.8 percent of all survey respondents. In contrast, students who live in Zone 6, south of the CBD, and Zone 9, north of the Evansdale Campus are underrepresented. Students living in Zone 4, the zone with the largest student population, are also underrepresented because a large number have classes only on the adjacent Downtown Campus. Thus the Student Sample represents student MPM users, not the student body as a whole.

Faculty and Staff

The faculty/staff respondents were representative of the faculty and staff

Exhibit C-1

POPULATION DISTRIBUTION BY ZONE

ZONE	STUDENTS		FACULTY/STAFF		NON-UNIVERSITY AFFILIATES	
	ACTUAL DISTRIBUTION	SAMPLE DISTRIBUTION	ACTUAL DISTRIBUTION	SAMPLE DISTRIBUTION	ACTUAL DISTRIBUTION	SAMPLE DISTRIBUTION
1	1.6%	10.2%	1.5%	1.9%	1.9%	3.3%
2	5.3	6.0	5.1	7.9	4.9	5.8
3	-	-	-	-	-	-
4	34.3	25.4	9.8	7.5	12.1	12.1
5	6.1	8.2	4.6	3.4	2.7	5.4
6	13.1	5.8	35.3	33.9	43.6	35.0
7	9.3	23.8	1.8	3.3	0.4	2.5
8	10.0	7.2	5.4	7.1	5.2	10.0
9	19.8	12.4	33.2	28.7	17.3	25.0
10	0.5	1.0	3.3	6.3	11.9	0.9
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

as a whole. Exhibit C-1 gives a comparison of the residence locations by zone between survey respondents and the entire faculty and staff as estimated by WVU [7]. There is close agreement for all zones. The largest percentage differences that occur are for Zones 7 and 10, both with small faculty/staff populations. Residents of Zone 7 which is close to the MPM are overrepresented suggesting an interest in the MPM. Residents of Zone 10, which is far from the MPM, are underrepresented, suggesting indifference.

Faculty/staff occupations were also checked against the responses to the questionnaire. Exhibit C-2 shows this comparison. The left hand column was taken from a random sample of 200 listings in the staff directory. This directory underreports service and maintenance personnel because most do not have individual listings. Also some estimates were made about occupations that were not clear. Nonetheless, there is good agreement between the two columns of Exhibit C-2, suggesting that faculty and staff did respond more or less in accordance with directory listings if not actual numbers.

The two tests give support for the contention that the Faculty/staff respondents are representative of their universe.

Non-University affiliates

The sample of non-University respondents compares reasonably well with data compiled by WVU and with data from the 1970 census, Four checks were performed: (1) residence location; (2) age; (3) sex, and (4) occupation.

Although non-University affiliates were not requested to give their residence locations, those whose last MPM trip began at home did report residence location. This sub-group accounted for 70.3 percent of the respondents who have ridden the MPM. The residence distribution for this sub-group is listed in Exhibit C-1 where it can be compared with the population distribution compiled by WVU [7]. There is good agreement for most zones.

Exhibit C-2

FACULTY/STAFF OCCUPATIONS

	DISTRIBUTION FROM STAFF DIRECTORY	DISTRIBUTION FROM SURVEY
Administrators	3.5	2.9
Faculty	42.8	36.5
Research/Technical Staff	12.4	13.0
Academic Unit Staff	8.5	9.5
Medical Center Staff	12.8	14.7
Administrative Staff	10.8	13.8
Maintenance9Staff	4.0	1.5
Other	5.2	8.1
Total	100.0	100.0

Zone 9 is overrepresented in the sample, likely because Zone 9's location beyond the Evansdale Campus makes the MPM a very visible landmark. As a result more residents may be inclined to use the MPM at least to satisfy curiosity. Zone 6 is underrepresented for the opposite reason. Zone 6 is an older part of Morgantown that is distant from the Campus. Zone 6 residents may have little interest in University affairs or the MPM.

Exhibit C-3 lists the age distribution of respondents and the 1970 age distribution of Morgantown residents. When the census age distribution is corrected to remove children 17 and younger, who were not interviewed, there is close agreement between the sample and the population.

Because many of the telephone interviews were conducted during the day, there were a larger number of female respondents than male ones.

	Census	Respondents
Female	49.5	60.0%
Male	50.5	40.0%

If one can assume that homemakers have experiences and attitudes that are comparable to their familys' breadwinners, then one can accept the sample. Even so, it is necessary to recognize that homemakers are overrepresented.

Exhibit C-4 lists the distribution of occupations by those working outside the home as reported to the Census Bureau in 1970 and the distribution reported by survey respondents. There are some large differences. Professional employees are underrepresented in the sample because all University faculty have been removed. If one corrects the census figures to remove University faculty and staff occupations as reported in the survey, then the result approaches the survey respondents as indicated in the center column of Exhibit C-4.

It appear reasonable to accept the survey sample as representative of the non-University affiliated Morgantown population.

Exhibit C-3

AGE DISTRIBUTION OF NON-UNIVERSITY AFFILIATES

	1970 CENSUS		
	AS REPORTED	CORRECTED TO REMOVE CHILDREN	SURVEY RESPONDENTS
19 OR UNDER	34.2%	3.9%	3.9%
20 TO 44	41.0	59.8	54.0
45 TO 64	15.7	22.9	26.5
65 AND OVER	9.1	13.4	15.6
Total	100.0	100.0	100.0

REFERENCES

1. Elias, S.E.G. et al. "PRT Impact Study: Pre-PRT Phase, Volume 1 - Travel Analysis; Volume 2 - Data Collection Procedure and Coding Manual; Volume 3 - Frequency Tabulation from Four Transportation Related Surveys" (West Virginia University, Morgantown WV: March 1976).

2. Elias, S.E.G. and R.E. Ward, "PRT Impact Study: The Phase 1 PRT Impact on Morgantown Travel and Associated Activities" (West Virginia University, Morgantown WV: 1979).

3. Elias, S.E.G. et al., "PRT Impact Study: Operational Phase, Volume 1 - Travel Analysis; Volume 2 - Data Collection Procedure and Coding Manual" (West Virginia University, Morgantown WV: 1979).

4. Trent, R.B. and C.N. Redwine, "Public Acceptance of New Mass Transit System," Journal of the Urban Planning and Development Division of the ASCE (August 1976).

5. Elms, C. et al., "Assessment of the Phase 1 Morgantown People Mover System," N.D. Lea & Associates and SNV Studrengesellschaft Nahverkehr mbH (Washington D.C.: 1979).

6. Automated Management Systems, Inc., "AGT Energy Assessment and Analysis" (Landover MD: February 1981).

7. Elias, S.E.G. et al., "Study of Traffic and Travel Patterns in the Vicinity of the Expanded Morgantown Downtown People Mover System" (West Virginia University, Morgantown WV: April 1981).

8. Trent, R.B., "Community Acceptance Study: The Morgantown People Mover System" (West Virginia University, Morgantown WV: 1981).

9. Von Rosenvinge, M.E., "Supplement III, Cost Experience of Automated Transit Systems," U.S. Department of Transportation, Transportation Systems Center, Cambridge MA: 1981.

200 copies

R-1/R-2

☆ U.S. GOVERNMENT PRINTING OFFICE: 1984--700-958--314

. Department
Transportation

search and
ecial Programs
ministration

tall Square
bridge, Massachusetts 02142

Official Business
Penalty for Private Use $300

Postage and Fees Paid
Research and Special
Programs Administration
DOT 513