

Final Report

University of North Dakota Campus Shuttle Study



Prepared By

Small Urban & Rural Transit Center

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KEY STUDY FINDINGS

The following are key points identified in conducting the campus shuttle service and ridership study:

- Respondents were asked about the particular factors that influence their mode choice. They were given a list that included convenience, accessibility, cost of vehicle, cost of parking, weather, parking availability, time, and other. Convenience was identified as the major factor determining mode choice 80% of respondents. It was followed by weather at 70.9%, time at 60.8%, accessibility at 54.3%, parking availability at 50.9%, cost of parking at 38%, cost of vehicle at 22.3%, and other at 3.2%.
- In terms of respondents' awareness of the campus shuttle services, 95.5% indicated that they were aware of the services. Interestingly, when asked as to whether or not they utilize these shuttle services, 46.2% replied they did while 53.8% responded they did not.
- When identifying what was perceived to be the benefits of the availability of shuttle services on campus, the highest perceived benefit identified by students was convenience with a response rate of 66.8%. It was followed by reducing parking demand at 48.2%, saving money at 45.7%, saving time at 43.5%, reducing traffic congestion at 40.8%, reducing greenhouse gas at 28%, and improving safety at 22.7%. Approximately 11% of respondents had no opinion. Other benefits were listed by 5.7% of respondents. Primary among these were the fact that the shuttle service is good for students without access to a vehicle, and that it provides a warmer alternative to walking in winter.
- Students that used the campus shuttle system were asked to identify the characteristics of the service that they deem most valuable. The listed characteristics were driver friendliness, comfort, reliability, convenience, bus on scheduled time, and other. Of all the listed service characteristics, convenience had the highest rating at 74.5%. It was followed by bus on scheduled time at 54.5%, reliability at 49%, comfort at 28.4%, and driver friendliness at 25.3%. Approximately 7% of respondents listed the service as having other valuable characteristics. Providing warmth in winter, not having to pay for the service, and the service being a faster alternative to walking, specifically to the aviation facilities, were identified.
- When asked about the longest time they will prefer to wait after missing a campus shuttle bus, 61.2% of respondents indicated that less than 10 minutes as being ideal. This was followed by 10 minutes at 28.2%, 15 minutes at 9%, and 20 minutes at 1.4%.
- The Campus Shuttle Service's total annual passenger trips decreased by 21% from FY 2006 to FY 2010. Total annual passenger trips fell from 258,978 trips in FY 2006 to 203,608 in FY 2010.
- The Night Shuttle Service's total annual passenger trips decreased by 41% from FY 2006 to FY 2010. Total annual passenger trips fell from 24,376 trips in FY 2006 to 14,280 in FY 2010.
- With regard to accessibility of campus shuttle services to individuals with disabilities, each of the fleet's six buses is equipped with two wheelchair positions. This is good from two perspectives. First, it communicates UND Transportation's customer-centric view. Additionally, it establishes UND Transportation's compliance to the Americans with Disabilities Act of 1990's (ADA) regulatory requirements.

- In an attempt to measure the cost effectiveness of both the Campus Shuttle Service and the Night Shuttle Service from FY 2006 to FY 2010, their combined operating cost per passenger trip was calculated. This figure increased by 31% over the period, from \$0.90 in FY 2006 to \$1.18 in FY 2010.
- A total of 34.4% of survey respondents believed that there were additional stop locations that the campus shuttle service can cover. These stop locations included both on-campus and off-campus locations. Additionally, 44.7% of respondents indicated that there were locations on campus that are too far to walk to in a reasonable time. These locations, relative to corresponding start locations, offer important information that can be used to improve both service and route design.

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1. INTRODUCTION

The University of North Dakota (UND) contracted with the Small Urban & Rural Transit Center (SURTC) of the Upper Great Plains Transportation Institute (UGPTI) to complete a campus shuttle service and ridership study. The over-arching drivers behind conducting the study was the intention of UND leadership to gain a deeper understanding of students' attitudes toward, perceptions of, and satisfaction with provided shuttle services; and their desire to identify shuttle service design alternatives that improve both customer satisfaction and service efficiency and effectiveness.

The study involved collecting and reporting information on the travel behavior of UND students; collecting and reporting information on their preferences and attitudes toward campus shuttle services; analyzing shuttle service passenger trip data; evaluating existing shuttle services; and providing both short-term and long-term recommendations to improve campus shuttle services.

1.1 Purpose of the Study

The objective of UND Campus Shuttle Study was to collect and evaluate available and generated data on both the shuttle system's service and its ridership. The study's second purpose, after achieving the aforementioned objectives, was to provide recommendations on improving UND shuttle services.

1.2 Study Approach

The approach in conducting the UND Campus Shuttle Study consisted of three distinct, yet related, components. The first component involved collecting information and data on the existing campus shuttle services. The second component involved analyzing student survey responses, analyzing route-specific passenger trip data, and assessing shuttle service performance. The third component involved providing an evaluation and recommending actions to improve shuttle services.

1.3 Organization of Report

The study's report is made up of six chapters including:

- Chapter 2 – provides background information on UND and its shuttle system
- Chapter 3 – provides an analysis of student survey responses and an analysis of Campus Shuttle Service and Night Shuttle Service passenger trip data.
- Chapter 4 – provides an assessment of Campus Shuttle Service and Night Shuttle Service performance
- Chapter 5 – provides an evaluation of campus shuttle services and provides service improvement recommendations
- Chapter 6 – presents concluding positions and perspectives on the shuttle system

2. EXISTING UND SHUTTLE SERVICES

2.1 University of North Dakota

Established in 1883, the University of North Dakota is the oldest university in North Dakota. It is a public university that, as of fall 2010, has 14,194 students enrolled pursuing studies in over 218 fields and disciplines.

With its main campus located in Grand Forks, UND consists of 223 buildings on 549 acres of land. From east to west the campus covers 1 ½ miles and is divided by the English Coulee which flows in a north-south direction. The campus is generally referred to as comprising four geographical areas – central campus, eastern campus, western campus, and northern campus. With respect to the chronological age of buildings, the central and eastern areas of the campus are older than the western and northern areas. The central and eastern areas of the campus house the majority of academic departments while the northern and western areas of the campus, to a greater extent, consist of sporting arenas, research centers, the Aerospace Complex, the Student Wellness Center, the book store, housing facilities, and commercial properties.

Of importance, particular with respect to its influence on the mobility needs of specific student groups on campus, UND has established a smaller campus at the Grand Forks International Airport. Students in the increasingly popular aviation program attend classes at this facility.

The map illustrated in Figure 1 shows the layout of the University of North Dakota.

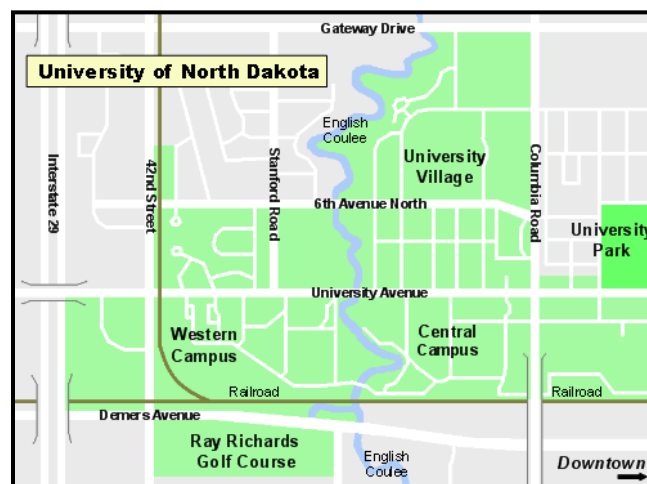


Figure 1 University of North Dakota

UND is noted for its focus on environmental sustainability and the incorporation of this concept into numerous aspects of its operations. This focus was initiated with the signing of the American College and University Presidents' Climate Commitment (ACUPCC), by then UND President Charles Kupchella, on January 29 2008. UND committed then, and continues to commit, to reducing the amount of green house gases emitted by the university. UND's score on the College Sustainability Report Card, as reported by

the Sustainable Endowment Institute, has improved from a C in 2009 to a C+ in 2010. Note that in the transportation segment of the report, UND received a grade B.

Enrollment at UND and how it has changed over the years is of significance in this study. During the period of FY 2006 to FY 2010 there was a net increase in enrollment. For each year within this period there was a modest increase in enrollment. The exception was 2007 where there was a decrease of 2% when total enrollment dropped to 12,559 from 12,834 in 2006. Conversely, there was a noticeably higher increase in enrollment in 2010 of 7%, when enrollment grew from 13,172 in 2009 to 14,194 in 2010. Total enrollment during FY 2006 to FY 2010 increased 10%, from 12,834 in 2006 to 14,194 in 2010.

When enrollment is observed according to a students' classification level from FY 2006 to FY 2010, there was a net increase in enrollment of 7.4%, while graduate student enrollment grew at the significantly higher rate of 24.3%.

Table 1 shows UND enrollment from the years FY 2006 to FY 2013. Figure 2 shows enrollment from FY 2006 to FY 2013 in graphical format. The additional enrollment projections for 2011, 2012, and 2013 were provided by UND.

Table 1 UND Enrollment for FY 2006 to FY 2013

Year	Undergraduate	Graduate – Law & Medicine	Total
2006	10,376	2,458	12,834
2007	10,085	2,474	12,559
% Change	-3%	1%	-2%
2008	10,129	2,619	12,748
% Change	0.4%	6%	2%
2009	10,440	2,732	13,172
% Change	3%	4%	3%
2010	11,139	3,055	14,194
% Change	7%	12%	8%
2011 (Projected)	11,146	3,057	14,203
% Change	0.1%	0.1%	0.1%
2012 (Projected)	11,162	3,061	14,223
% Change	0.1%	0.14%	0.14%
2013 (Projected)	11,177	2,819	14,242
% Change	0.1%	0.13%	.13%
Total % Change FY 2006 to FY 2010	7.4%	24.3%	10.6%
Total % Change 2010-20113	0.3%	0.3%	0.3%
Total % Change 2006-20113	7.7%	24.7%	11%

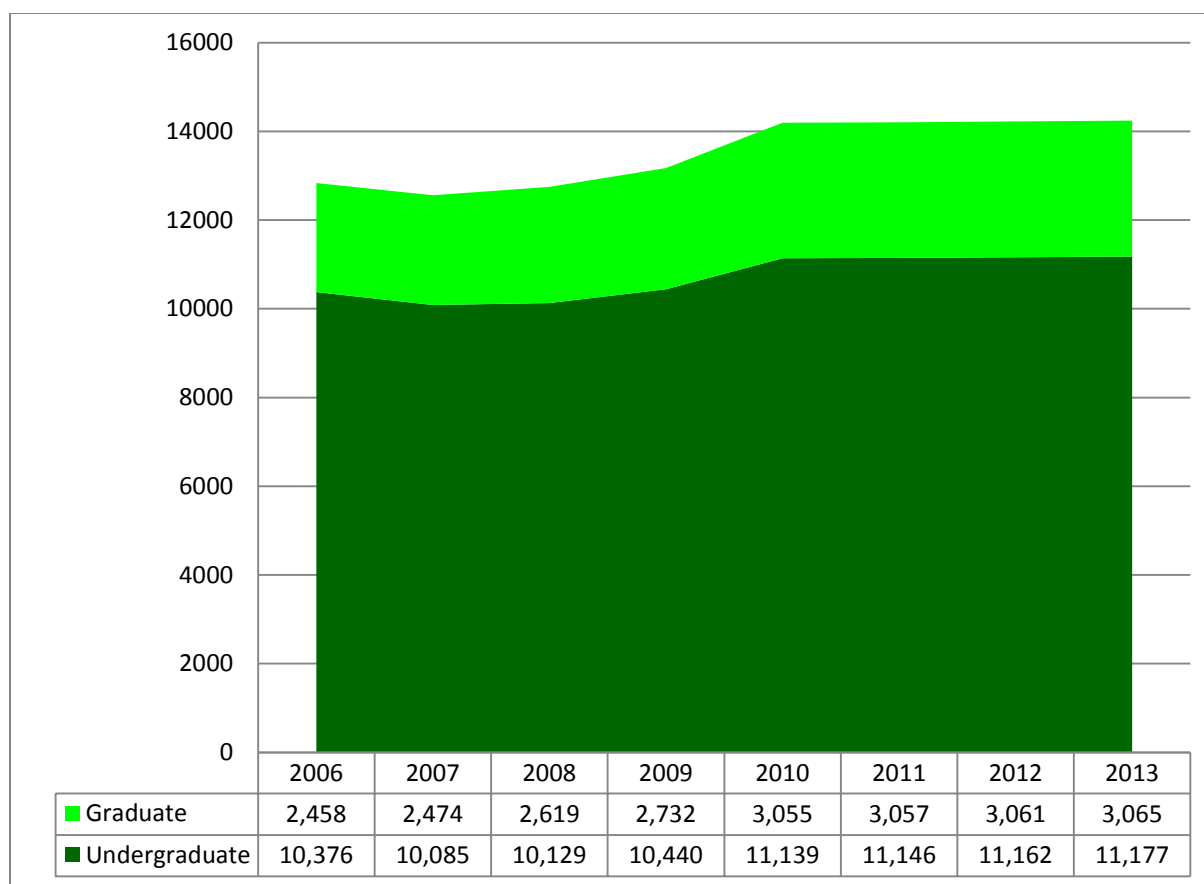


Figure 2 UND Undergraduate and Graduate Enrollment - FY 2006 to FY 2013

Information on students' residential location is critical for any university transportation- or mobility-related study. Using student enrollment data for the years 2006 through 2010, residential information was observed. At UND, students are generally categorized as belonging to one of three housing categories – university housing, Greek housing, or off-campus housing. University housing generally accounts for between 27% and 29% of enrolled students. It includes three sub-categories – residence halls, apartment-style housing (introduced in 2008), and family housing and single student apartments. Among these three sub-categories most students are housed in university residence halls. For all years, between 20% and 23% of enrolled students lived in university residence halls. Apartment-style housing consistently accounted for 2% of enrolled students while family housing and single student apartments fluctuated between 5% and 6% over the period.

Generally, Greek housing accommodated approximately 4% of enrolled students with an equal split of 2% between fraternities and sororities.

Of note, off-campus residential locations accounted for between 67% and 69% of enrolled students. This fact has many mobility implications for the university's shuttle service system. Table 2 and Table 3 show information on the type of residence occupied by students enrolled at UND for FY2006 to FY 2010.

Table 2 UND Enrolled Student Residential Information from 2006 to 2011

	Housing	2006	2007	2008	2009	2010	2011
University Housing	Residence Halls	3004	2816	2473	2611	2765	2979
	Apartment Style Housing	n/a	n/a	260	264	267	273
	Family Housing and Single Student Apartments	723	696	695	693	754	777
Greek Housing	Fraternities	271	257	261	224	241	235
	Sororities	240	205	201	210	225	218
Off-Campus and Not Reported	Off-Campus (Not Reported)	8716	8860	8669	8746	8920	9712
	Total	12954	12834	12559	12748	13172	14194

Table 3 UND Enrolled Student Residential Information in Percentages from 2006 to 2011

	Housing	2006	2007	2008	2009	2010	2011
University Housing	Residence Halls	23%	22%	20%	20%	21%	21%
	Apartment Style Housing	0%	0%	2%	2%	2%	2%
	Family Housing and Single Student Apartments	6%	5%	6%	5%	6%	5%
Greek Housing	Fraternities	2%	2%	2%	2%	2%	2%
	Sororities	2%	2%	2%	2%	2%	2%
Off-Campus and Not Reported	Off-Campus (Not Reported)	67%	69%	69%	69%	68%	68%
	Total	100%	100%	100%	100%	100%	100%

2.2 UND Shuttle Services

2.2.1 UND Transportation Department

Established in the early 1970s, the University of North Dakota's Transportation Department (UND Transportation) services all mobility and vehicular needs on the campus or for the university's faculty, staff, or students with specific types of off-campus mobility needs. UND Transportation also serves as a dispatch and service center for the North Dakota State Fleet Services (NDSFS), a division of the North Dakota Department of Transportation (NDDOT). UND Transportation provides services that include car rental, van transportation, shuttle bus services, and motor coaches to university departments, faculty, staff, students, student groups, athletic teams, and state agencies on occasion.

2.2.1.1 Mission and Goals

The mission of UND Transportation is to provide a high level of transportation and vehicle maintenance service to all departments and divisions within the NDSFS system. This mission is articulated in its most recently available annual report, Annual Report 2008-2009. Additionally, the creation of a solid working relationship with the university community, other schools in the North Dakota university system, North Dakota state agencies, and vendors is a primary goal of UND Transportation.

2.2.2 UND Shuttle System

2.2.2.1 Campus Shuttle Services

Campus shuttle services are among the various services provided by UND Transportation. The campus shuttle system comprises seven types of services. Eight types of services were provided from 2002 to December 2008. These services include the Campus Shuttle Service, the Night Shuttle Service, the Aviation Shuttle Service, service for individuals with disabilities referred to as Disability Support, the Ralph Engelstad Arena (REA) Hockey Shuttle Service, the Alerus Football Shuttle Service, and additional services. The Safe Ride Shuttle service was implemented in 2002 to provide shuttle services to UND students to and from student housing facilities and study facilities. This service was discontinued in December 2008 because of relatively low ridership.

The campus shuttle system's service area encompasses the majority of campus. The service area is depicted in Figure 3.

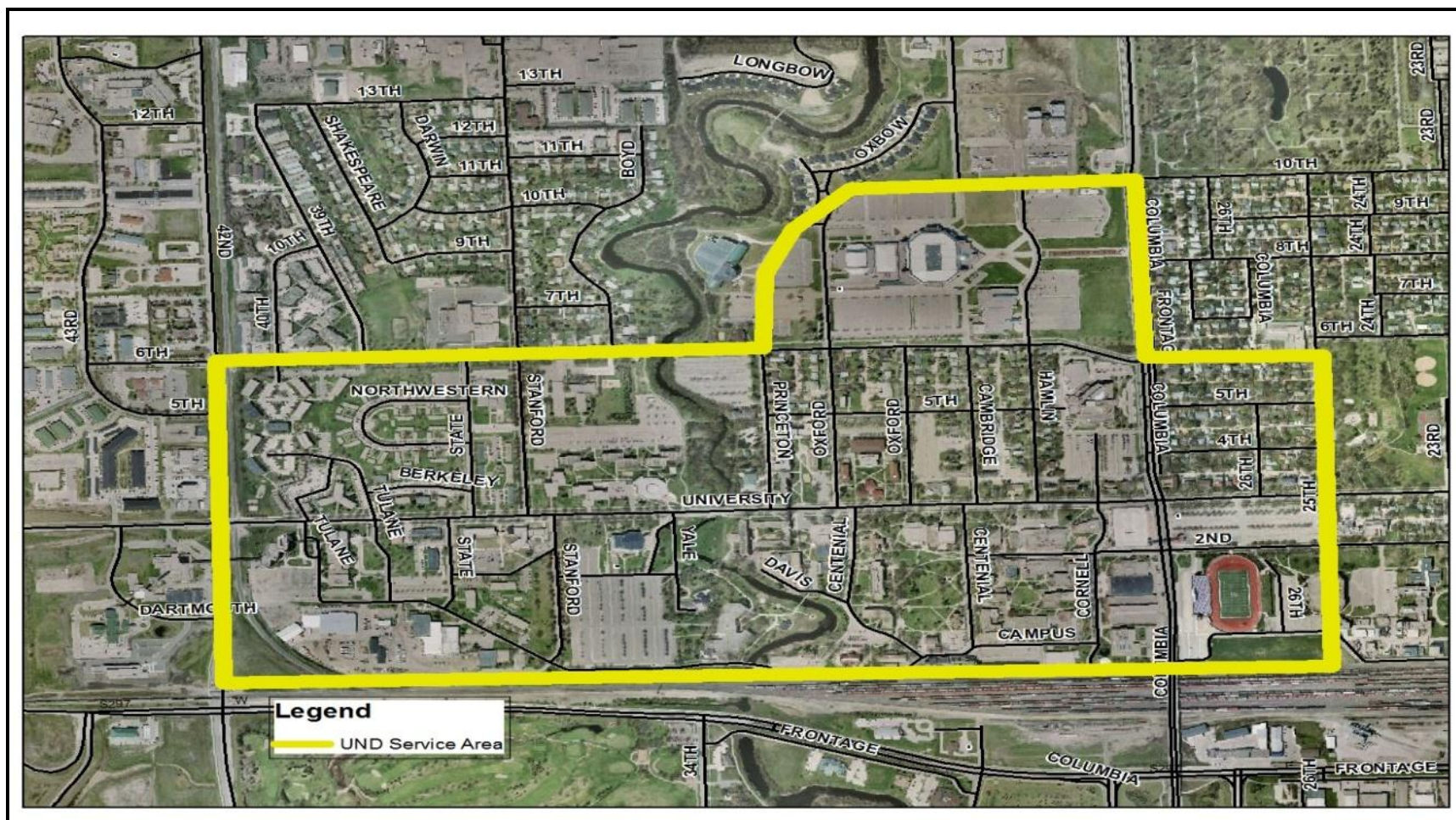


Figure 3 UND Campus Shuttle System Service Area

The Campus Shuttle Service

The Campus Shuttle Service comprises four routes – the Red (#1), the Blue (#2), the Green (#3), and the Purple (#4). Each of these routes operates on an independent schedule. Collectively, the four routes provide services at a combined total of 29 bus stops, each located at various sites across the campus. Table 4 shows the stops associated with each of the four Campus Shuttle Service routes; each route’s vehicle headway, i.e. the distance between subsequent shuttle buses at a given campus bus stop location expressed in time; each route’s service frequency, i.e. the number of times a shuttle bus passes a particular given campus bus stop location within a specified time – in this case an hour; the time span over which service is available on each route; and the each route’s travel time.

Table 4 UND Campus Shuttle Service Route Characteristics

Route Stops	Route			
	Route 1-Red	Route 2- Blue	Route 3- Green	Route 4 - Purple
	Odegard West Side	Odegard West Side	Gallery Apartments	Odegard East Side
	University Place	Central Receiving	Odegard East Side	Gallery Apartments
	Chester Fritz Audt.	Hughes Fine Arts	University Place	Stanford Road
	Johnstone/Gamble	Upton I	Chester Fritz Audt.	Wellness Center
	Memorial Union	Hyslop	Johnstone/Gamble	Ralph Engelstad Arena
	Stadium Parking Lot	Stadium Parking Lot	Memorial Union	Bookstore
	Witmer	Memorial Union	Bookstore	Memorial Union
	Upton I	Hancock/Bek	Ralph Engelstad Arena	Hancock/Bek
Route Vehicle Headway	Hughes Fine Arts	Wilkerson	Wellness Center	Wilkerson
	Central Receiving	State St./Univ. Ave.	Stanford Road	State St./Univ. Ave.
Route Service Frequency	Four times per hour	Four times per hour	Three times per hour	Three times per hour
Route Service Time Span	8:21 am to 4:06 pm	7:28 am to 3:13 pm	7:25 am to 3:29 pm	8:36 am to 4:16 pm
Route Travel Time	15 minutes	15 minutes	20 minutes	20 minutes

Routes #1 and #2 are identical in that they transverse the same streets and roads. The differences between them are that they run in opposite directions and that four out of the ten stop locations along them differ. Likewise, Routes #3 and #4 are identical in that they transverse the same streets and roads. Again, the difference between them is that they run in opposite directions and that three of the ten stop locations along them differ. Each of the Campus Shuttle Service’s routes provides service utilizing one 40-passenger shuttle bus. Figures 4, 5, 6 and 7 show the route maps for each of the Campus Shuttle Service’s routes.

The Night Shuttle Service

The Night Shuttle Service comprises a sole route which services stops located at 15 sites across the campus. With a service frequency of two times per hour, the service is provided from Mondays through Thursdays and is available from 4:08 p.m. to 9:48 p.m. on those days. The service is provided utilizing one 40-passenger shuttle bus. Table 5 shows the service’s bus stops, its vehicle headway, its service frequency, the time span over which service is available on the route, and the route’s travel time. Figure 8 shows the Night Shuttle Service route.

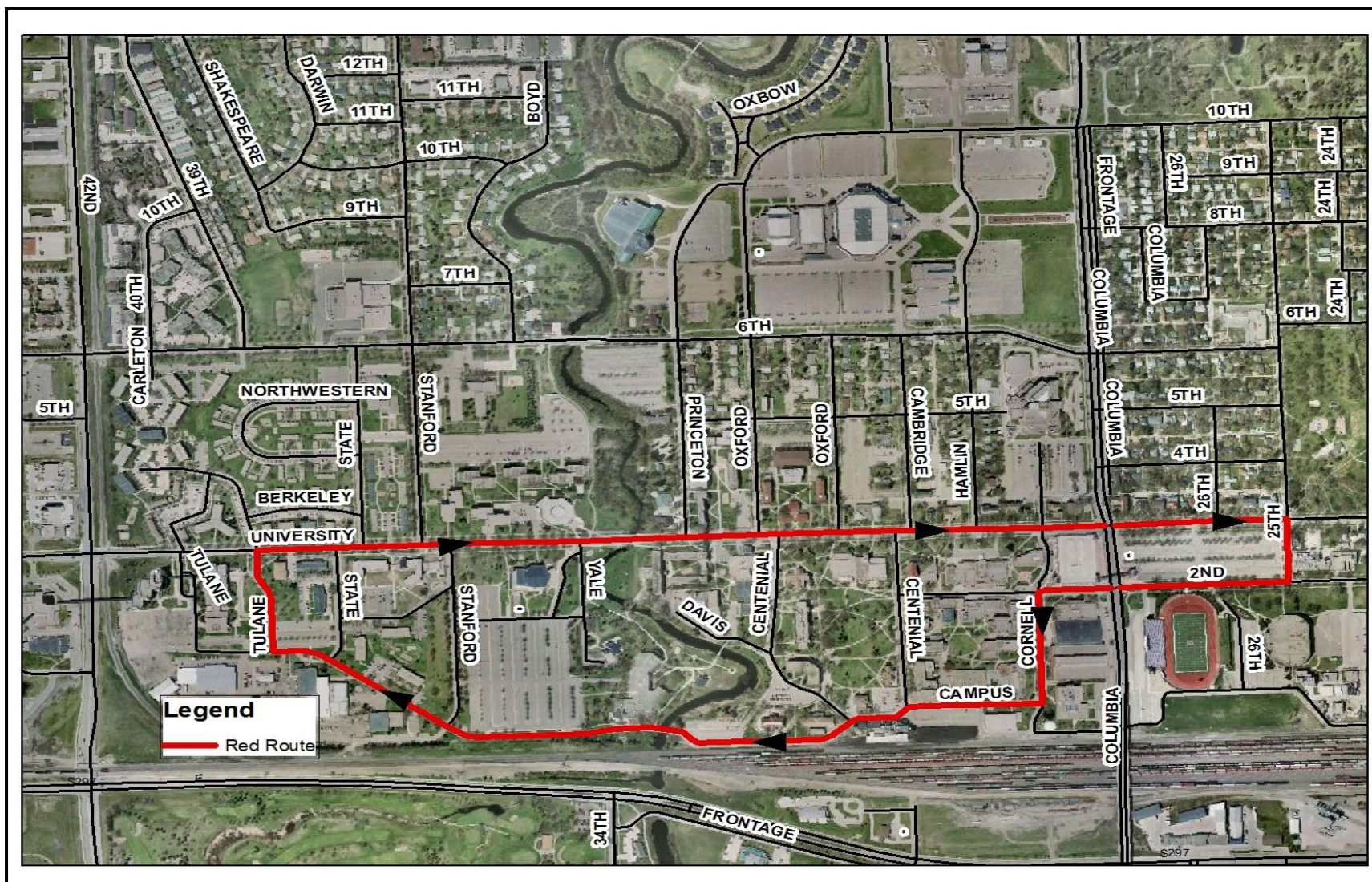


Figure 4 UND Campus Shuttle Service - Red Route (#1)



Figure 5 UND Campus Shuttle Service - Blue Route (#2)

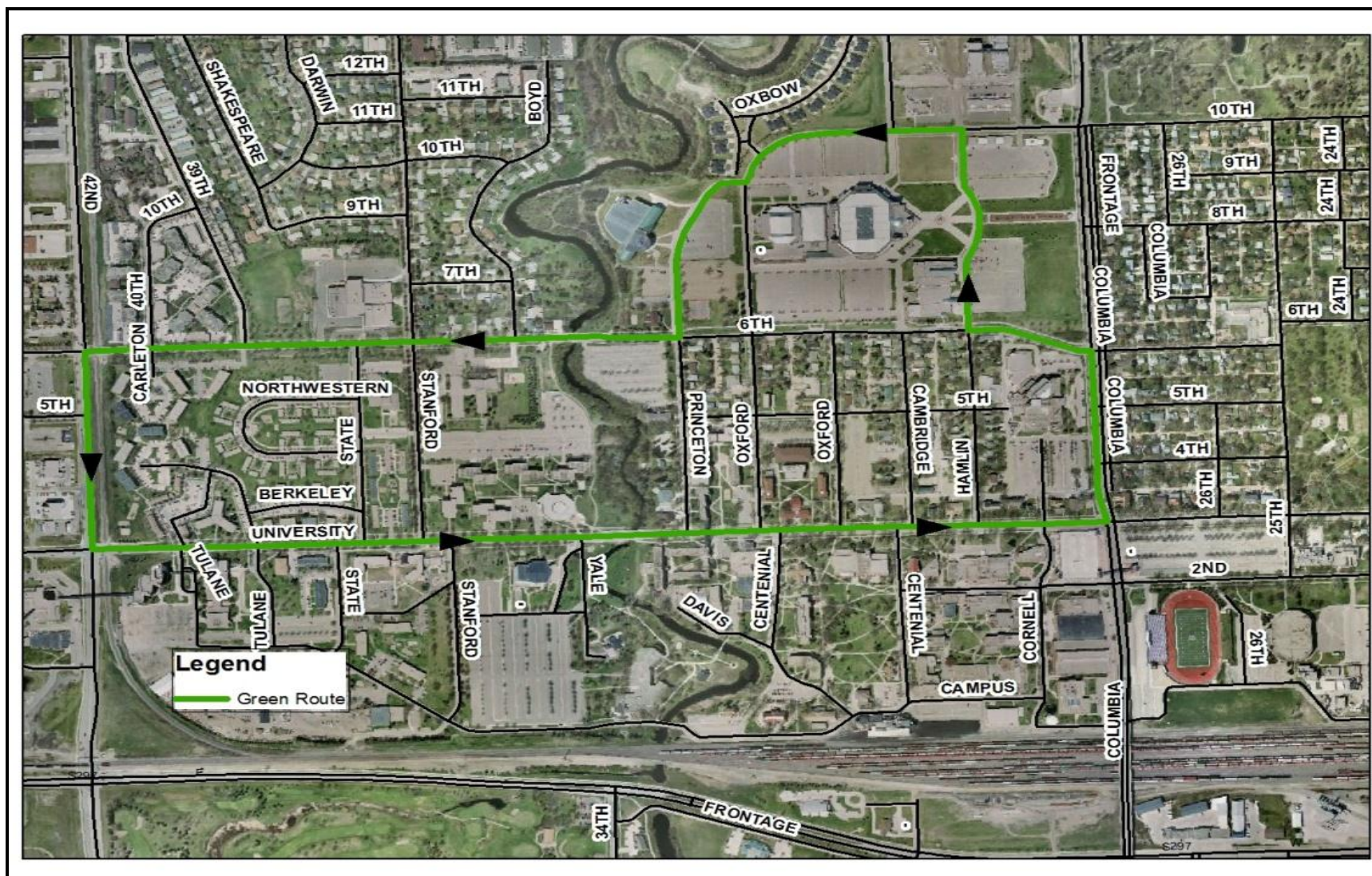


Figure 6 UND Campus Shuttle Service - Green Route (#3)



Figure 8 UND Night Shuttle Service Route

Table 5 UND Night Shuttle Service Characteristics

Night Shuttle Service Route	
Route Stops	Odegard East Side
	Central Receiving
	Hughes Fine Arts
	Upton I
	Hyslop
	Stadium Parking Lot
	Memorial Union
	Hancock/Bek
	Wilkerson
	State St./Univ. Ave.
	Wellness Center
	Ralph Engelstad Arena
	Stanford Road
	Gallery Apartments
Route Vehicle Headway	30 minutes
Route Service Frequency	Two times per Hour
Route Service Time Span	4:08 pm to 10:08 pm
Route Travel Time	30 minutes

Aviation Shuttle Service

UND's Aviation Shuttle Service provides shuttle service to students who want to access UND's campus facilities at the Grand Forks International Airport. Students travelling to these facilities are generally students enrolled in the university's aviation program. As of FY 2009 the service is provided using two passenger vans, the second of which was added to provide additional service in March 2008. The Aviation Shuttle Service is available throughout the school year on Mondays through Sundays.

The Aviation Shuttle Service's two vans, referred to as Van #1 and Van #2, make pick-up stops on campus at Odegard and Ryan, and then off-campus at the Grand Forks International Airport. On Saturdays and Sundays an additional stop, State Street/University Avenue, is included before the vans proceed to the airport.

Both operating on the identical route, Van #1 and Van #2 operate on different time schedules. Van #1 operates on Mondays through Saturdays from 5:45 a.m. until midnight and on Sundays from 7:45 a.m. until midnight. Van #2 operates on Mondays through Saturdays from 7:30 a.m. until midnight and on Sundays from 7:00 p.m. until midnight. In FY09, the Aviation Shuttle Service provided 98,109 trips. Table 6 provides information on the Aviation Shuttle Service's characteristics as it relates to Van #1 and Van #2.

Table 6 UND Aviation Shuttle Service Characteristics

Route Stops	Van	
	Van #1	Van #2
	Ryan Hall (15 minutes after and before the hour)	Ryan Hall (On the hour and 30 minutes after the hour)
	Odegard	Odegard
	Ryan Hall	Ryan Hall
	State St. /Univ. Ave. (On Saturdays and Sundays Only)	State St. /Univ. Ave. (On Saturdays and Sundays Only)
	Grand Forks International Airport (On the hour and 30 minutes after the hour)	Grand Forks International Airport (15 minutes after and before the hour)
Route Vehicle Headway	30 minutes	30 minutes
Route Service Frequency	Twice per hour	Twice per hour
Route Service Frequency (Combined)	Four times per hour (Monday to Sunday – 7:30 am to 7:00 pm)	
Route Service Time Span	Monday to Saturday – 5:45 am to 12:00 am Sunday – 7:45 am to 12:00am	Monday to Sunday – 7:30 am to 7:00 pm
Route Travel Time	30 minutes	30 minutes

Disability Support

UND Transportation provides shuttle services through vans equipped to cater to the needs of students with disabilities. These services are provided on a demand-response basis, i.e. providing service based on requests from student passengers. This service is also sometimes done in coordination with UND's Student Health Services Department. In FY09, the Disability Support service provided 289 trips.

Sporting Event Shuttle Services

UND Transportation provides shuttle services to UND sporting events, particularly hockey and football. These services are provided for UND students, UND sports teams, and the general population. Sports event attendees are transported from various campus parking sites to event arenas. The Ralph Engelstad Arena (REA) Hockey Shuttle provides shuttle service to the (REA) hockey facility. In FY09, this service provided 27,483 trips. The Alerus Football Shuttle provides shuttle services to the Alerus football arena from two campus locations – the Chester Fritz Auditorium and, when transporting the football team, from the Memorial Stadium. In FY09 this service provided 7,618 trips.

Additional Shuttle Services

UND Transportation also makes shuttle services available, on a user pay basis, to various student groups, university departments, and state agencies on a year round basis. This shuttle service is provided for predominantly in-town destinations. However, it can be acquired for specific out-of-town destinations. Specific activities for which additional shuttle service has been utilized include workshops, conventions, conferences, tours, and athletic events. Note that, in FY 09 additional shuttle service was provided to transport volunteers to participate in the flood volunteer effort in Fargo, ND, from March 23 to 27. This additional service was provided utilizing seven shuttle buses, one of which has since been sold. Generally,

additional shuttle services are paid for by the groups utilizing the service. The minimum fee for this service, as of FY09, was \$125 a day per bus. In FY09, 343 of these types of trips were provided.

2.2.2.2 Shuttle Fares

The Campus Shuttle Service, Night Shuttle Service, and Disability Support services are provided to UND students, and faculty and staff free of charge. The other types of shuttle services are provided where fares are not directly charged on a per-rider basis but costs are covered through a user-pay fee system. Services utilizing this user-pay fee system are the sporting event services and the additional shuttle services. Other departments and organizations pay to cover the costs associated with providing the service, i.e. UND Transportation provides the service on an at-cost basis.

2.2.2.3 Shuttle Staff

The personnel employed in providing UND shuttle services are all staff of UND Transportation. In FY09, UND Transportation's staff consisted of 38 employees, 25 of whom were student employees. From an organizational perspective, the UND shuttle service is supervised by the mass transit coordinator who reports to the transportation department head who, previously, reported to the director of campus safety and security who, in turn, reported to the vice president for finance and operations. However, the director of campus safety and security position has been appointed to a special project and, until further notice, the transportation department manager reports to the associate vice president for finance and operations.

At any given time, approximately 15 to 20 student drivers, one three-quarter time employee, and one full-time employee are dedicated to providing campus shuttle services. The shuttle services' driving staff consists primarily of student drivers. Figure 9 shows the organizational structure of UND Transportation.

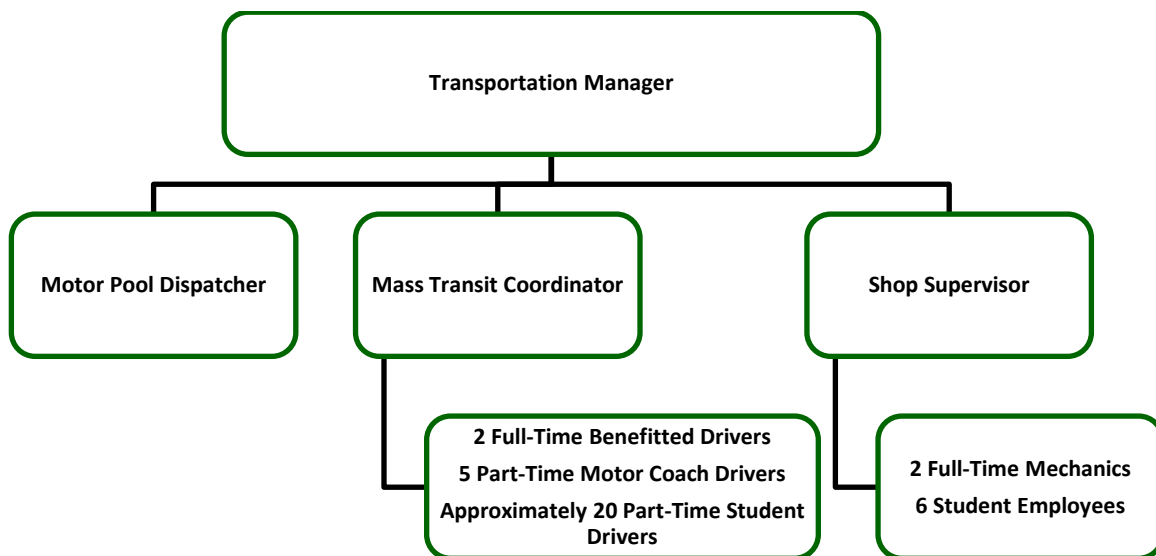


Figure 9 Organizational Structure of UND Transportation

2.2.2.4 Fleet and Facility Information

All vehicles utilized by UND Transportation are leased from NDSFS. These vehicles, all owned, insured, and maintained by NDSFS, are leased on a per-mile or per-hour basis. The buses used for shuttle services are leased on a per-hour basis. The most recent rate was \$29 per hour. However the rate is re-evaluated every three months by NDSFS and may fluctuate throughout a given year.

Six buses are used for shuttle services. These buses are on 15-year depreciation schedules and may be replaced earlier based on their condition and the availability of NDSFS funds to do so. Replacement evaluation occurs yearly with the NDSFS conducting meetings to assess vehicle condition with various UND representatives. Information on the shuttle service's bus fleet is provided in Table 7.

Table 7 UND Transportation Shuttle Service's Bus Fleet Information

Manufacturer	Model	Vehicle Type	Model Year	Seating Capacity	No. of Wheelchair Positions
International (IC Bus)	RE Commercial	School Bus	2001	40	2
International (IC Bus)	RE Commercial	School Bus	2002	40	2
International (IC Bus)	RE Commercial	School Bus	2004	40	2
International (IC Bus)	RE Commercial	School Bus	2004	40	2
International (IC Bus)	RE Commercial	School Bus	2007	40	2
International (IC Bus)	RE Commercial	School Bus	2011	40	2

2.2.2.5 Funding

Various sources of funding used to provide UND shuttle services generally include appropriated funds, local allocations, and other sources. Appropriated funds consist of institutional collections, primarily tuition and appropriations from the university's general fund. Local allocation funds are generated from student fees and other forms of institutional revenues including interest income and facilities and administrative fees. Other sources of funding can include departmental funds, funding generated from specific academic or administrative departments, and funding generated from organizations like Alerus, as pertains to the football arena. These other funding sources are usually directed to UND Transportation in the form of user-pay fees charged for shuttle services.

Notably, UND Transportation, and by extension UND, does not receive any form of federal funding from the US DOT or any of its formula or discretionary programs. Table 8 shows the primary funding sources for each type of shuttle service.

Table 8 Primary Funding Sources by Shuttle Service Type

Shuttle Service Type	Primary Funding Source
Campus Shuttle Service	Local Allocation, Appropriated Funding
Night Shuttle Service	Local Allocation, Appropriated Funding
Aviation Shuttle Service	Aerospace Sciences Student Fees, Local Allocation, Appropriated Funding
Disability Support	Local Allocations
REA Hockey Shuttle Service	Event Parking Funds
Alerus Football Shuttle	The Alerus and Football Team Funds

2.2.2.6 Revenues and Expenses

Revenues

The revenue sources used in providing shuttle services vary according to the type of shuttle service provided. For both the Campus Shuttle Service and the Night Shuttle Service, services for which detailed financial data was available for use in this study, appropriated funds and transferred-in funds are the primary revenue sources. For FY 2006 to FY 2010, with 2010 figures being reported up to mid-June 2010, appropriated funds remained fixed at \$120,341 annually. Over the same period, the level of transferred-in funds showed steady yearly increases from \$138,631 in 2006 to \$167,918 in 2010.

For the Aviation Shuttle Service, local funds and appropriated funds account for a substantial proportion of funding. Funding also comes from the Aerospace Science Department's contributions to cover service costs. In FY 09 this contribution was \$25,000.

The Disability Support shuttle service is funded through local allocations.

The REA Hockey Shuttle Service, the Alerus Football Shuttle, and extra shuttle services are all fully funded through user fees charged at cost of the service. In FY09, REA Hockey Shuttle Service generated \$24,150 in revenues paid for by the Parking Department. The Alerus Football Shuttle generated \$5,625 in revenues paid for by Alerus and the UND football team. Revenues were generated for providing extra shuttle services by charging a rate of \$125 a day per bus.

Expenditures

Expenditures resulting from providing the Campus Shuttle Service and the Night Shuttle Service fluctuated over the period of FY 2006 to FY 2010. The lowest annual expenditure over the period was \$248,360 in 2007 and the highest, \$276,451, was in 2009.

The Aviation Shuttle Service incurred an operating cost of \$247,253 in FY09. The operating cost of providing the Disability Support service in FY09 was \$5,918.

The operating costs of providing the REA Hockey Shuttle Service and the Alerus Football Shuttle Service were \$24,150 and \$5,625 respectively.

Table 9 provides yearly data on the combined revenues and expenses of the Campus Shuttle Service and the Night Shuttle Service from FY 2006 to FY 2010.

Table 9 Revenue and Costs for the Campus and the Night Shuttle Services for FY 2006 to FY 2010

	Revenue			Expenditure
	Transferred-in	Appropriated	Total	
FY 2006	\$138,631	\$120,341	\$258,972	\$255,132
FY 2007	\$141,644	\$120,341	\$261,985	\$248,360
FY 2008	\$150,621	\$120,341	\$270,962	\$270,830
FY 2009	\$156,110	\$120,341	\$276,451	\$276,451
FY 2010	\$167,918	\$120,341	\$288,259	\$258,503

2.2.3 Transportation Alternatives and Complimentary Services

In addition to the shuttle services provided by UND, students have various transportation alternatives they can utilize. The student government at UND has established programs with various local transportation service providers that facilitate increased transportation options for UND students. Two such services are known as the Cab Crawler and the CAT Prowler.

The Cab Crawler service provides discounted taxi rides to UND students through partnership with a local taxi company. With appropriate identification, taxi rides within the Grand Cities area are provided at a cost of \$3.

The CAT Prowler service facilitates free public transportation service for any UND student with Cities Area Transit, the local public transportation service provider for Grand Forks, ND, and East Grand Forks, MN. The service applies to any of CAT's services and routes. UND Student Government pays CAT monthly for each one-way student trip taken. CAT charges \$0.75 for each fixed-route service trip taken and \$2.75 for each dial-a-ride service trip taken by students.

CAT's general public transportation service is provided through various programs that include both fixed-route and paratransit services. CAT provides services through eight routes, Mondays through Saturdays. More specifically, regular fixed-route services are provided Mondays through Fridays from 6:30 a.m. to 6:30 p.m. and on Saturdays from 10:00 a.m. to 6:30 p.m. CAT's night service, referred to as Night CAT, is available Mondays through Saturdays from 6:00 p.m. to 10:00 p.m. Dial-a-ride service, which is also referred to as paratransit service, is available Mondays through Fridays from 6:00 a.m. to 10:00 p.m. and on Saturdays from 8:00 a.m. to 10:00 p.m.

As an alternative, walking is of importance at UND. This is especially so when considering the university's commitment to sustainability and environmental responsibility. Indoor walkways and tunnels exist across the campus and are managed and maintained by the UND Facilities Management department. All residence halls to both the west and east of the English Coulee are connected by these walkways. Additionally many of the university's academic buildings are connected via tunnels or walkways. Further, the parking ramp facility has an indoor walkway connection to the Memorial Union.

Each of the aforementioned transportation alternatives will wield influence, in various measures, on student and staff usage of the campus' shuttle system. These influences are discussed in a subsequent section.

2.2.4 Existing Shuttle System Challenges and Issues

In May 2010, in an initial meeting with UND shuttle system stakeholders and the UND Campus Shuttle Study Project Advisory Committee, the SURTC project team was informed of various challenges and issues related to the university's shuttle bus system. These challenges and issues are predominantly in four areas: driver scheduling, fleet and facilities maintenance, ridership levels, and funding.

- Driver scheduling. Most shuttle service drivers are students, so developing a well-planned and executed student driver work schedule is problematic. This issue is accentuated when considered in context of anticipated shuttle service expansions.
- Fleet and facilities maintenance. The department's vehicle refurbishing time, summer, is not in tandem with the state's budgetary cycle. This can often result in UND shuttle facilities receiving less funding for refurbishment. The inadequate size of the transportation department's garage results in vehicle congestion and delays in repair and maintenance.
- Ridership levels. UND faculty and staff are permitted to use the shuttle system, but their utilization rate is relatively low. Although all shuttle service vehicles are accessible, concern was expressed over awareness of the service among the population of individuals with disabilities. Challenges to shuttle system usage resulting from university parking policy and practices also was identified as an issue.
- Funding. A desire for more inter-department cost-sharing was communicated by committee members.

2.2.5 Parking

UND's parking policies, its parking lot locations, and the way that parking is priced will have an impact on campus shuttle system usage. Various types of parking permits are available to UND students. The type of parking permit a student is issued depends on their residential location and, in other instances, their preference. Students that reside on-campus purchase "H" permits that allow parking at residence hall parking lot facilities. "H" permits are further subdivided according to residence halls. Students acquiring these permits are allowed to park only at the residence hall for which a permit is issued, the one in which they reside. Students that reside off-campus may purchase "S" permits that allow parking in designated "S" parking lots. Students acquiring "S" permits are allowed to park at any "S" lot location across campus. "G" lot parking, or general parking facilities, can be utilized by anyone with a UND issued parking permit, making it another parking option for both on-campus and off-campus students.

There are additional parking options available to UND students. There are "Time Zone" lots available that allow free parking up to 30 minutes. No permit is required to use these parking spaces. "Meter Zone" parking is also available. These parking facilities do not require a parking permit but a fee must be paid. "Meter Zones" are usable by anyone on the campus. After 5 p.m., some meter parking facilities are available to vehicles with UND permits without charge. "Park and Ride" facilities are also provided to students at a price that is discounted relative to other student parking permits. The main purpose in offering this type of parking is to provide an option for students to park at the perimeter of campus and then utilize the campus' shuttle services to get to more central campus locations. Another type of parking, reserved parking, is also available to students. Reserved parking lots for students are provided at UND's parking ramp facility located at the intersection of University Avenue and Columbia Road. This reserved permit is priced higher than that of others available to students. The parking ramp facility also permits "G," general parking, for anyone having a UND parking permit except holders of "PM" and "Park and Ride" permits. This general parking is available on ramp levels 3, 4, and 5.

Note that “Accessible” parking, parking that caters specifically to the needs of individuals with disabilities, is available at various parking lots throughout the UND campus. Students and employees must have “Accessible” parking permits to use these facilities.

Parking is also available on city streets within the vicinity of the campus. Parking permits are not required to park on city streets north of University Avenue. However, parking without a permit is not allowed on Centennial Drive and the majority of campus streets south of University Avenue. Parking space not requiring a permit is available on Stanford Road but only as dictated by street signs.

The implications of UND’s parking policy and practices to campus shuttle service usage will be discussed in a subsequent section. Table 10 shows the prices of the various types of parking permits available to students at UND. Table 11 shows the prices of the various types of parking permits available to university staff.

Table 10 UND Student Parking Permit Type and Cost

Student Parking Type	Permit	Color Code	Cost
Residence Hall	H	Green	\$155
Off-Campus	S	Blue	\$155
On-Campus Apartments	S	Blue	\$155
Evening Parking (4 PM – 11PM)	PM	Orange	\$65
Accessible Parking	SHZ	Purple	\$155
Park and Ride	PR	Pink	\$125
Ramp	RCS	Grey	\$300

Table 11 UND Employee Parking Permit Type and Cost

Employee Parking Type	Permit	Color Code	Cost
Faculty/Staff	A	Red	\$225
Residence Hall Directors	AHR	Red	\$225
Faculty/Staff Accessible	AHZ	Red	\$225
Deans, Directors & Associate Directors	AD	Red	\$810
Presidents and Vice Presidents	AVP	Red	\$810
Evening Permit (between 5PM and 4 AM)	PMA	Orange	\$65
Park & Ride	PL	Pink	\$125
Ramp	RCA	Red/Yellow	\$400

Use of the campus shuttle system at UND is contingent, as noted in this chapter, on various factors. Primary among these factors are the type of shuttle services available, the types of transportation alternatives available, and the travel behavior of students and staff. As noted, UND Transportation provides various types of shuttle services. In addition to the campus shuttle system, the availability of taxi cabs, the CAT public transportation system, the university’s extensive indoor walkway and tunnel system, and both the availability and price of parking contribute to a multifaceted university transportation system. The following chapters investigate the influence of these various factors on not only how the campus shuttle system performs, but on students’ travel behavior and their perception and use of the campus shuttle system.

3. SHUTTLE BUS SURVEY AND SERVICE ANALYSIS

This section addresses the UND campus shuttle system from two perspectives. The first perspective involves determining students' travel behavior as well as their attitudes toward the campus shuttle system, their perception of the shuttle services, and their preferences and recommendations regarding the campus shuttle system's service characteristics. This analysis uses the results of a survey developed by SURTC and distributed to the UND student body.

The second perspective involves conducting a ridership analysis of the campus shuttle system's Campus Shuttle Service and Night Shuttle Service. An analysis of both the Campus Shuttle and Night Shuttle Services' ridership, as measured by one-way passenger trips, by year, month, and time-period of day is conducted for FY 2006 to FY 2010. This analysis is facilitated through the use of route ridership data provided by UND Transportation.

3.1 Shuttle Bus Survey Analysis

3.1.1 Survey Development and Administration

In May 2010, after an initial meeting with the UND Campus Shuttle Study Project Advisory Committee, the SURTC team began developing a customized survey focused on generating student responses. With continual cooperation and input from members of the UND Campus Shuttle Study Project Advisory Committee, the final survey was developed in September 2010. Authorization to use the finalized survey was acquired from the Institutional Review Boards at both the University of North Dakota and North Dakota State University and from early October 2010 through the third week in November 2010, the survey was available online to all members of the UND student population.

3.1.2 Survey Response Analysis

Description of Survey Respondents

In total, 1,468 students responded to the survey. This figure represents over 10% of UND's total enrollment, a proportion that facilitates making inferences about the general student population from a statistical perspective. The sample of students from whom survey responses were collected represents a well-balanced sample that includes representatives from various categories in which UND students could be categorized. These categories include gender, student classification, number of semesters spent at UND, and student status.

Pertaining to gender, 59.2% of respondents were female while 40.8% were male. In the student classification category, the highest percentage of respondents was seniors, at 25.9%. They were followed by sophomores at 18.1%, graduate students at 17.3%, juniors at 17%, and freshmen at 16.1%. The student classification groups of law school, medical school, distance learning, and non-degree seeking students represented significantly less proportions of the survey respondent population at 2.1%, 1.2%, 1.3%, and 1% respectively. Figure 10 shows the student classification distribution of the survey respondents.

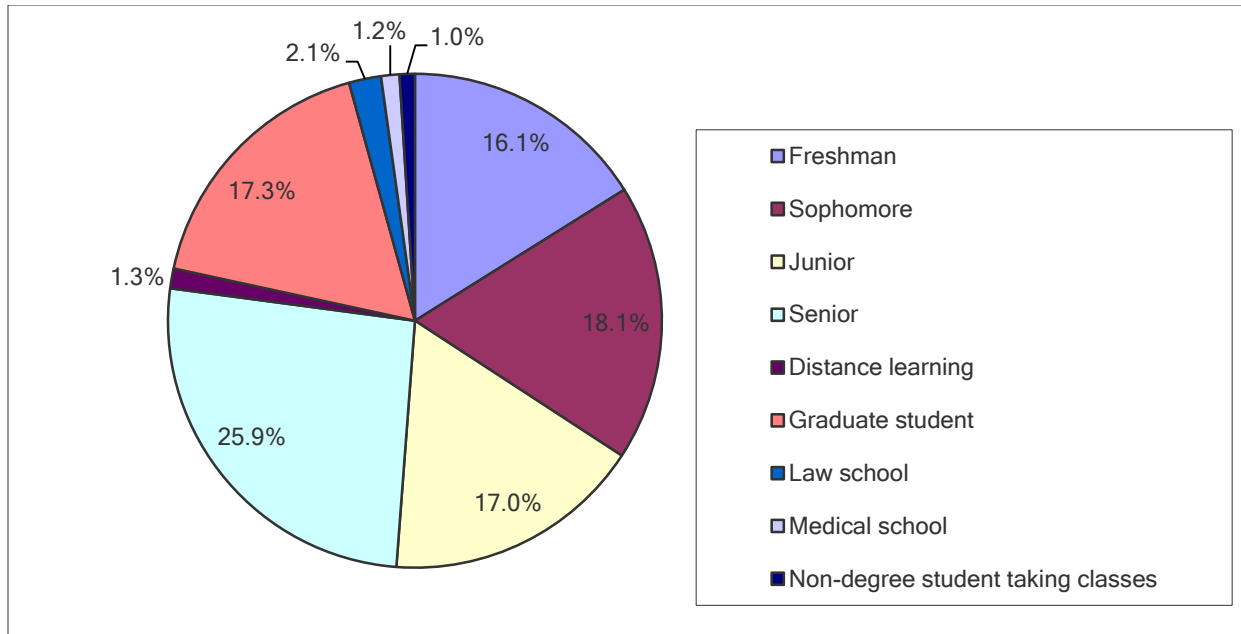


Figure 10 Survey Respondents' Student Classification

The highest proportion of responses, 30%, came from students who have attended UND for 0-2 semesters. This was followed by 3-4 semesters at 23.5%, 5-6 semesters at 17.8%, 9 or more semesters at 14.9%, and 7-8 semesters at 13.8%. Figure 11 shows the respective proportions of the number of semesters attended at UND by survey respondents.

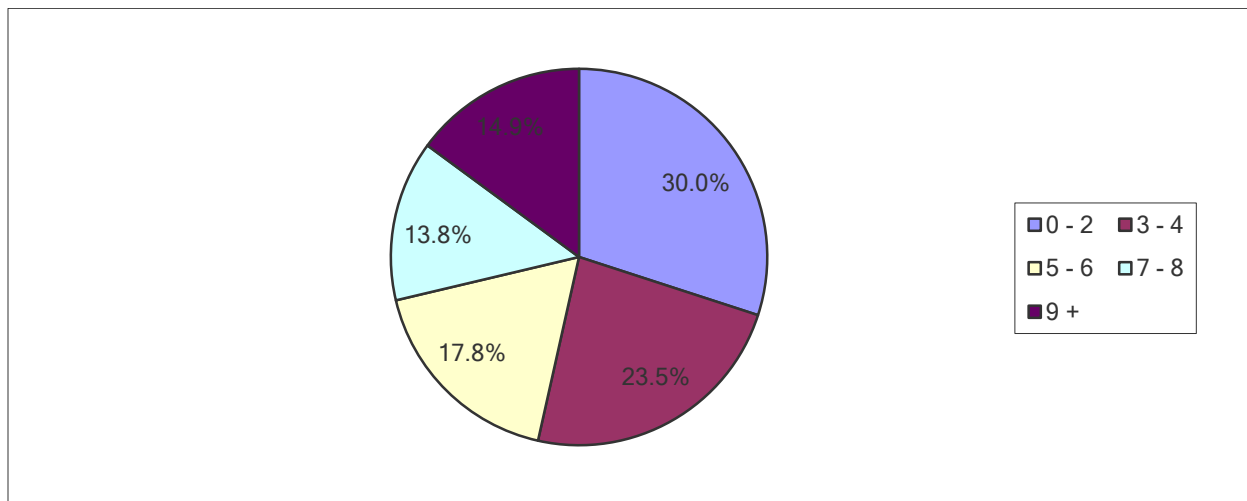


Figure 11 Survey Respondents' Number of Semesters at UND

Of the survey respondents, 93.8% were full-time students while 6.2% were part-time students.

Survey Respondents' Residential and Vocational Location

Knowledge of survey respondents' residential and work locations serves various purposes. These purposes include providing deeper insight into location's influence on campus shuttle system usage and in determining whether or not the shuttle system services' routes are aligned with respect to the location of existing and potential passengers.

The survey instrument sought to gather student location data of various natures. These included permanent addresses, addresses while attending UND, whether or not a respondent lives on-campus or off-campus, whether or not a respondent works on-campus or off-campus, and the distance a respondent lives away from campus.

Interestingly, 39.6% of survey respondents indicated that their address while attending UND is their permanent address. In terms of residential location, 56.4% of respondents indicated they lived off-campus. The rest of respondents resided in on-campus housing. They resided in apartments, Greek housing, or residence halls with representations of 14.6%, 3.9%, and 25.1% respectively. Figure 12 shows the distribution of residential location among survey respondents.

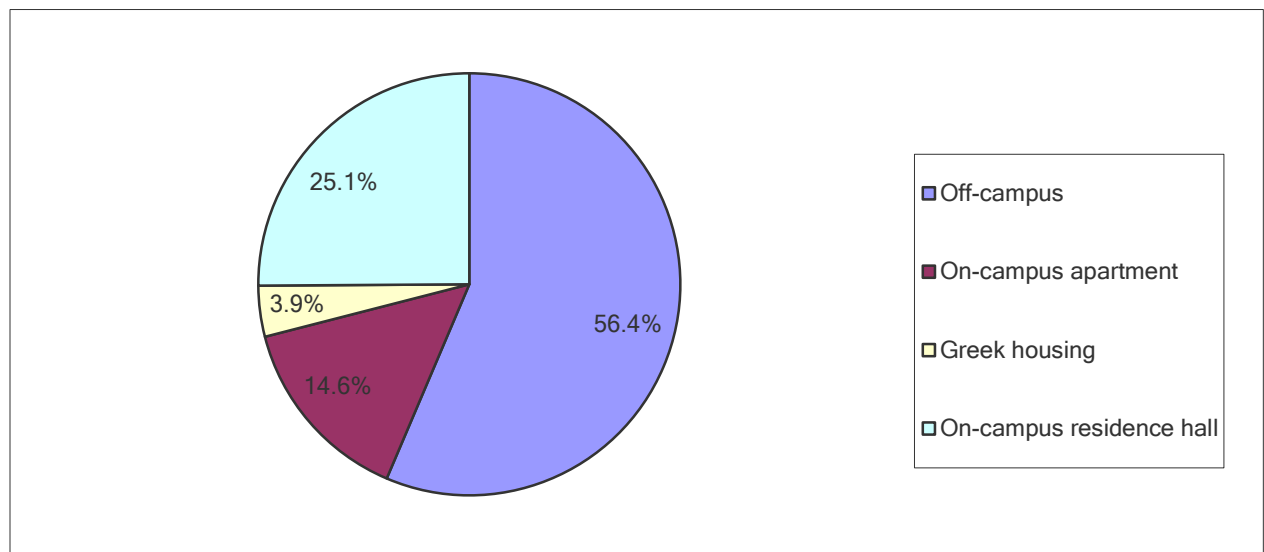


Figure 12 Survey Respondents' Residential Location

As relates to vocational locations, 32% of students work off-campus while 39.9 % work on-campus. Interestingly, 8.3% of respondents indicated that they are employed both on-campus and off-campus while 29.8% of student respondents indicated that they were unemployed. Figure 13 shows the distribution of work location among survey respondents.

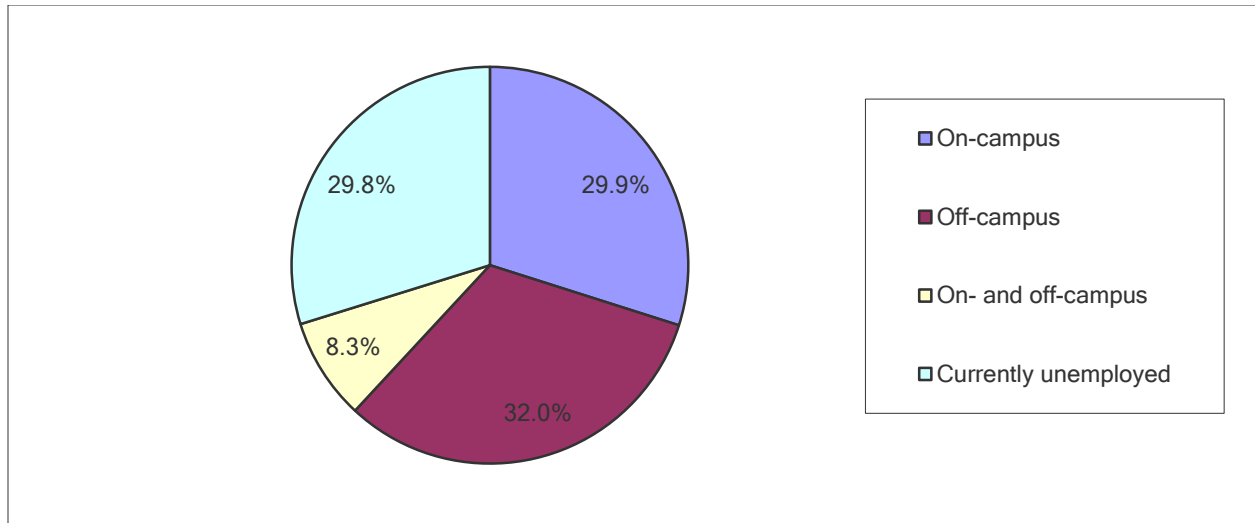


Figure 13 Survey Respondents' Vocational Location

In determining the distances which survey respondents travel when making trips from home to campus, the largest proportion of respondents, 40.8%, were found to live more than 1½ miles, 19 or more blocks, from campus. This was followed by those respondents that lived 1 mile, or 7 to 12 blocks, from campus at 24.2%. Closely following was respondents that lived ½ mile, or six blocks or less, from campus at 20.9%. The least amount of respondents represented were those that lived 1½, or 12 to 18 blocks, from campus at 8.3%. Figure 14 shows the results relating to respondents' home-to-school distance.

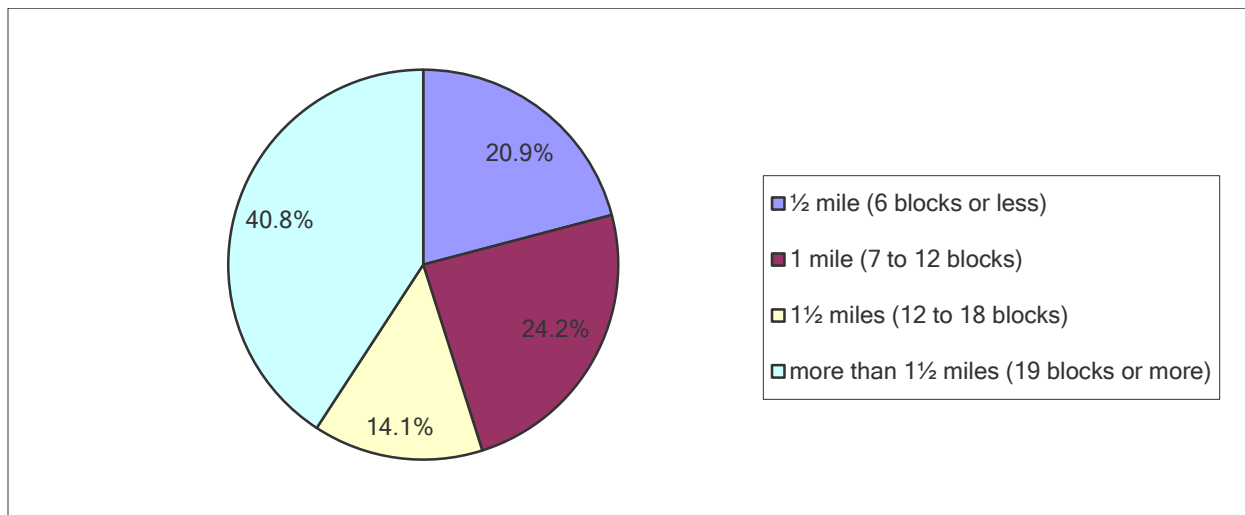


Figure 14 Survey Respondents' Residential Location Distance from Campus

Survey Respondents' Travel Behavior

To determine survey respondents' travel behavior, the survey collected information on the days respondents most frequently spent on campus, the time periods of the day they most frequently spent on campus, the number of one-way trips they made to and from campus daily, the location they most frequently travelled from when going to campus, the purpose for which they most often left campus, and what they considered to be a reasonable walking distance given a certain temperature.

As expected, students most frequently spent Monday through Friday on campus. Each of those five days received a response rate of 70 percent or higher. Among those days, Mondays and Wednesdays had the highest proportions at 86.3% each. They were followed by Tuesdays at 82.2%, Thursdays at 80.6%, and Fridays at 71.1%. Saturdays and Sundays were at 6.5% and 7.6% respectively. Figure 15 illustrates the response to weekdays most frequently spent on campus.

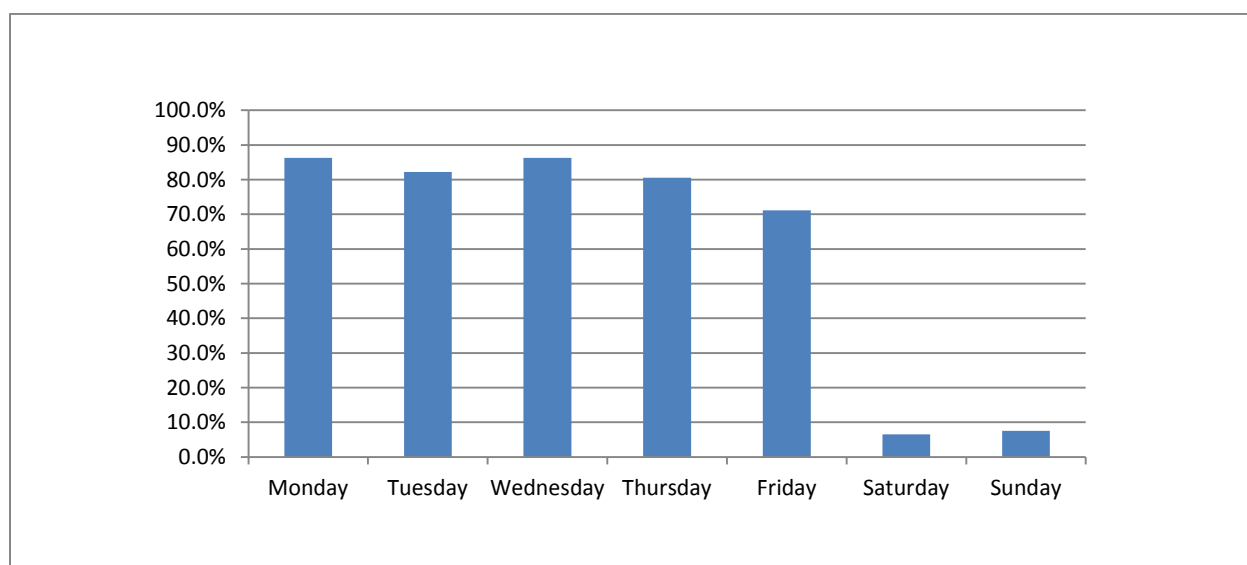


Figure 15 Survey Respondents' Weekday Most Frequently Spent on Campus

The time period of the day respondents most frequently spent on campus was the period between 10 a.m. and 12 p.m. at 84.4%. This was followed by 12 p.m. to 2 p.m. at 78.8%, 2 p.m. to 4 p.m. at 69.2%, 8 a.m. to 10 a.m. at 64.1%, and 6 p.m. to 8 p.m. at 21.8%. Figure 16 shows the results for the time period of the day most frequently spent on campus.

With respect to the number of one-way trips made to and from campus on a daily basis, 47% of respondents indicated that they make two one-way trips daily while 38% indicated they make four one-way trips daily. Figure 17 shows the number of one-way trips to and from the UND campus taken by respondents on a daily basis.

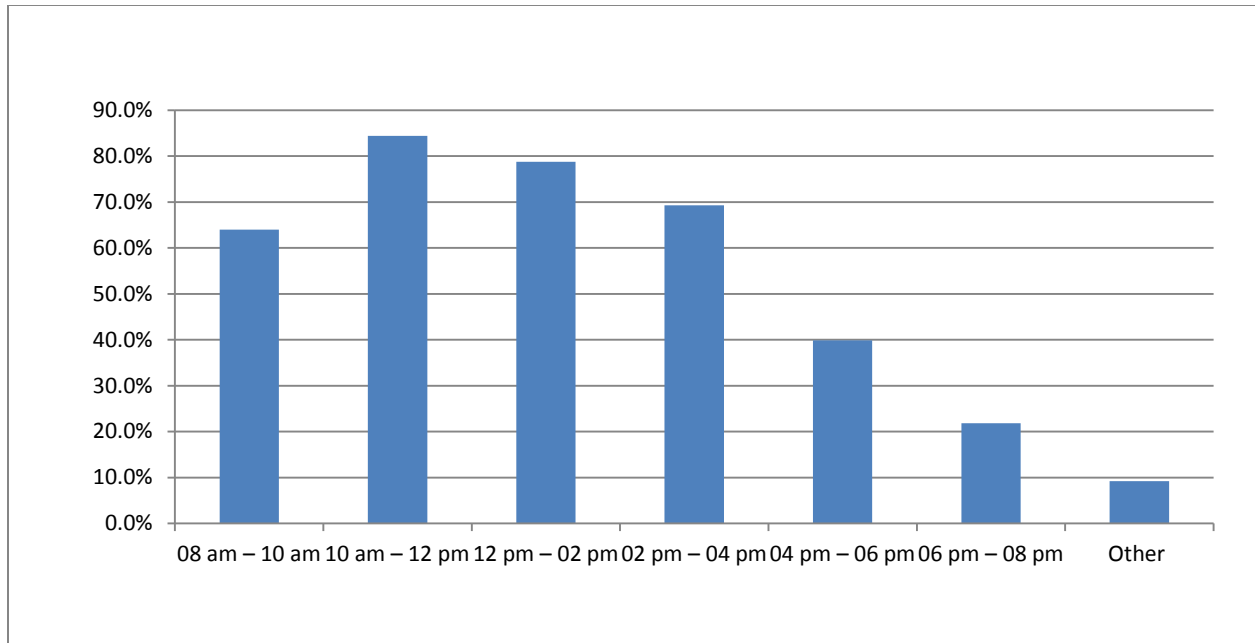


Figure 16 Survey Respondents' Time Period of Day Most Frequently Spent on Campus

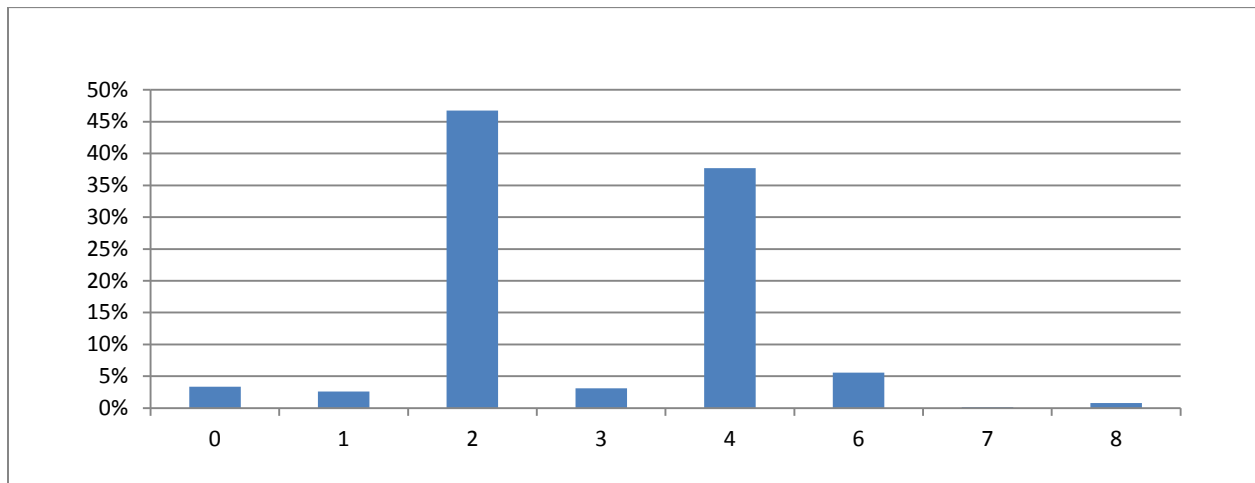


Figure 17 Survey Respondent's Number of Daily One-Way Trips to and From Campus

When asked from which location do they most frequently travel from when going to campus, 93.5% of respondents indicated they left from home. This was followed by work at 2.3%, other at 1.6%, the airport at 1.3%, and a child care facility at approximately 1%. Figure 18 illustrates the results for location most frequently travelled from.

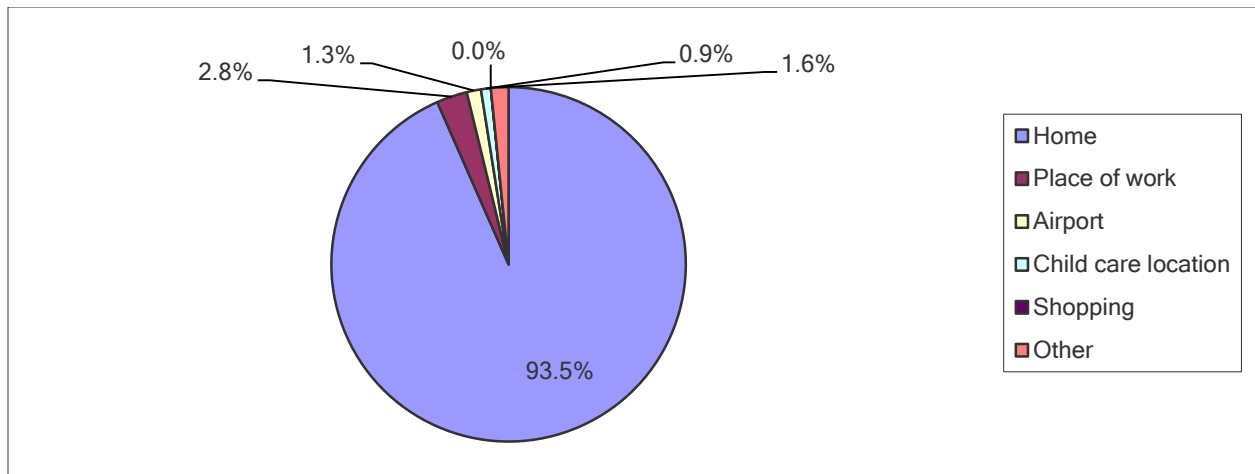


Figure 18 Survey Respondents' Location Most Travelled From When Going to Campus

When asked about the primary reason for which they most frequently left campus, 55.3% of respondents indicated that a trip home was the primary reason. Grocery shopping followed at 15.9%, going to work at 11%, entertainment-related destinations at 7.6%, other trips at 5.4%, restaurants at 3%, retail shopping locations at 1.2%, and the movie theatre at approximately 1%. Figure 19 shows the results for respondents' primary trip purposes when leaving campus.

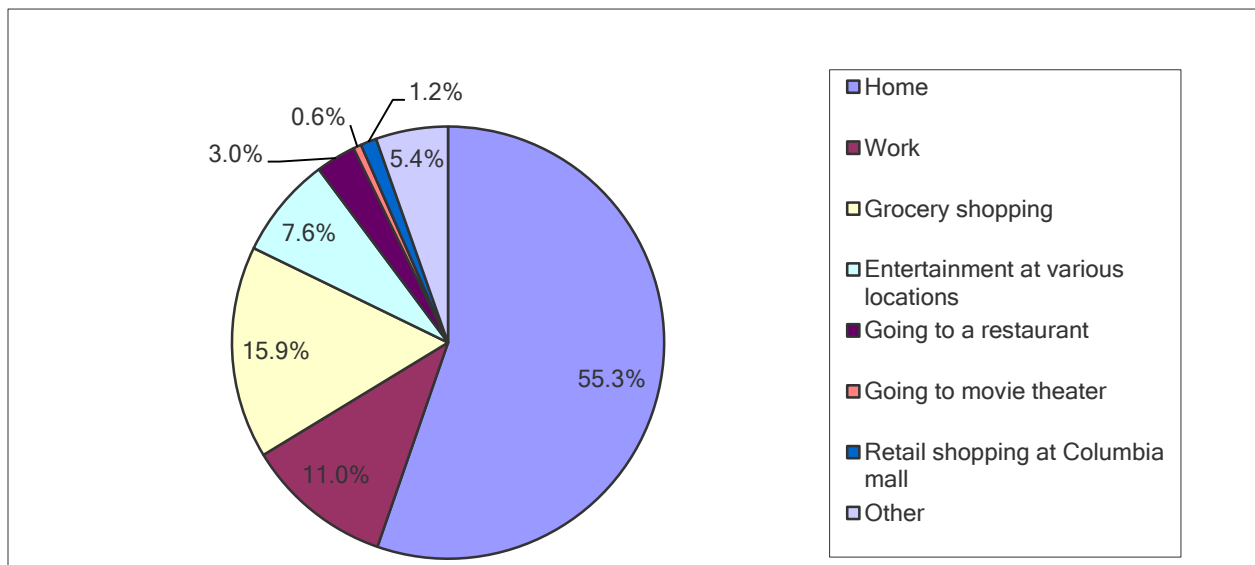


Figure 19 Survey Respondents' Primary Trip Purpose When Leaving Campus

When asked about the distance they are willing to walk relative to the temperature, 32.4% of respondents considered 12 city blocks to be a reasonable walking distance when temperatures are 32°F or warmer,. This was followed by six city blocks at 24.7%, four city blocks at 18.9%, eight city blocks at 17%, two city blocks at 5.1%, and less than two city blocks at 1.9%.

When temperatures are at 32°F or colder, 28.1% of respondents found two city blocks to be a reasonable walking distance. This was followed by less than two city blocks at 25.1%, four city blocks at 24.5%, six

city blocks at 13.4%, 12 city blocks at 5.3%, and eight city blocks at 3.6%. Figure 20 shows the differences in survey respondents' perception of reasonable walking distances based on temperature.

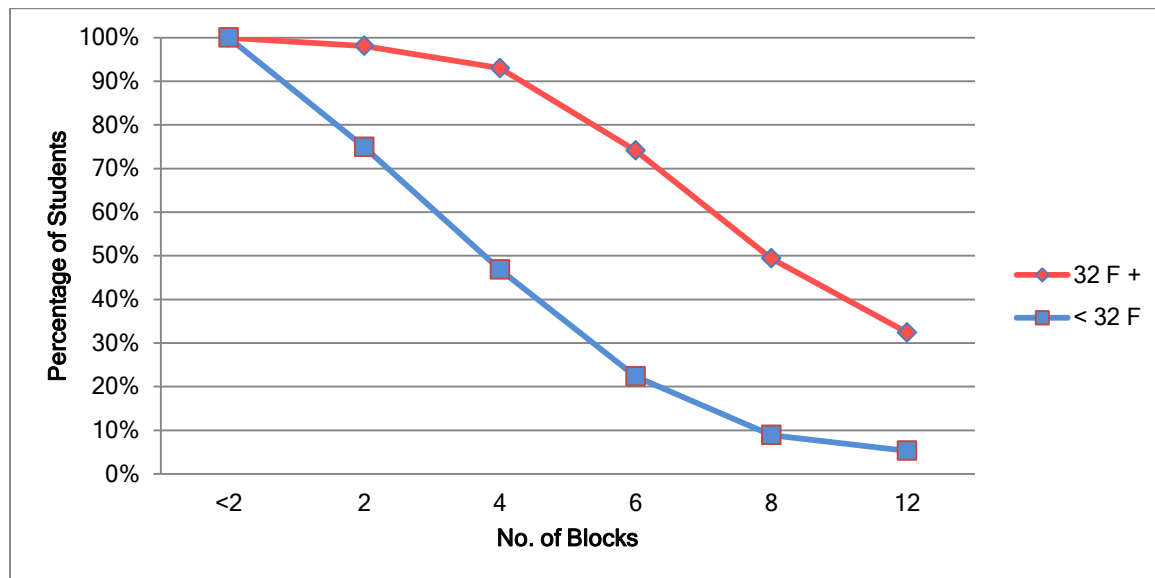


Figure 20 Survey Respondents' Preferred Walking Distance Relative to Temperature

Respondent Mode Choice and Preference

In determining which transportation modes survey respondents tend to frequently choose and prefer, respondents' access to a vehicle and parking, the modes they most frequently utilized in a particular climatic season, and the factors and characteristics of a particular transportation mode that made it their preference were identified.

Pertaining to respondents' access to a vehicle while attending school, 85.8% had access while 14.2% did not. In specifying the type of parking permit they possessed, 61.8% of respondents indicated they had student permits, 35.5% didn't possess any type of parking permit, 3.9% had student ramp permits, and approximately 1% had PM parking permits. Together, daily permits, monthly permits, and perimeter/park and ride permits accounted for less than 1% of parking permit types. When asked how they rated campus parking, 40.8% of respondents responded fair, 29.2% said poor, 16.1% said very poor, 12.9% said good, and 1% said very good.

When asked about the particular factors that influence their mode choice, 80% of respondents identified convenience as an important factor. It was followed by weather at 70.9%, time at 60.8%, accessibility at 54.3%, parking availability at 50.9%, the cost of parking at 38%, the cost of a vehicle at 22.3%, and other factors at 3.2%. Figure 21 shows the factors affecting respondents' mode choice.

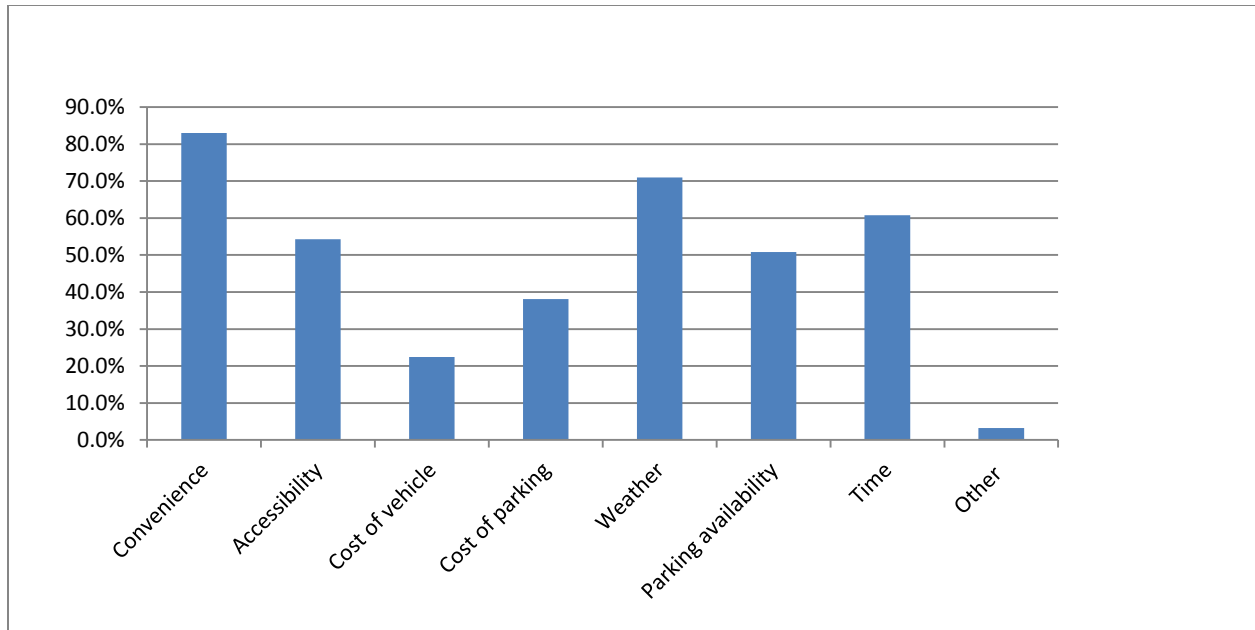


Figure 21 Factors Affecting Survey Respondents' Mode Choice

Respondents were asked to indicate the mode of transportation they most frequently use in each season of the year – spring, summer, fall, and winter.

For mode use in the spring, auto was the most utilized at 73.6%. It was followed by walking at 57.6%, the campus shuttle at 31.7%, bicycles at 27.7%, car pooling at 20.1%, CAT bus at 10.5%, other at 3.6%, motorcycle at 1.9%, and scooter at approximately 1%.

For mode choice in the summer, auto was the most utilized at 72.1%. It was followed by walking at 56.5%, bicycles at 36%, car pooling at 15.3%, the campus shuttle at 13.2%, CAT bus at 7.5% other at 5.6%, motorcycle at 2.6%, and scooter at approximately 1%.

For mode choice in the fall, auto was the most utilized at 73.3%. It was followed by walking at 58.9%, the campus shuttle at 30.8%, bicycles at 28.7%, car pooling at 20.4%, CAT bus at 9.8% other at 5%, motorcycle at 2%, and scooter at approximately 1%.

For mode choice in the winter, auto was the most utilized at 75.1%. It was followed by walking at 44.2%, the campus shuttle at 43.2%, car pooling at 22%, CAT bus at 11.7%, bicycles at 2.7%, and other at 2.5%. Combined, motorcycle and scooter account for less than 1%.

Other modes used by respondents include taxi cabs, roller blades, long boards, and skate boards.

Table 10 shows these results for all seasons. Graphs representing mode choice in all of the aforementioned seasons are presented in Figures 22, 23, 24, and 25.

Table 12 Respondents' Mode Use Based on Season

Survey Respondent Mode of Choice	SEASON			
	FALL	WINTER	SPRING	SUMMER
	%	%	%	%
Auto	73.3	75.1	73.6	72.1
Walk	58.9	44.2	57.6	56.5
Campus Shuttle	30.8	43.2	31.7	13.2
Bicycle	28.7	2.7	27.7	36.0
Carpool	20.4	22.0	20.1	15.3
City Bus - CAT	9.8	11.7	10.5	7.5
Other	5.0	2.5	3.6	5.6
Motorcycle	2.0	≈0	1.9	2.6
Scooter	≈1	0	≈1	≈1

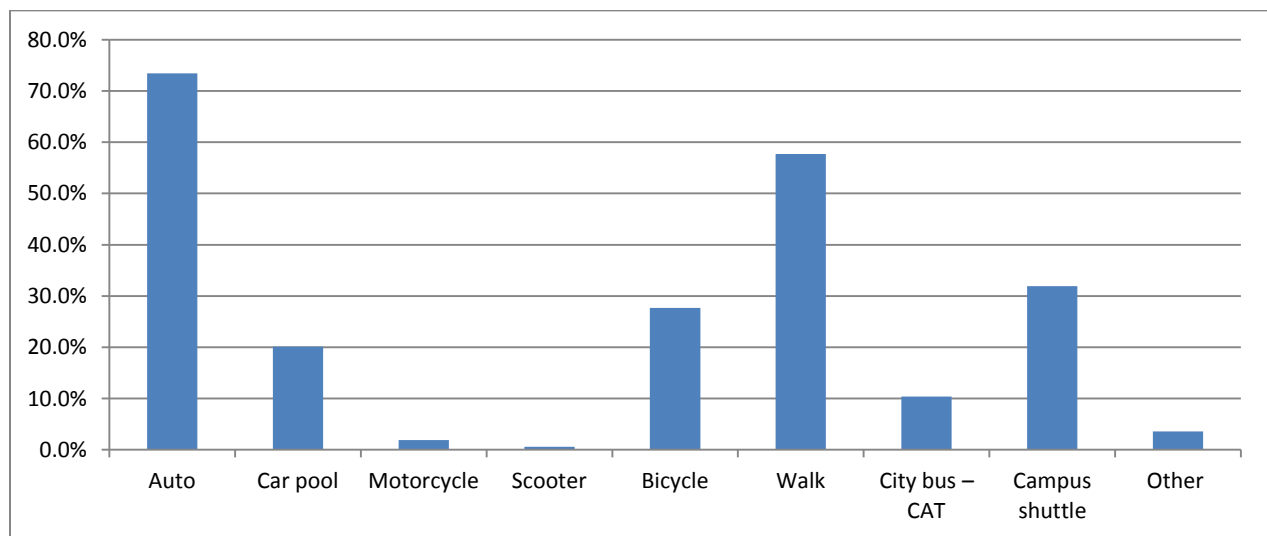


Figure 22 Transportation Mode Most Used by Survey Respondents During Spring

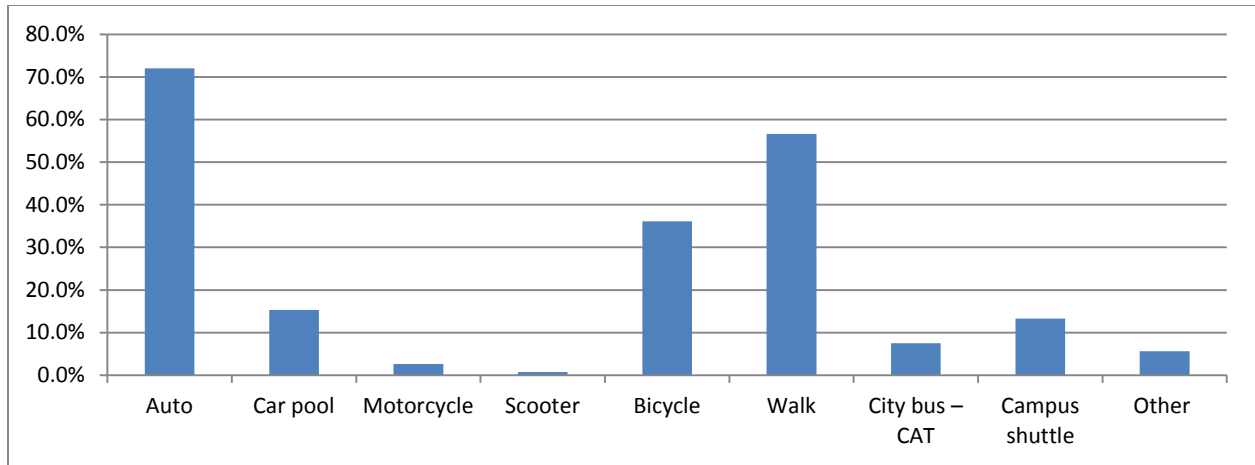


Figure 23 Transportation Mode Most Used by Survey Respondents During Summer

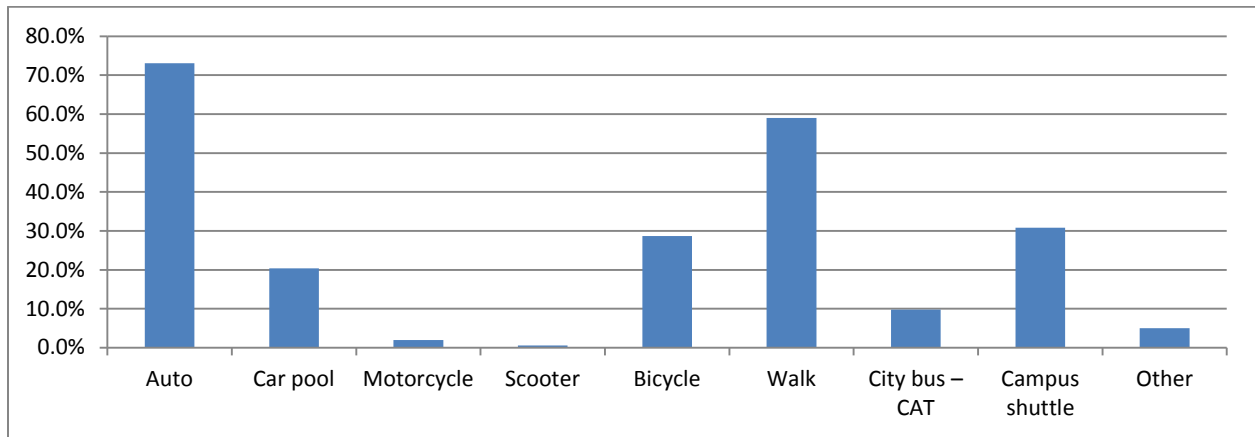


Figure 24 Transportation Mode Most Used by Survey Respondents During Fall

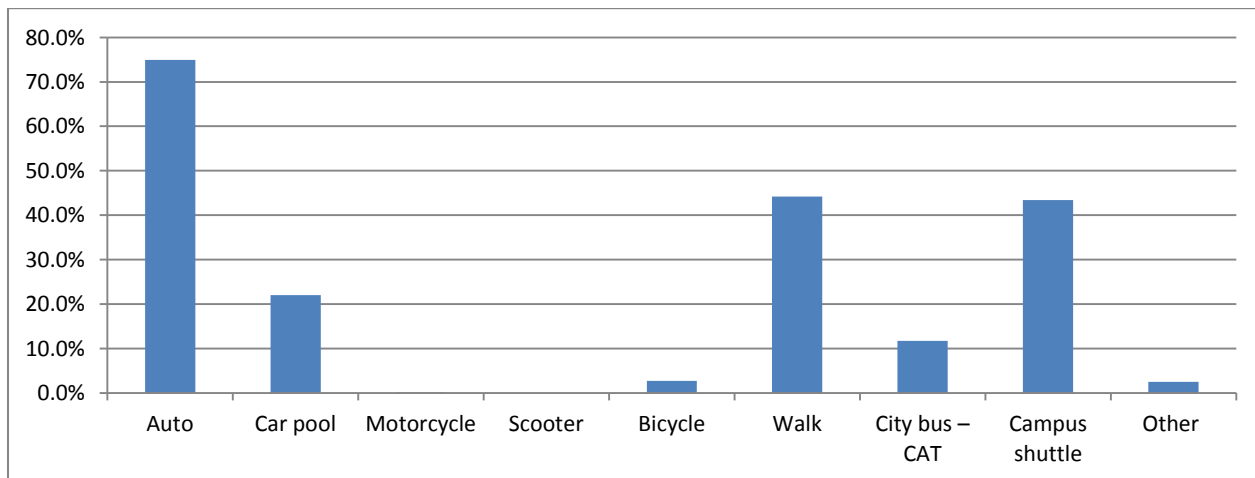


Figure 25 Transportation Mode Most Used by Survey Respondents During Winter

Student Attitude Toward, Experience With, and Perception of the Campus Shuttle System

The manner in which students thought of, experienced, and perceived campus shuttle services was collected through the survey instrument by gathering information on respondents' awareness of the campus shuttle service, their usage of shuttle services, their perceptions of the benefits of the availability of campus shuttle services, the service characteristics they value when using the campus shuttle, their preferences to service frequency and vehicle headway, and additional locations they would like the shuttle services to cover.

In terms of respondents' awareness of the campus' shuttle services, 95.5% of respondents indicated that they were aware that shuttle services were available. When asked as to whether or not they utilize available shuttle services, 46.2% replied they did while 53.8% indicated they did not.

In determining what students perceived to be the benefits of the availability of shuttle services on campus, convenience was perceived to be the most important benefit at 66.8%. Convenience was followed by reducing parking demand at 48.2%, saving money at 45.7%, saving time at 43.5%, reducing traffic congestion at 40.8%, reducing greenhouse gas at 28%, and safety at 22.7%. Approximately 11% of respondents had no opinion while 5.7% listed other benefits. Primary among the other benefits listed by respondents was the fact that the shuttle service is good for students without cars and provides a warmer alternative to walking in winter. Figure 26 shows the perceived benefits of the campus shuttle system.

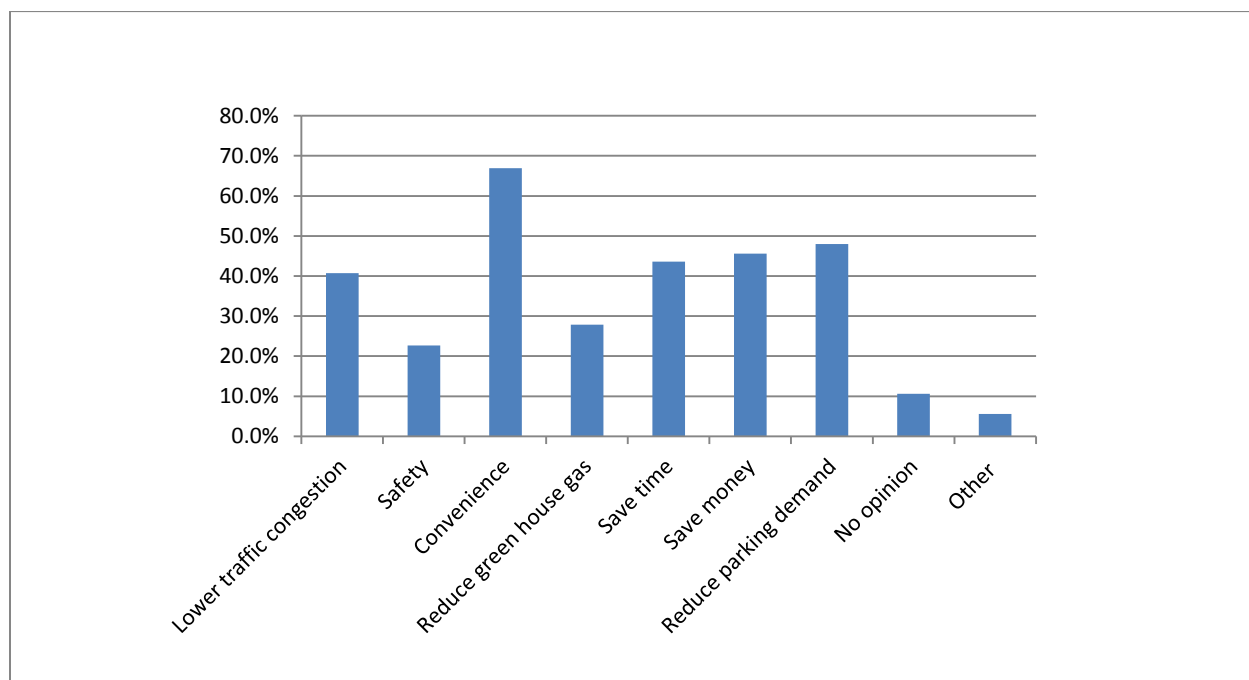


Figure 26 Survey Respondents' Perceived Benefits of UND Shuttle Services

Respondents were asked to identify the characteristics of the campus' shuttle services that they deemed most valuable. Convenience had the highest rating at 74.5%. Convenience was followed by the bus being on time at 54.5%, reliability at 49%, comfort at 28.4%, and driver friendliness at 25.3%. Approximately 7% of respondents listed the service as having other valuable service characteristics. Frequently mentioned among other valuable characteristics were an alternative that provides more warmth in winters, not having to pay for the service, and the service being a faster alternative to walking, specifically to the university's aviation facilities. Figure 26 shows the valuable characteristics of the shuttle service identified by respondents that use the service.

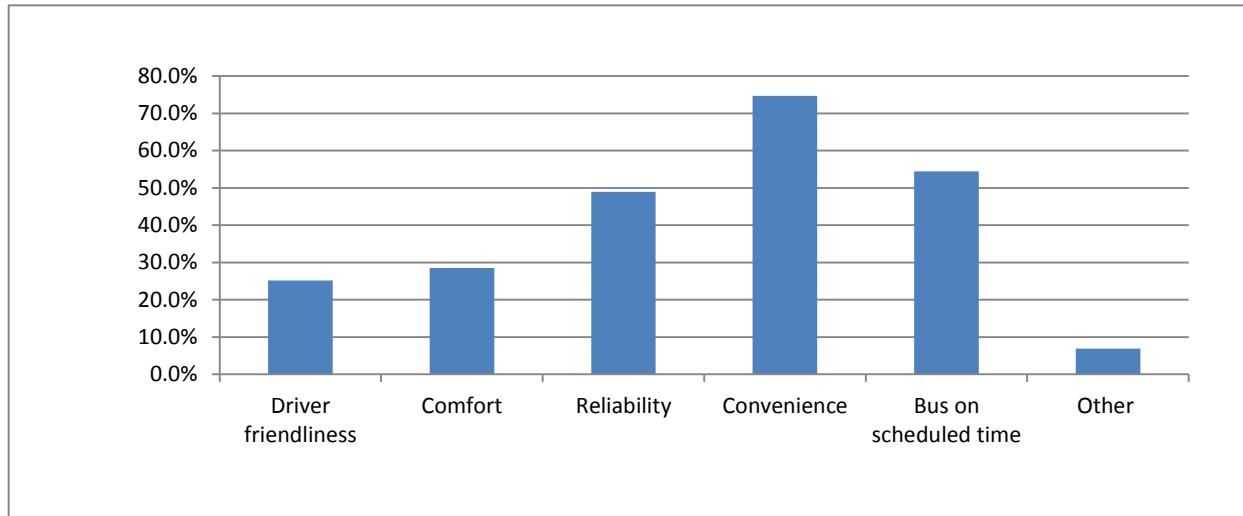


Figure 27 Most Valuable Campus Shuttle System Characteristics

When asked about the longest time they will wait after missing a campus shuttle bus, 61.2% of respondents indicated that less than 10 minutes was preferable. This was followed by 10 minutes at 28.2%, 15 minutes at 9%, and 20 minutes at 1.4%. Figure 28 illustrates these results.

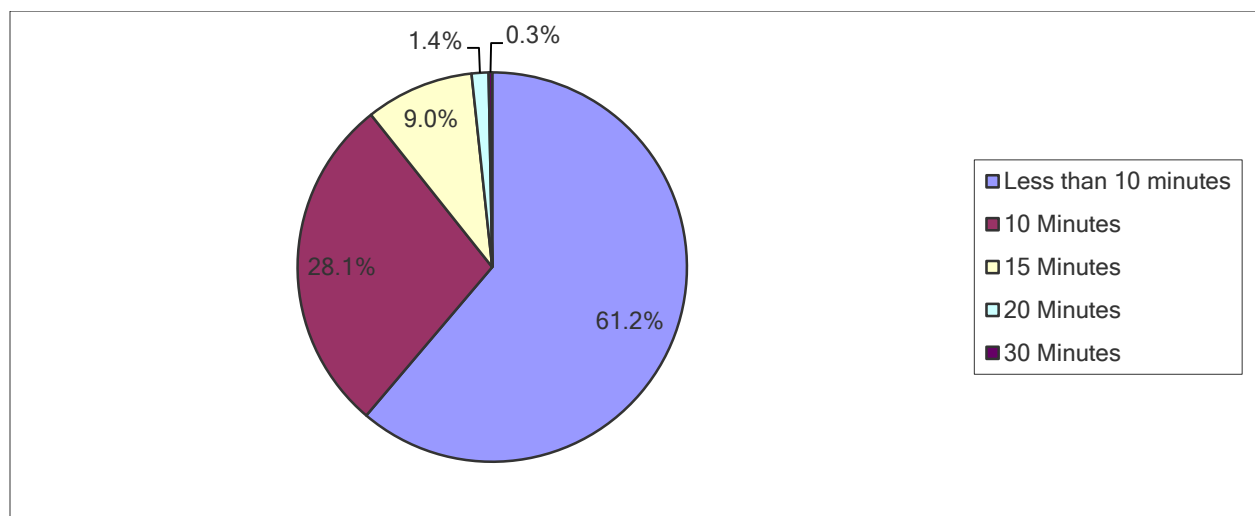


Figure 28 Survey Respondents' Preferred Waiting Times for the Next UND Shuttle Bus

When asked if the campus shuttle system should cover additional stops and locations, 65.6% of respondents replied that it should not while 34.4% indicated yes. The identified additional stops and locations are addressed in a subsequent section that discusses potential service opportunities.

Student Attitude Toward, Experience With, and Perception of the CAT System

Information as to students' thought of, experience with, and perception of the Cities Area Transit (CAT) system and service was collected by asking respondents about their utilization of the CAT service, their receipt of the student-government-issued bus pass allowing free rides, what types of trips they would consider using CAT services for, their perceived benefits of the CAT system on campus, the service characteristics they value when using CAT service, their preferences toward CAT's service frequency and vehicle headway, and the factors they believe detract from their desire to use CAT services.

The survey indicated that 78.3% of students had used CAT services while 21.7% had not. Note that when asked about their receipt of the student-government-issued free CAT ride cards, 69.6% of students responded they haven't received the card while 30.4% said they had.

When asked what type of trip they would consider using the CAT services for, the trip type with the highest response was to get to and from campus at 66.4%. This was followed by to get around campus at 35.5%, to get to and from work at 28.1%, to get to the east side of campus –Memorial Union and Hyslop Club at 25%, to get to the west side of campus –Aerospace Complex and 42nd & University at 22.5%, and to get to Northland Community and Technical College at 5.2%. Interestingly, 11.1% of respondents identified other trip purposes for which they will consider utilizing CAT services. These other trip purposes included downtown, the shopping mall, the grocery store, and to travel around the city. Figure 29 shows the results for the trip purposes for which CAT services will be considered by respondents.

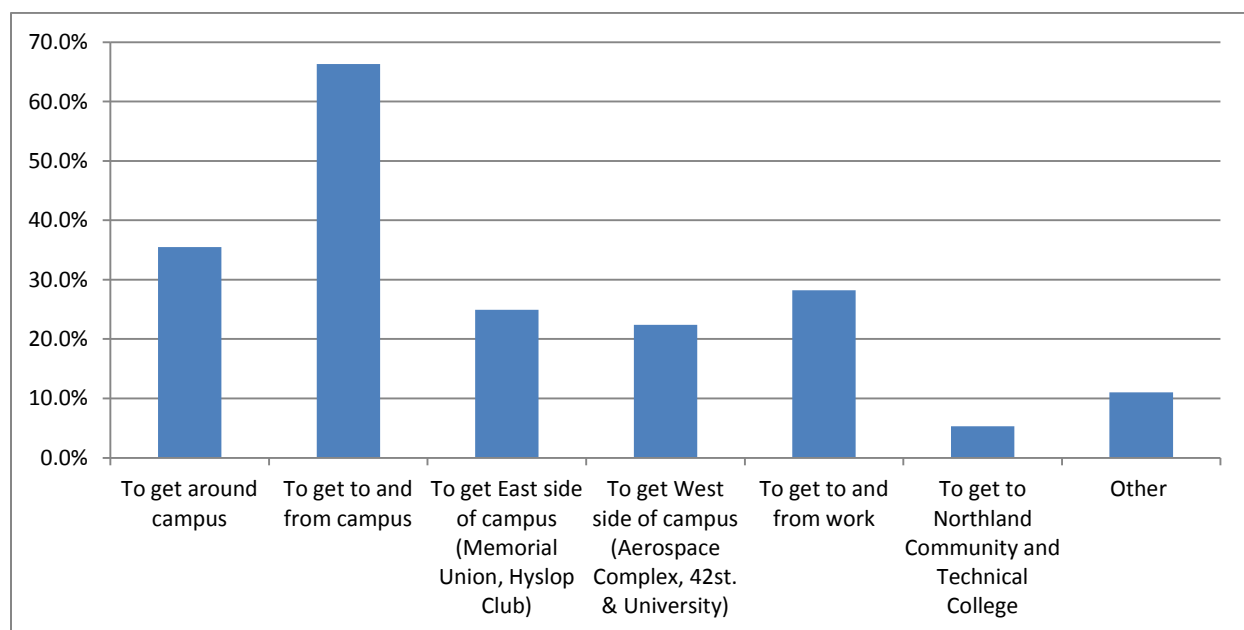


Figure 29 Survey Respondents' Trip Purposes for which CAT Service Will Be Considered

Students were asked to rate CAT's service's benefits in the areas of reducing traffic congestion, improving safety, enhancing convenience, reducing green house gas, saving time, saving money, and reducing parking demand. The highest perceived benefit is that of convenience at 48.4%. It was followed by saving money at 48.1%, reducing parking demand at 38.7%, reducing traffic congestion at 37%, reducing greenhouse gas at 27.7%, saving time at 25.9%, and safety with 9.3%. Approximately 3% of respondents listed other benefits of CAT service. These benefits included the fact that the CAT service is extremely beneficial to UND students who live in the downtown area, CAT's potential to serve off-campus students, and the benefit of it being an alternative in winter. Comments were also made about CAT services being a warmer alternative to walking in winter. Figure 30 shows respondents' perceived benefits of the CAT system.

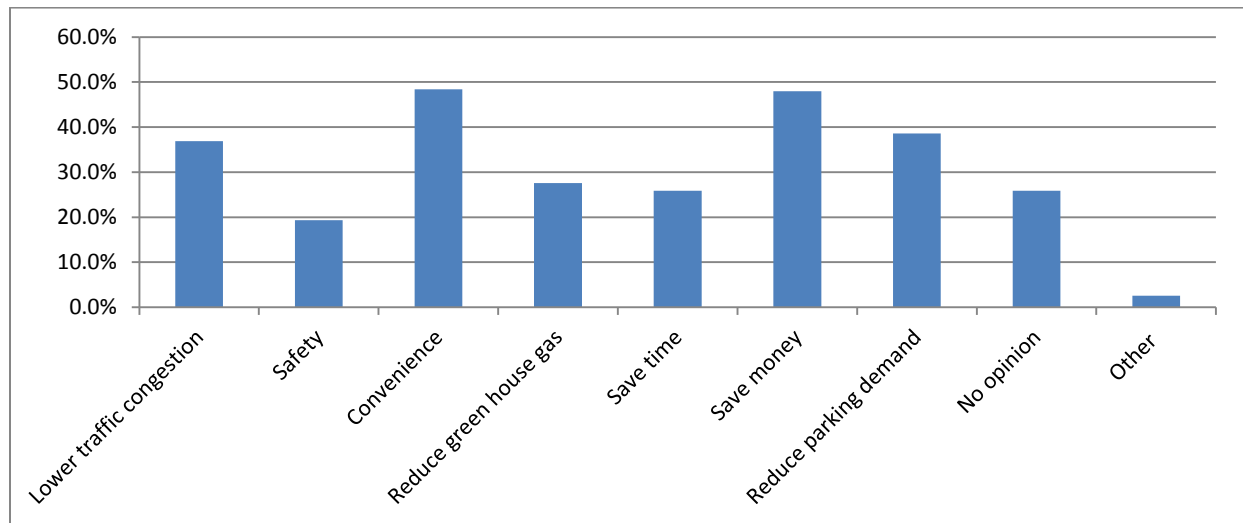


Figure 30 Survey Respondents' Perceived Benefits of the CAT System Services

Those students who ride the CAT system were asked to identify the characteristics of the service that they deemed most valuable. Of all the listed service characteristics, convenience had the highest rating at 72.7%. It was followed by the bus being on time at 54.7%, reliability at 53.3%, driver friendliness at 41.2%, and comfort at 36.3%. Figure 31 illustrates these results.

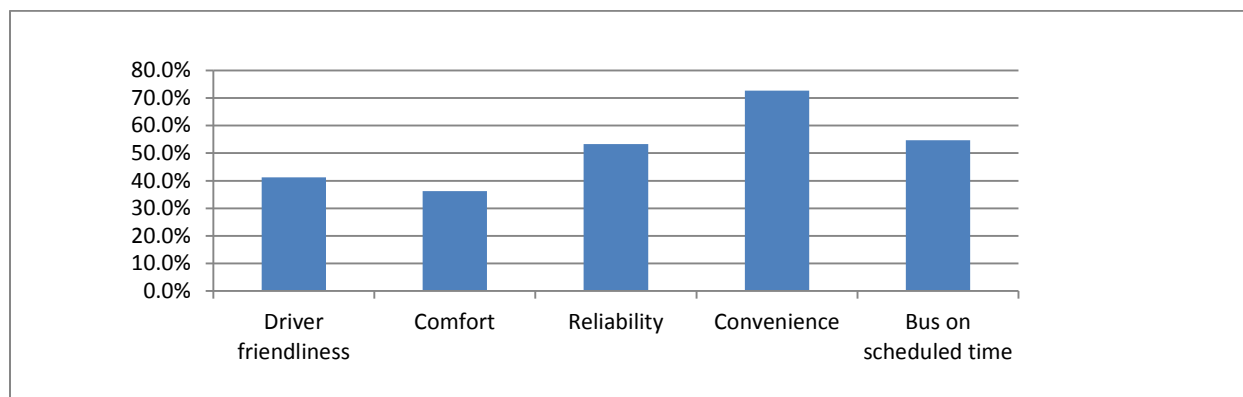


Figure 31 Most Valuable CAT Service Characteristics

When asked about the longest time they will wait for a CAT bus, 52.8% of respondents indicated 10 minutes. This was followed by 15 minutes at 26.9%, 20 minutes at 10.1%, and 30 minutes at 10.1%. Figure 32 illustrates these results.

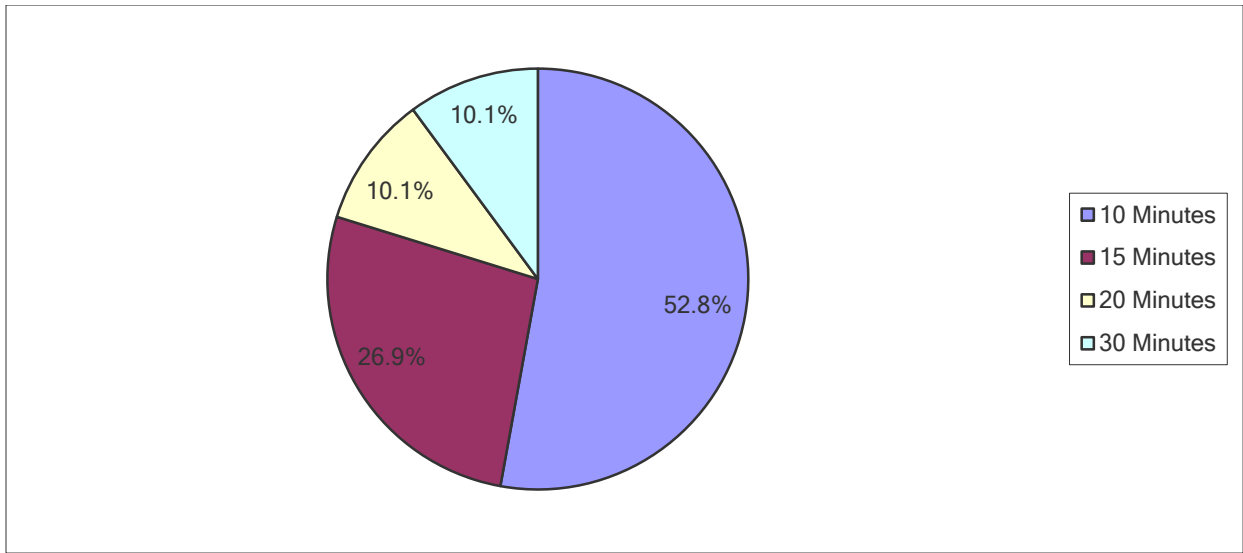


Figure 32 Survey Respondents' Preferred Waiting Times for Next CAT Bus

When respondents were asked, if not using CAT bus service, which factors detract from utilizing the service, 62.1% of respondents replied that a lack of information was a primary factor. This was followed by the service being inconvenient at 34.8%, a lack of sufficient route coverage at 25.8%, the rides are considered too long at 13.3%, lengthy transfer station waiting times at 8.6%, the bus not being on time at 7.6%, and the bus service not being cool at 5.9%. Approximately 20% of respondents had identified additional deterrents, including insufficient access to information on CAT services and routes, students didn’t have the UND Student-Government-issued free bus ride cards, service frequency was once an hour, the lack of stops and service coverage at various locations across campus, and the uncertainty related to safety while travelling on CAT buses. Figure 33 shows the responses to the factors that deter students from utilizing CAT services.

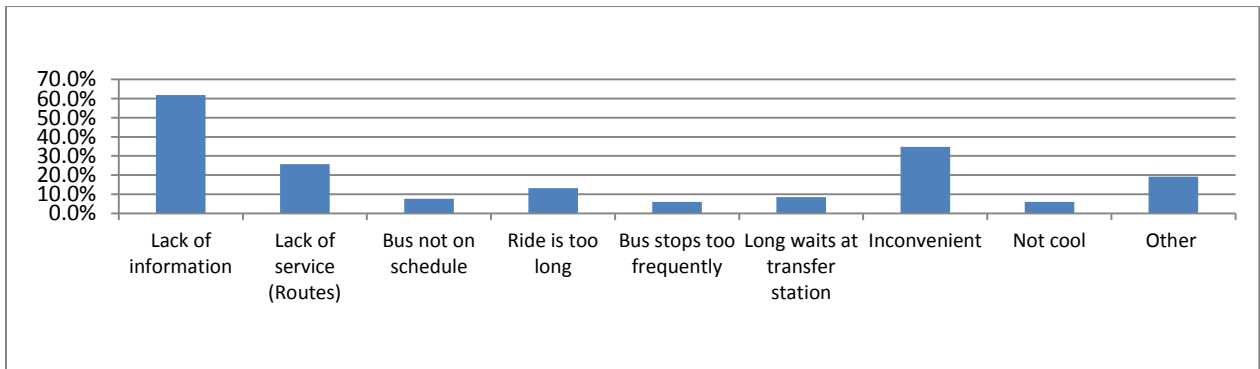


Figure 33 Factors Negatively Affecting CAT Service Use

The survey also attempted to capture respondents' preferred method of communication when receiving information pertaining to transit service changes. With a response rate of 83.7%, text messaging was identified as the best communication method. It was followed by cellular phone at 23.2%, email at 14.5%, Facebook at 5.8%, Twitter at 1.5%, and blogs at approximately 1%. Approximately 5% of respondents identified additional methods of communication. These methods included electronic bus stop displays, electronic bus schedule meters, automated call-centers, and automated signs displaying bus locations. Figure 34 illustrates the responses to students' preferred communication methods.

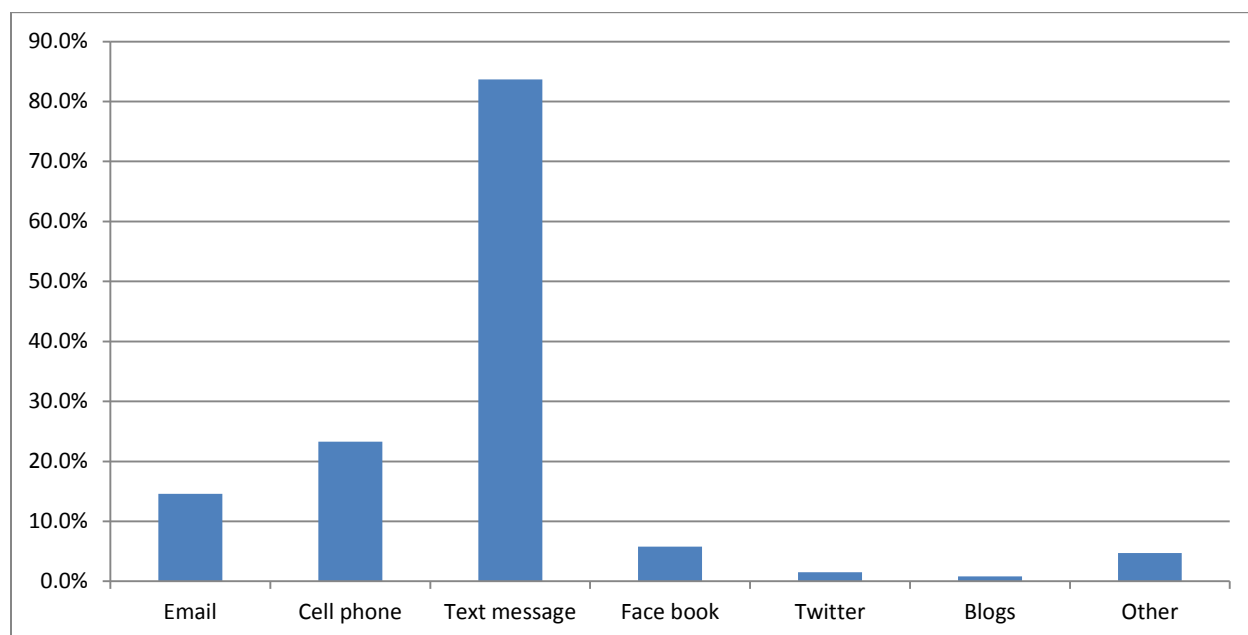


Figure 34 Respondents' Preferred Communication Methods

3.2 Service Route Ridership Analysis

In an attempt to understand the route ridership dynamics of the UND shuttle system, route ridership analyses for the Campus Shuttle Service and the Night Shuttle Service were conducted. The results of these analyses were evaluated in light of the survey results. More specifically, by observing changes in route ridership, i.e. passenger trips for the identified routes over the period FY06 to FY10, patterns in changes and trends can be observed to determine if any particular information collected from the survey can explain patterns or changes in ridership levels. Route analyses were only done for the Campus Shuttle Service and the Night Shuttle Service because they are the primary and most utilized of campus shuttle services and more complete sets of data were readily available for those services.

3.2.1 Campus Shuttle Service Route Ridership Analysis

In conducting the analysis, route ridership was observed from various perspectives. These perspectives included observing passenger trips by total trips per year from FY 2006 to FY 2010; passenger trips by specific route, i.e. Red(1), Blue(2), Green(3), and Purple(4) over the time period FY 2006 to FY 2010; by number of passenger trips per month for each from FY 2006 to FY 2010; by passenger trips per month in aggregate from FY 2006 to FY 2010, and by passenger trips according to the time period of day, i.e. AM or PM by route.

There was a net decrease of 21% in the Campus Shuttle Service's total annual passenger trips from FY 2006 to FY 2010. Annual passenger trips decreased from 258,978 trips in 2006 to 203,608 in 2010. While minor increases of 3% and 2% occurred in 2007 and 2010 respectively, the decreases in passenger trips in 2008 and 2009 were more substantial at 16% and 11% respectively. These results are shown in Table 13. Figure 35 illustrates the Campus Shuttle Service's total annual passenger trips from FY 2006 to FY 2010. As can be observed, with the exception of the years 2007 and 2010, there is a general downward trend in total annual passenger trips.

Table 13 Campus Shuttle Service's Total Annual Passenger Trips FY 2006 to FY 2010

Year	Total Annual Passenger Trips	% Change from Previous Year
2006	258,978	
2007	266,850	3%
2008	224,557	-16%
2009	198,877	-11%
2010	203,608	2%
		% Change from FY 2006 to FY 2010
		-21%

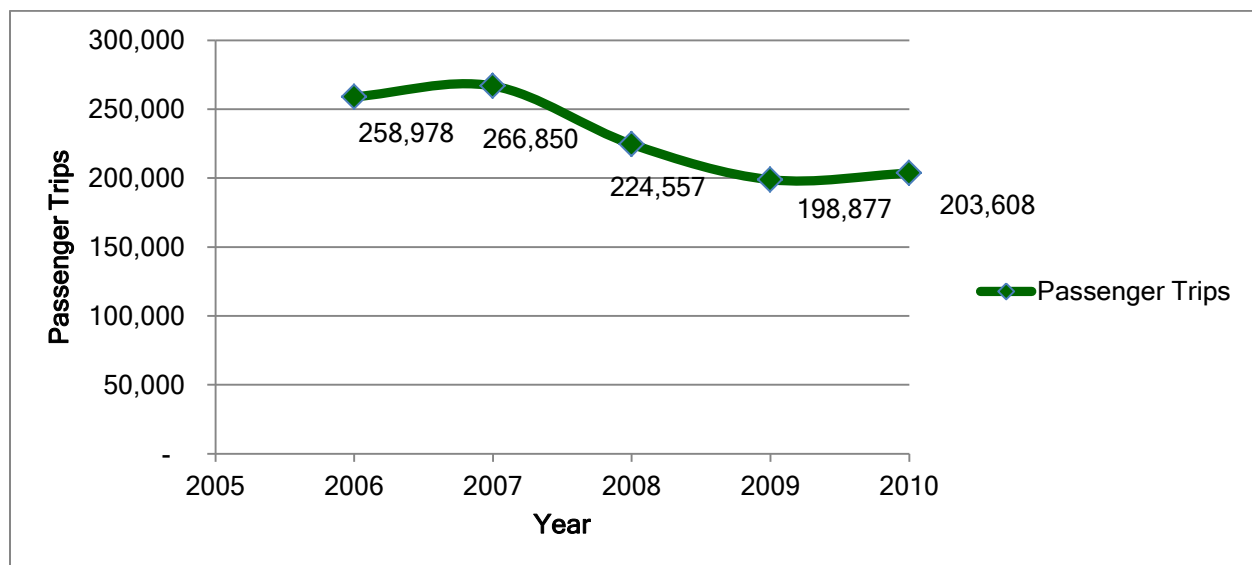


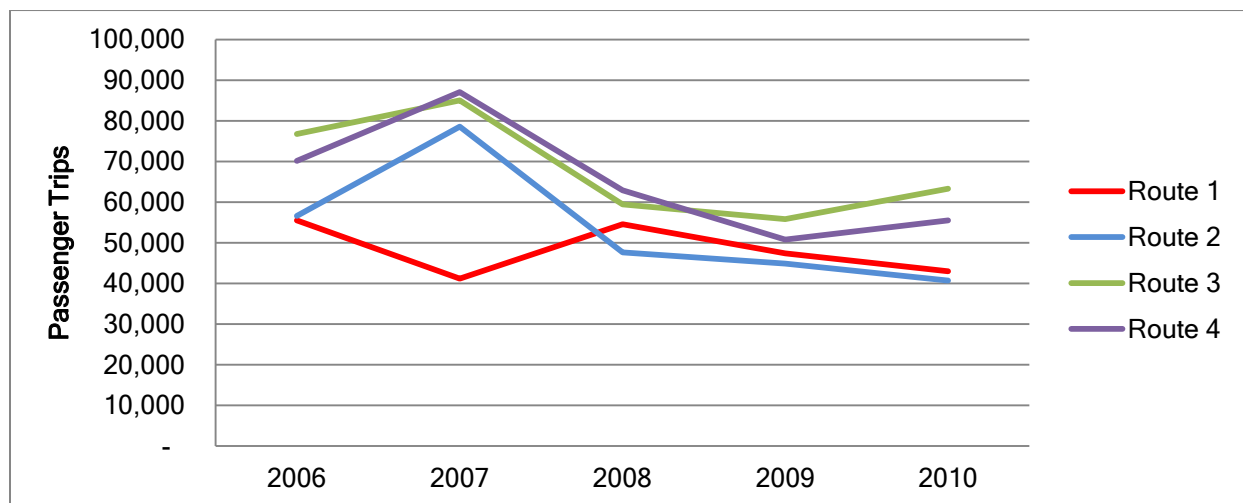
Figure 35 Campus Shuttle Service's Total Annual Passenger Trips FY 2006 to FY 2010

From FY 2006 to FY 2010, all routes experienced net decreases. The Red, Blue, Green, and Purple routes experienced net decreases of 22%, 28%, 18%, and 21% respectively. However, intermittently throughout the time period, each of these routes experienced passenger trip growth in specific years. Table 14 shows the Campus Shuttle Service's total annual passenger trips by route for FY 2006 to FY 2010.

Table 14 Campus Shuttle Services' Total Annual Passenger Trips by Route FY 2006 to FY 2010

Year	Route							
	Route 1		Route 2		Route 3		Route 4	
	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change
2006	55,476		56,594		76,761		70,147	
2007	41,217	-26%	78,548	39%	85,051	11%	87,080	24%
2008	54,548	32%	47,659	-39%	59,448	-30%	62,902	-28%
2009	47,372	-13%	44,911	-6%	55,791	-6%	50,803	-19%
2010	43,018	-9%	40,703	-9%	63,282	13%	55,485	9%
	% Change 2006 - 2010		% Change 2006 - 2010		% Change 2006 - 2010		% Change 2006 - 2010	
	-22%		-28%		-18%		-21%	

Figure 36 illustrates the Campus Shuttle Service's annual passenger trips by route from FY 2006 to FY 2010. With the exception of 2007 for the Blue, Green, and Purple routes and 2008 for the Red route, there has been a general downward trend in total annual passenger trips for all routes over the period. However, since 2009 the two routes with the highest numbers of annual passenger trips, the Green and Purple routes, have experienced increases in passenger trips. These increases were 13% and 9% respectively.

**Figure 36** Campus Shuttle Service's Annual Passenger Trips by Route FY 2006 to FY 2010

From FY 2006 to FY 2010, the passenger trips taken within each month of the year varied. For all months of the school year, August through May, there were net decreases in the number of passenger trips taken. The lowest net decrease of 11% was in April and the highest net decrease of 59% was in August. September, October, November, January, February, and March experienced net decreases in monthly passenger trips of 35%, 17%, 34%, 29%, 13%, 13%, and 11% respectively. Interestingly, both May and December, for which one would expect decreased campus shuttle use because of school breaks, are the months for which the only net increases in monthly passenger trips from FY 2006 to FY 2010 were

observed. During this period they experienced net increases in passenger trips of 4% and 19% respectively. Table 15 shows the monthly passenger trips from FY 2006 to FY 2010. Figure 37 illustrates monthly passenger trips for each month in each year. Figure 30 shows the total trips for each month in aggregate from FY 2006 to FY 2010.

Table 15 Campus Shuttle Service's Passenger Trips per Month for FY 2006 to FY 2010

	Month							
	August		September		October		November	
Year	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change
2006	10,815		31,266		33,329		31,997	
2007	12,578	16%	30,259	-3%	35,383	6%	31,547	-1%
2008	10,267	-18%	21,242	-30%	28,156	-20%	25,532	-19%
2009	3,609	-65%	19,926	-6%	23,635	-16%	20,309	-20%
2010	4,434	23%	20,294	2%	27,691	17%	21,176	4%
	% Change 2006 - 2010		% Change 2006 - 2010		% Change 2006 - 2010		% Change 2006 - 2010	
	-59%		-35%		-17%		-34%	
	Month							
	December		January		February		March	
Year	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change
2006	15,948		30,484		40,986		31,830	
2007	13,299	-17%	36,322	19%	41,901	2%	31,414	-1%
2008	10,913	-18%	35,470	-2%	39,595	-6%	21,183	-33%
2009	16,170	48%	27,198	-23%	35,373	-11%	21,777	3%
2010	16,613	3%	21,683	-20%	35,490	0%	27,827	28%
	% Change 2006 - 2010		% Change 2006 - 2010		% Change 2006 - 2010		% Change 2006 - 2010	
	4%		-29%		-13%		-13%	
	Month							
	April		May					
Year	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change				
2006	24,053		5,861					
2007	28,286	18%	3,427	-42%				
2008	28,772	2%	6,356	85%				
2009	24,524	-15%	6,964	10%				
2010	21,436	-13%	6,964	0%				
	% Change 2006 - 2010		% Change 2006 - 2010					
	-11%		19%					

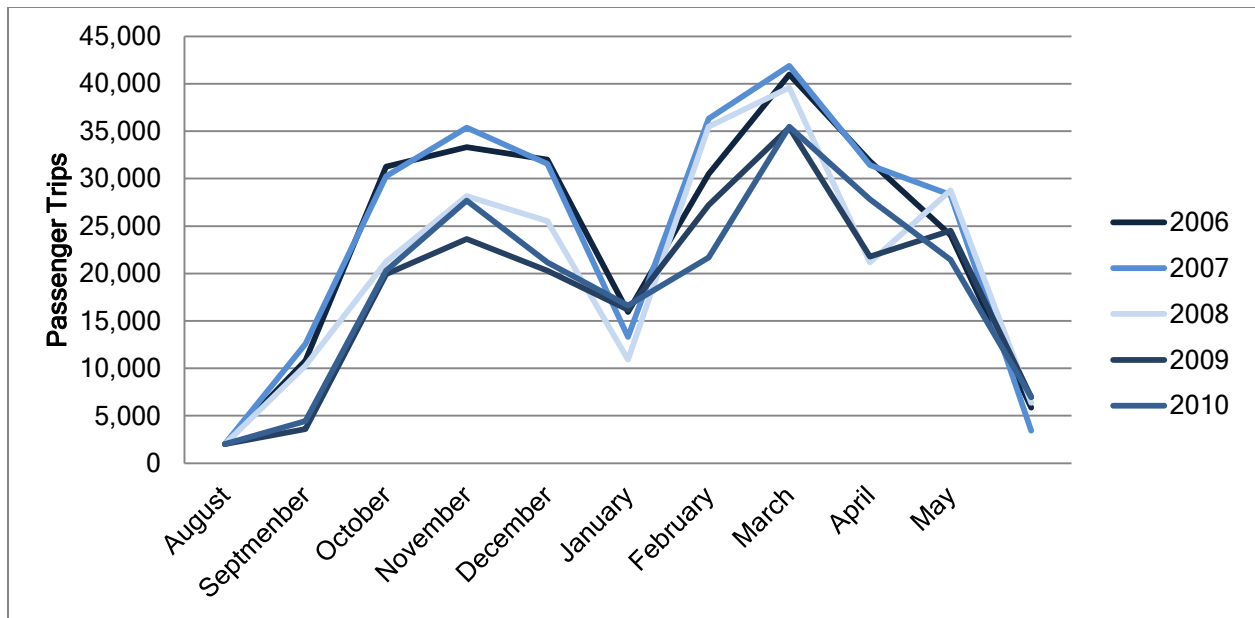


Figure 37 Campus Shuttle Service's Passenger Trips per Month

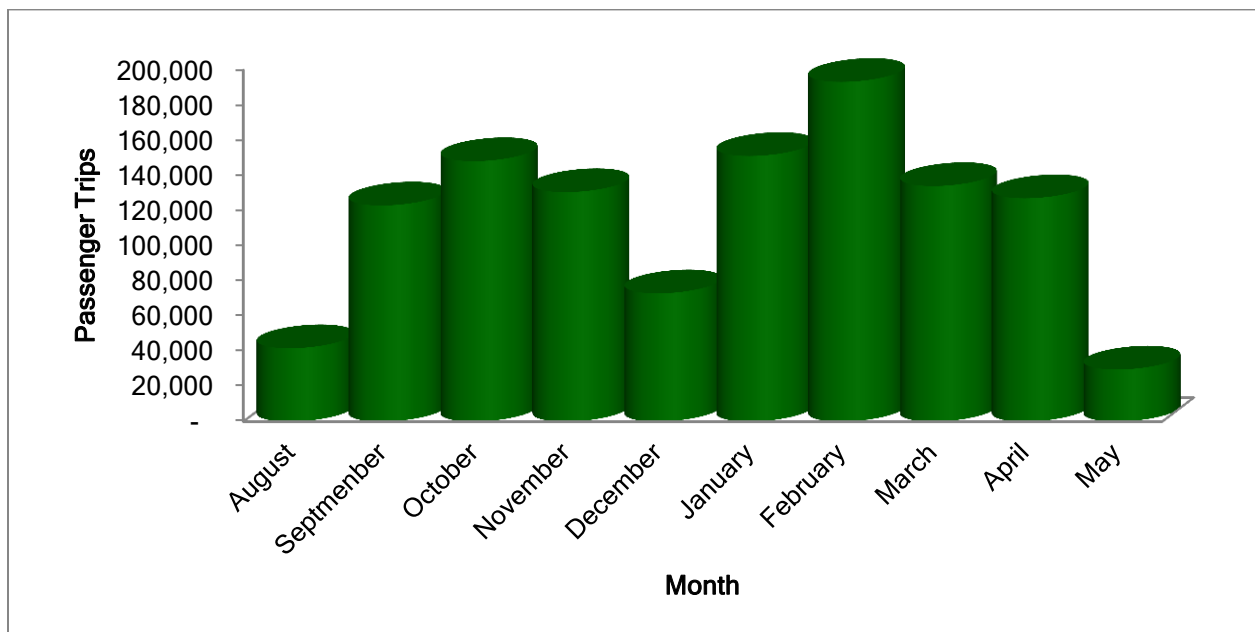


Figure 38 Campus Shuttle Service's Cumulative Passenger Trips per Month

During FY 2006 to FY 2010, the number of passenger trips taken in each month trended downward. During the month-periods of October to December and of February to March monthly passenger trips were consistently at their highest. From FY 2006 to FY 2010, the month of February accounted for the most passenger trips. The month-periods of September to November and January to February accounted for the month-periods where cumulative monthly passenger trips were at their highest.

Annual passenger trips on each route of the Campus Shuttle Service were observed to determine whether or not those trips were taken in the AM or PM period of the day. The Red route, while experiencing a 25% decline in passenger trips in the AM period of the day, experienced a 19% decrease in the PM period from FY 2006 to FY 2010. Likewise, while the passenger trips for the PM period of the Purple route's service decreased by 13%, its AM period passenger trips decreased by the significantly higher percentage of 28%. Conversely, the Blue and Green routes experienced the opposite passenger trip number dynamics. While the Blue route's AM passenger trips decreased by 18% over the period, its PM trips decreased by 39%. Similarly, while the Green route's AM passenger trips decreased by 4%, its PM trips decreased by 37%. Table 16 shows the passenger trips by time period of day for FY 2006 to FY 2010. Figure 39 illustrates the same information in graphical format.

Table 16 Campus Shuttle Service's Route's Passenger Trips by Time Period of Day

	Route							
	Route 1				Route 2			
	AM		PM		AM		PM	
Year	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change
2006	32,846		22,630		29,328		27,266	
2007	24,632	-25%	16,585	-27%	28,187	-4%	25,315	-7%
2008	34,761	41%	19,787	19%	24,711	-12%	22,948	-9%
2009	26,701	-23%	20,671	4%	26,136	6%	18,775	-18%
2010	24,672	-8%	18,346	-11%	24,063	-8%	16,640	-11%
	% Change 2006 - 2010		% Change 2006 - 2010		% Change 2006 - 2010		% Change 2006 - 2010	
	-25%		-19%		-18%		-39%	
	Route							
	Route 3				Route 4			
	AM		PM		AM		PM	
Year	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change
2006	45,228		31,533		36,708		33,439	
2007	50,361	11%	34,690	10%	45,833	25%	41,247	23%
2008	35,856	-29%	23,592	-32%	35,403	-23%	27,499	-33%
2009	37,659	5%	18,132	-23%	25,027	-29%	25,776	-6%
2010	43,331	15%	19,951	10%	26,333	5%	29,152	13%
	% Change 2006 - 2010		% Change 2006 - 2010		% Change 2006 - 2010		% Change 2006 - 2010	
	-4%		-37%		-28%		-13%	

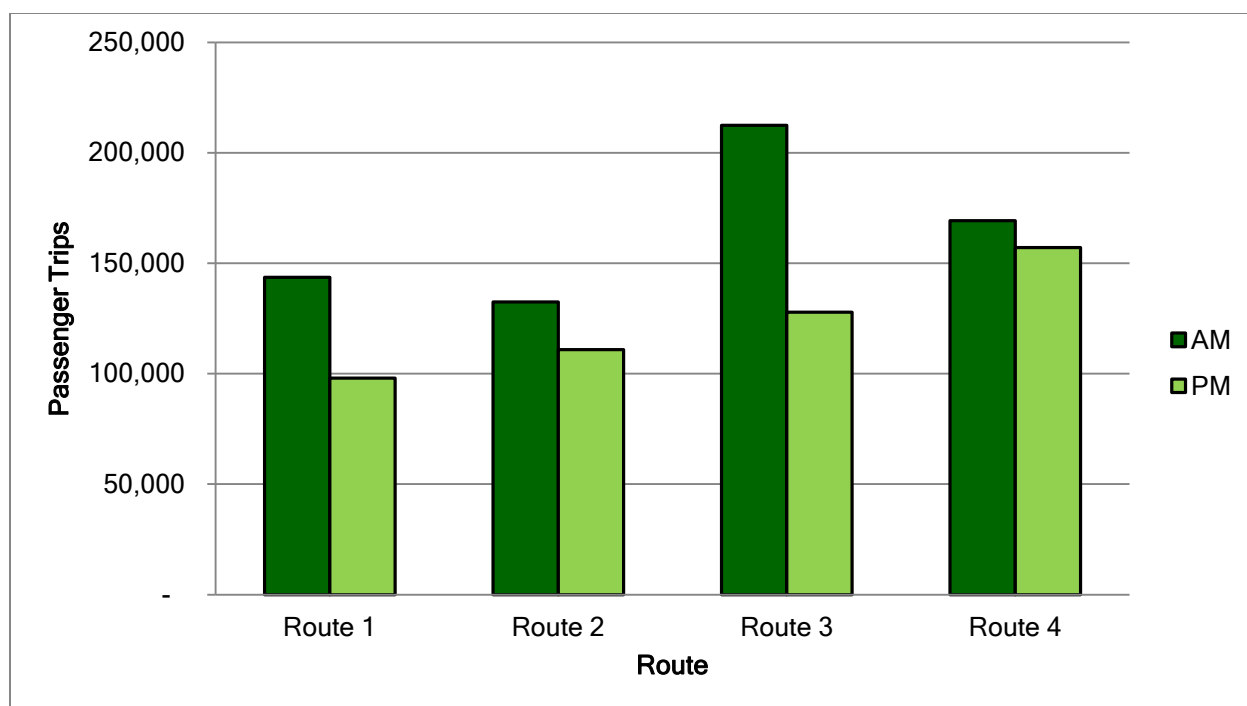


Figure 39 Campus Shuttle Service’s Passenger Trips by Time Period of Day FY 2006 to FY 2010

3.2.2 Night Shuttle Service Route Ridership Analysis

The analysis for the Night Shuttle Service’s route ridership from FY 2006 to FY 2010, showed total passenger trips experienced a net decrease of 41% over the period from 24,376 trips in FY 2006 to 14,280 in FY 2010. All of the years, with the exception of FY 2009, experienced substantial decreases in passenger trips. The only year of passenger trip increases, 2009, experienced 6% growth. The annual passenger trips for the Night Shuttle Service from FY 2006 to FY 2010 are shown in Table 17. Figure 40 illustrates the Night Shuttle Service’s total annual passenger trips from FY 2006 to FY 2010.

Table 17 Night Shuttle Service’s Annual Passenger Trips FY 2006 to FY 2010

Year	Total Annual Passenger Trips	% Change from Previous Year
2006	24,376	
2007	20,580	-16%
2008	14,920	-28%
2009	15,858	6%
2010	14,280	-10%
		% Change from FY 2006 to FY 2010
		-41%

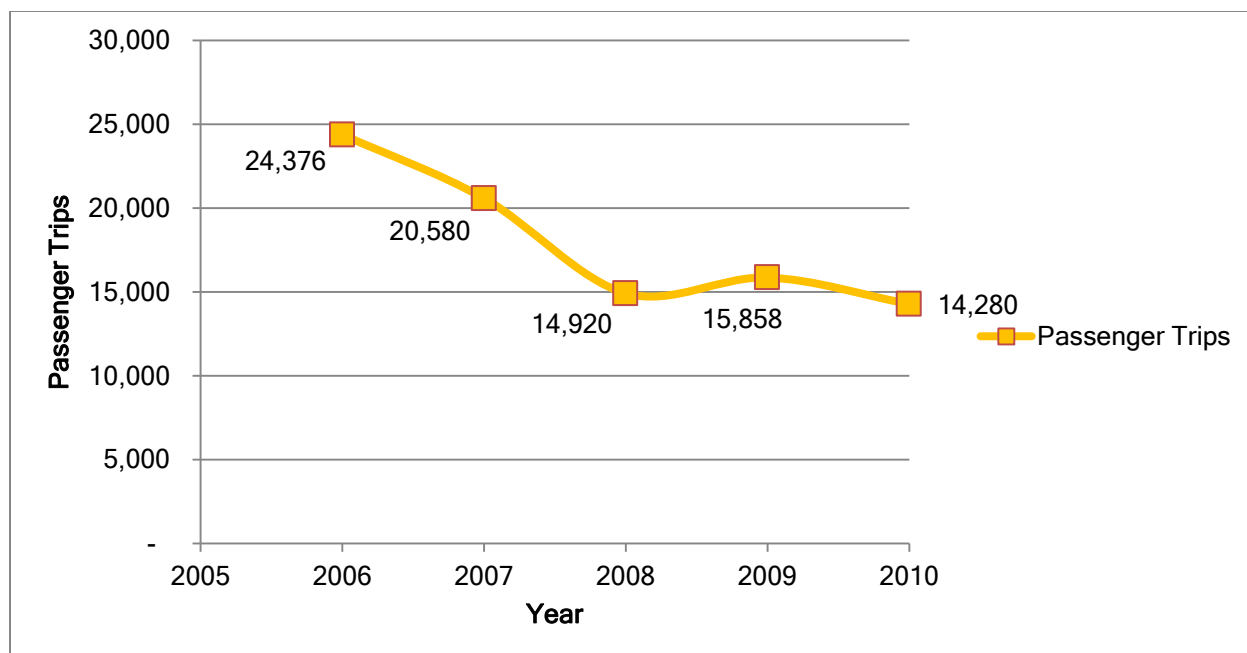


Figure 40 Night Shuttle Service's Annual Passenger Trips FY 2006 to FY 2010

For the Night Shuttle Service, all months of the school year from FY 2006 to FY 2010 experienced net decreases in monthly passenger trips. The largest of these decreases, 76%, was for the month of August when passenger trips decreased from 1,013 in 2006 to 241 in 2010. The lowest monthly passenger trip decrease, 20%, was for the month of December which decreased from 1,896 in 2006 to 1,518 in 2010. Table 18 shows the Night Shuttle Service's monthly passenger trips from FY 2006 to FY 2010. Figure 41 illustrates monthly passenger trips for each month in each year. Figure 42 shows the total trips for each month, in aggregate, from FY 2006 to FY 2010.

As observed Figure 41, the number of passenger trips taken in each month is trending downward. The month-periods of October to December and of February to April, particularly the month of March, were periods where monthly passenger trips are consistently at their highest.

Figure 42, in showing the cumulative passenger trips per month for all years, shows that the month of February accounted for the most monthly passenger trips. Additionally, the month-periods of September to November and January to February account for the months where monthly passenger trips are at their highest.

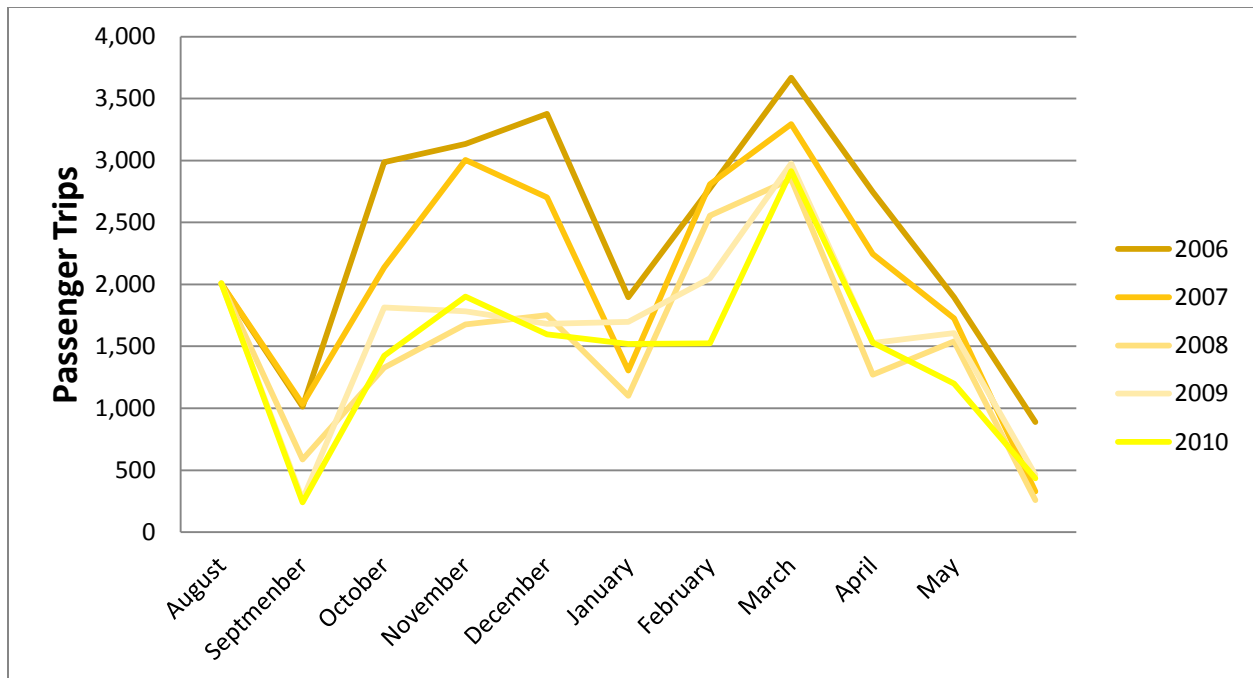


Figure 41 Night Shuttle Service's Passenger Trips per Month for FY 2006 to FY 2010

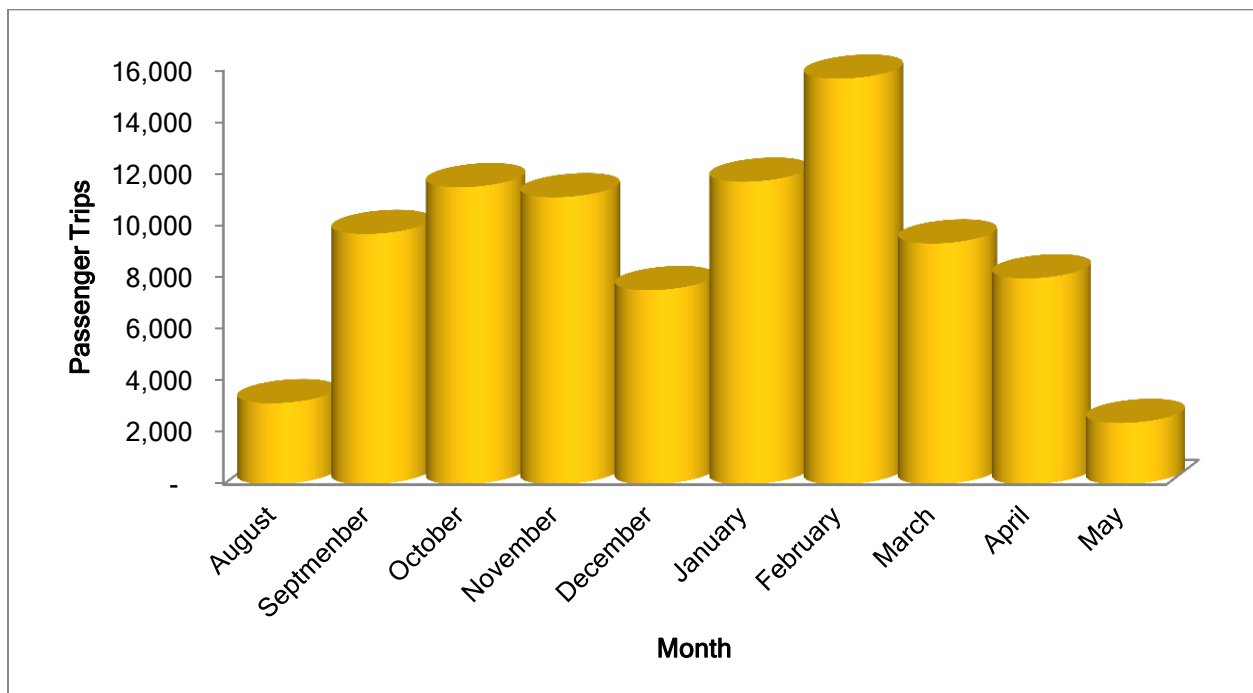


Figure 42 Night Shuttle Service Cumulative Passenger Trips per Month

A review of the Night Shuttle Service's passenger trips related to the time period of night they are taken for each route, as expected, showed the number of passenger trips tended to decrease as the night progressed. For FY 2006 to FY 2010, the number of passenger trips taken in each of the six time periods in which service is available experienced net decreases. Table 19 shows the number of passenger trips by the time-period of night in which they were taken, from FY 2006 to FY 2010. Figure 43 illustrates the same information in graphical format.

Table 18 Night Shuttle Service's Passenger Trips by Time-Period of Night for FY 2006 to FY 2010

	Time Period of Night							
	4PM-5PM		5PM-6PM		6PM-7PM		7PM-8PM	
Year	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change
2006	6,549		5,932		4,885		3,272	
2007	4,971	-24%	4,821	-19%	3,789	-22%	2,747	-16%
2008	3,872	-22%	3,647	-24%	2,718	-28%	1,808	-34%
2009	3,872	0%	3,647	0%	2,718	0%	1,808	0%
2010	4,347	12%	3,356	-8%	2,637	-3%	1,806	0%
	% Change 2006 - 2010		% Change 2006 - 2010		% Change 2006 - 2010		% Change 2006 - 2010	
	-34%		-43%		-46%		-45%	
	Time Period of Night							
	8PM-9PM		9PM-10PM					
Year	Annual Passenger Trips	% Change	Annual Passenger Trips	% Change				
2006	2,844		1,399					
2007	2,443	-14%	1,809	29%				
2008	1,580	-35%	1,295	-28%				
2009	1,580	0%	1,295	0%				
2010	1,392	-12%	1,276	-1%				
	% Change 2006 - 2010		% Change 2006 - 2010					
	-51%		-9%					

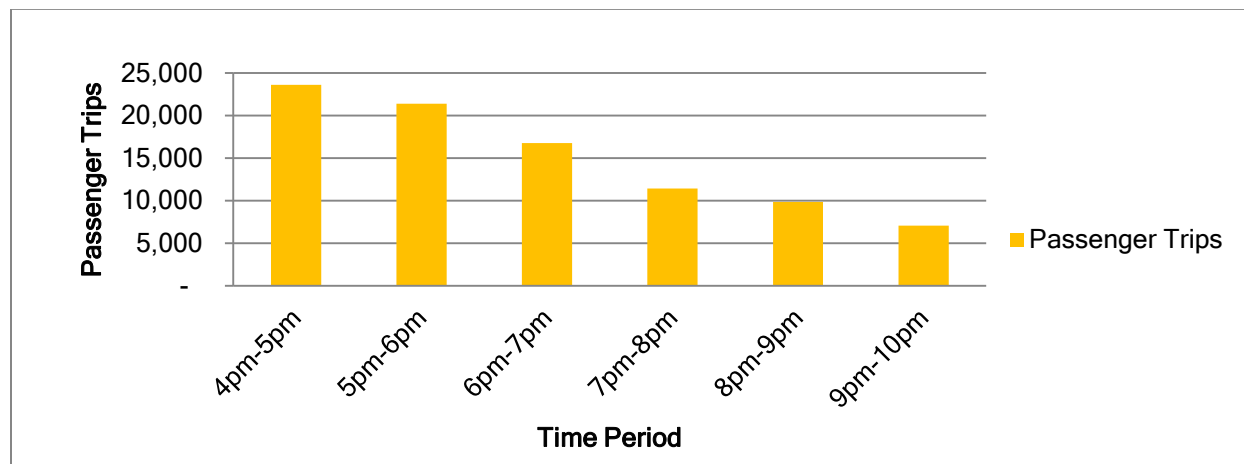


Figure 43 Night Shuttle Service Passenger Trips by Time Period of Day FY 2006 to FY 2010

The information derived from the results of both the student survey and the route ridership analyses in this section identify several important findings and points. These include the fact that most student respondents have access to an automobile while going to school and consequently auto was the most frequently used transportation mode of students. This use may be accentuated by the fact that most respondents' residential locations are at least 1½ miles away from campus, beyond the service area of the campus shuttle system. Also, when deciding on which mode of transportation to use, the mode's convenience is the most important factor. Findings suggest that factors that are linked to time tend to be more important.

Another general and important finding of this section was the fact that from FY 2006 to FY 2010 both shuttle services and their constituent routes experienced net decreases in ridership. Probable causes and potential solutions to this phenomenon are discussed in a subsequent section.

4. SHUTTLE OPERATIONS AND PERFORMANCE ASSESSMENT

4.1. Funding Assessment

At UND, students are not charged directly for rides, there are no fare revenue sources. Funds for the shuttle system come from sources belonging to either of two categories – appropriated revenue or transferred-in revenue. Appropriated funds represent funds set aside for the campus shuttle services explicitly. These funds come from the university’s general fund and from institutional collections, primarily tuition. Transferred-in funds are comprised solely of local funds. Local funds, in the context of the UND campus shuttle system, refer to funding derived from student fees and other institutional fees including interest income and facilities and administrative (F&A) revenue sources. Table 19 shows the revenue and expenditures for the Campus and Night Shuttle Services between FY 2006 and FY 2010.

Table 19 Campus and Night Shuttle Combined Revenue and Expenditure FY 2006 to FY 2010

	Revenue			Expenditures
	Transferred-in	Appropriated	Total	
FY 2006	\$138,631	\$120,341	\$258,972	\$255,132
FY 2007	\$141,644	\$120,341	\$261,985	\$248,360
FY 2008	\$150,621	\$120,341	\$270,962	\$270,830
FY 2009	\$156,110	\$120,341	\$276,451	\$276,451
FY 2010	\$167,918	\$120,341	\$288,259	\$258,503

From FY 2006 to FY 2010 total annual revenue has increased each year. These annual increases account for an aggregate increase in shuttle service revenue of 11% from \$258,972 in 2006 to \$288,259 in 2010. While appropriated revenue remained fixed at \$120,341 for each year over the period, transferred-in revenue increased annually. From FY 2006 to FY 2010, transferred-in funding increased by 21% from \$138,631 in FY 2006 to \$167,918 in FY 2010. This suggests that any increase in the expenses of operating campus shuttle services has been predominantly covered by the increases in transferred-in funds. This may point to the fact that student fees, interest income, and F&A revenues are instrumental in meeting the increased cost of campus shuttle services and can be extremely important sources of revenue when the campus shuttle system, as planned, expands its service. Figure 44 shows the comparison between appropriated funds and transferred-in funds as campus shuttle system revenue sources.

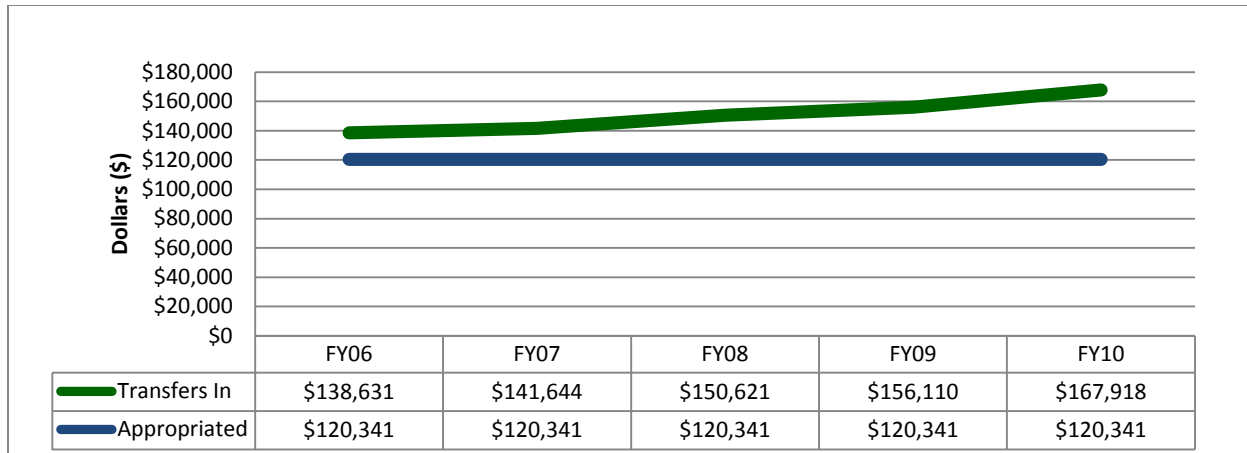


Figure 44 Campus Shuttle System Revenue Sources by Category FY 2006 to FY 2010

When considering the combined expenditures for providing the Campus Shuttle Service and Night Shuttle Service for the period, two observations are worth noting. First, expenditure has never been more than the allotted yearly budget, a very commendable feat. However, note that the department is able to transfer in funds to address cost escalations. Second, shuttle service expenses have tended to fluctuate around the approximate value of \$250,000. This may be the result of either of two general scenarios – operations cost-management or service cost-management. The fact that the costs to operate these shuttle services have fluctuated only moderately over the period may be as a result of UND Transportation making changes to operational factors, e.g. wages, number of staff, lease rates etc., that keep costs managed around a given range. However, this may also be a result of the department employing a strategy in which shuttle service is reduced as costs escalate. Figure 45 shows the combined expenditures for FY 2006 to FY 2010 for providing Campus and Night Shuttle Services versus the total revenue for the same period.

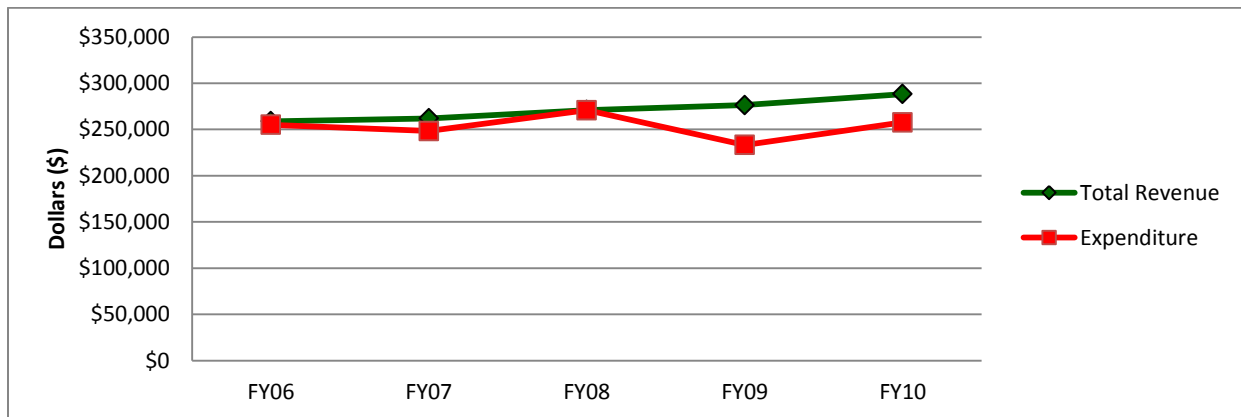


Figure 45 Campus and Night Shuttle Service Revenue vs. Expenditure FY 2006 to FY 2010

4.2. Shuttle Fleet Assessment

Information on the fleet used in providing the UND Campus Shuttle and Night Shuttle Services was collected with the intent of providing a general assessment. The process involved assessing the fleet for

accessibility to individuals with disabilities, average vehicle age, replacement and rehabilitation programming, maintenance and repair expenses, and alignment with environmental and sustainability goals and objectives. Table 20 shows the campus shuttle fleet information.

Table 20 Campus Shuttle Fleet Information

Model Year	Seating Capacity	No. of Wheelchair Positions	Age	Vehicle Miles FY10	Total Vehicle Miles	Vehicle Hours
2001	40	2	9	13,236	138,335	1,161
2002	40	2	8	12,434	119,374	1,205
2004	40	2	6	12,455	88,482	1,146
2004	40	2	6	10,683	86,956	937
2007	40	2	3	13,900	30,126	1,124
2011	40	2	0 (New)	No Data	No Data	No Data
			Fleet Average Age	FY10 Average Vehicle Miles	Total Average Vehicle Miles	Fleet Average Vehicle Hours
			5.3	1,0451.33	92,654.6	1,114.6
				FY10 Shuttle Service Miles		Shuttle Service Campus/Night Total Vehicle Hours
				54,132		5,719

Each of the fleet's six buses is equipped with two wheelchair positions. This communicates UND Transportation's customer-centric view and its awareness of the scope of mobility needs of UND's student population. It also shows UND Transportation's compliance with the Americans with Disabilities Act of 1990 (ADA). Conversely, an issue that was identified related to the availability of two wheelchair positions in each bus is the resulting reduction in seating capacity. On average, a wheelchair position may displace two to four passenger seats on a bus. This can be an issue when providing service in peak hours.

The average age of the campus shuttle fleet is 5.3 years. The fleet is therefore a relatively "young" fleet, with the oldest vehicle age being nine years and the youngest not yet one year old. This bodes well because the vehicles are on 15-year depreciation schedules. Given the fleet vehicles' ages, the resulting aesthetics should contribute to a favorable rider experience. Additionally, the fleet's average age should translate to a decreased need for major maintenance and repair work – both factors that can significantly affect service quality and the system's level of service.

NDSFS arranges for bus replacements at the end of a vehicle's 15-year depreciation schedule, or earlier if worsening vehicle conditions or decreased vehicular performance dictate so. NDSFS conducts annual rehabilitation and replacement evaluations. It is very beneficial that the shuttle buses belong to an established fleet program that implements ongoing vehicle condition and performance monitoring.

Given that the fleet's buses are all owned, insured, and maintained by NDSFS. The only direct cost to UND Transportation of operating the buses is the lease rate charged by NDSFS. The most recent rate was \$29 per hour. As a result, UND Transportation benefits because it does not have to directly absorb the entirety of variable costs. However, the variability of this rate can significantly affect operating costs especially because it changes every three months on average.

Note that all the fleet's vehicles are fueled by diesel. This seems contradictory to UND's sustainability focus. However, UND Transportation has little influence over this situation as the North Dakota Department of Transportation makes the final decision as to the propulsion systems of state fleet vehicles. With already existing state fueling infrastructure and locations established, one of which is housed at UND, and the increasing constraints of state budgets, the likelihood of a conversion to alternative fuel systems for the UND campus shuttle system buses is highly improbable.

4.3 Shuttle Performance Assessment

Where data was available, shuttle service performance was assessed in three areas: service effectiveness, service efficiency, and cost effectiveness. Service effectiveness was determined using two measures: passengers per service mile and passengers per service hour. Service efficiency was also determined using two measures: operating costs per service mile and operating costs per service hour. Finally, cost effectiveness was determined using one measure, operating costs per passenger. Note that data availability influenced the derivation of performance measures.

While the Campus Shuttle Service, the service that operates during the day at UND, operates four independent routes, certain types of data were not readily available on a per route basis. A major reason for this is that vehicles used to provide shuttle services are not used exclusively on any one route but are interchanged between them as needs arise. As a result, total service hours and total service costs are provided for the Campus Shuttle Service as a whole and not for its individual routes. However, due to the fact that the vehicles are constantly interchanged, total services hours and costs were divided equally among the four routes as a means of arriving at the nearest approximate measures. Conversely, for FY 2010, total passenger trips and total service miles were provided on a per route basis. This facilitated the calculation of fairly accurate shuttle performance measures for FY 2010.

Because the Night Shuttle Service is comprised of one route, all of the service hour, service cost, service mile, and service passenger trip data were more readily available and were used in calculating the service's performance measures.

From a broader perspective, both total annual passenger trip and the total annual expense data were available for all years in the study period, FY 2006 to FY 2010. This facilitated the calculation of performance measures that could be compared on a year to year basis.

Table 21 displays the performance measures for the Red, Blue, Green, Purple, and Night routes for FY 2010.

Table 21 Campus and Night Shuttle Service Performance Measures for FY 2010

OPERATING DATA FY 2010	Red Route	Blue Route	Green Route	Purple Route	Night Service
Passengers Trips	43,018	40,703	63,282	55,485	14,280
Total Service Miles	11,376	10,902	12,482	11,692	7,680
Total Service Hours	1,256	1,256	1,256	1,256	762
Operating Costs	\$57,287	\$57,287	\$57,287	\$57,287	\$34,463
Approximate Average Speed	9.1	8.7	9.9	9.3	10.1

PERFORMANCE MEASURES FY 2010	Red Route	Blue Route	Green Route	Purple Route	Night Service
Passenger Trips per Service Mile (Service Effectiveness)	3.78	3.73	5.07	4.75	1.86
Passenger Trips per Service Hour (Service Effectiveness)	34.25	32.41	50.38	44.18	18.74
Operating Cost per Passenger Trip (Cost Effectiveness)	1.33	1.41	0.91	1.03	2.41
Operating Cost per Service Mile (Service Efficiency)	5.04	5.25	4.59	4.90	4.49
Operating Cost Per Service Hour (Service Efficiency)	45.61	45.61	45.61	45.61	45.23

For passenger trips per service mile, the route with the highest passenger trip rate was the Green route with 5.07 trips per mile. It was followed by the Purple route at 4.75 trips per mile, the Red route at 3.78 trips per mile, the Blue route at 3.73 trips per mile, and the Night Route with 1.86 trips per mile. When observing passenger trips per service hour, the Green route had the highest rate with 50.38 trips per hour. It was followed by the Purple route with 44.18 trips per hour, the Red route with 34.25 trips per hour, the Blue route with 32.41 trips per hour, and the Night route with 18.74 trips per hour.

Therefore, as it pertains to service effectiveness, the performance measures indicate that the Green route is the most effective. It is followed by the Purple route, the Red route, the Blue route, and the Night Route. Note that while the Red, Blue, Green, and Purple routes can be compared to each other, the Night route operates at a different time of day and with different route and service characteristics. Therefore, and direct comparison between its performance measures and any of the other Campus Shuttle Service routes' performance measures must be conducted with these factors in mind. A more fitting comparison would be to compare the Campus Night Shuttle's performance measures to those of a comparable campus night circulator shuttle service.

With regard to operating cost per service mile, the most efficient is the Night route with a cost of \$4.49 per service mile. It is followed by the Green route with a cost of \$4.59 per service mile, the Purple route with a cost of \$4.90, the Red route at \$5.04, and the Blue route at \$5.25. When comparing each route's operating cost per service hour, the Night route has the marginally lower cost of \$45.23 cents and all the other routes, because of the aforementioned bundling of their service hours and costs, have the identical operating cost per service hour of \$45.61. The availability of route-specific service hours and cost data will facilitate the calculation of more accurate and definitive performance measures.

Therefore, as it pertains to service efficiency, the performance measures indicate that the Night route is the most efficient. However, caution must be taken interpreting these measures for two reasons. First, the Night Shuttle route is a service with a different set of characteristics than that of the Campus Shuttle routes. Second, due to the fact that the operating costs and service hours for the Campus Shuttle routes are bundled, their performance measures, while providing estimates, may not facilitate the accuracy needed to arrive at definite conclusions.

When observing each route's operating cost per passenger trip, which is also the measure of each route's cost effectiveness, the Green route provided service at a cost of \$0.91 per trip. It was followed by the Purple route at \$1.03 per trip, the Red route at \$1.33 per trip, the Blue route at \$1.41 per trip, and the Night route at \$2.41 per trip. This performance measure does provide a fairer measurement for

comparison between the service's routes due to the fact that it is the cost generated in providing each passenger trip and thus is based on a route's ability to generate and attract passenger trips.

Considering the three performance measurement areas, service effectiveness, service efficiency, and cost effectiveness, the Green and Purple routes appear to be the most effective and efficient. The Red and Blue routes are incrementally less so. From the perspective of cost effectiveness, the Night route can be compared on a relatively equal basis to the other four routes. However, its differences in service and operations characteristics render it incomparable with the other routes' performance measures in service efficiency and service effectiveness. The Night route can be more effectively evaluated when benchmarked against other "best in class" university and college night shuttle services.

For the period FY 2006 to FY 2010, the combined operating cost per passenger trip was calculated for the Campus Shuttle Service and the Night Shuttle Service. The results, as shown in Table 22, indicates that over the period there were consistent increases in the cost per passenger trip with the exception of FY 2010. This relays a general decrease in cost effectiveness from FY 2006 to FY 2010. The operating cost per passenger trip rose 31% from \$0.90 in 2006 to \$1.19 in 2010. Note that this increase in cost per trip over the study time period may be attributable to any one or a combination of factors that include increased general inflation, increased fuel prices, increased vehicle lease rates, and declines in ridership. Some of these factors may be beyond the control of UND Transportation's management while others, like ridership levels, may be directly controllable.

Table 22 Operating Cost per Passenger Trip FY 2006 to FY 2010

OPERATING DATA FY06-FY10	2006	2007	2008	2009	2010
Total Number of Trips	283354	287430	239477	214735	217888
Operating Cost	\$ 255,132	\$ 248,360	\$ 270,830	\$ 276,451	\$ 258,503
PERFORMANCE MEASURES FY06-FY10					
Operating Cost per Passenger Trip (Cost Effectiveness)	\$ 0.90	\$ 0.86	\$ 1.13	\$ 1.29	\$ 1.19

From an operations perspective, various points of interest concerning the UND campus shuttle system were identified. The ability of management to apply transferred funds to finance cost escalation is commendable and conveys two important points. First, the flexibility of the process that facilitates the application of student fees, interest income, and F&A revenues to address fluctuating shuttle expenses and allows management to be adaptable to both service needs and operational cost fluctuations. Second, this ability to transfer funds has allowed UND to avoid operating at a loss over the study period. It would be interesting to investigate whether or not the consistency of operating costs within a range of \$250,000 to \$270,00 is a result of the department primarily managing operations costs, the department altering service to manage costs, or a combination of both.

The shuttle's fleet has a favorable average age which will bode well for the department in terms of managing repair and maintenance costs. The shuttle's accessibility to individuals with disabilities is evident and commendable as well. One negative factor concerning the shuttle, in the context of UND's

sustainability efforts, is that UND has limited ability to introduce alternatively fueled vehicles into the fleet.

Various conclusions can be reached as a result of the performance measurement analyses. Important among them is the fact that vehicle hours and costs are not specific to each route of the Campus Shuttle Service and therefore influenced the calculation of its routes' performance measures. However, the calculated performance measures still gave insight into both the effectiveness and efficiency of observed routes. The Green and Purple routes were observed to be more efficient and effective than the Red and Blue routes. This may be attributable to the fact that cost was divided equally among Campus Shuttle Service's routes and the Green and Purple routes had more annual passenger trips. This point in itself leads to another area for potential investigation, i.e. to determine the factors that result in the Green and Purple routes experiencing higher ridership. The Night Shuttle Service's performance measures, though not compared directly to the Campus Shuttle Service's routes, facilitate the opportunity for future Night Shuttle Service route evaluation and peer system analysis. For the entire campus shuttle system, the calculation of the performance measures in this section can be utilized to monitor and evaluate the campus' shuttle system future performance.

5. SHUTTLE SERVICE EVALUATION AND RECOMMENDED ACTIONS

This section consists of an evaluation of the current state of service of the UND Campus Shuttle Service and the Night Shuttle Service. It also includes recommendations based on the results of the evaluation. The evaluation is based on UND campus information; data and information collected through the study survey instrument; and route ridership and cost data provided by UND Transportation. The recommendations discussed are based on the findings of the study and on the best practices of other campus shuttle systems.

5.1 Evaluation

This evaluation assesses both the Campus Shuttle Service and the Night Shuttle Service in light of the university environment in which they operate, the responses collected from the student body, consisting of both users and non-users, and from the analysis done on route ridership and operating performance measures.

The UND campus shuttle system operates on a campus that saw an enrollment increase of 10.6% during the period for which the data in this study was collected, FY 2006 to FY 2010. This increase represented growth from 12,834 in FY 2006 to 14,194 in FY 2010. Despite this growth in enrollment, every Campus Shuttle and Night Shuttle Services route experienced net decreases in passenger trips over the same period. On the Campus Shuttle Service, the Red, Blue, Green, and Purple routes experience net passenger trip decreases of 22%, 28%, 18%, and 21% respectively. The Night Shuttle Service experienced a 41% net decrease in passenger trips over the same period.

Factors that negatively impact passenger trip levels on a university campus include, among others, the spatial distribution of buildings and facilities across the campus, the general climatic conditions, the turnover rate of students, choice of academic major, and the level of awareness and marketing of the campus shuttle service. Specific to UND, various factors resulted in the net decreases in passenger trips on both of the observed shuttle services' routes. First, due to the general climatic conditions in North Dakota and UND's commitment to sustainability practices, the school has an extensive network of indoor walkways that facilitate walking from building to building when temperatures are too cold for students to comfortably walk outside. This situation, coupled with the fact that most students decide on a major after four or five semesters and subsequently spend most of their time in a specific building or network of buildings, results in declining use of the campus shuttle system on a per student basis. There are other university facilities that would not be related to a student's specific major e.g. the campus' gym facilities, libraries, parking facilities, residence halls and student unions, among others. However, mobility demand to these destinations must be large enough for there to be significant impact on the number of passenger trips taken on specific routes.

Closely related to the aforementioned point is what is referred to as the "seasonality" of the school year. Given the fact that the school year comprises various breaks, some of them lengthier than others, sustained passenger trip levels are rare and may result in fluctuations in annual passenger trips taken. Also, there is a high turnover rate for students on campuses with a corresponding high turnover rate for shuttle system riders. Note that students come from backgrounds with varied degrees of experience with

public transportation. The majority of the UND student body comes from North Dakota, between 46% and 56% annually for the study period. The second largest home state for students is Minnesota with between 28% and 32% annually for the study period. In both these states auto use tends to be high. This background can also be a factor influencing shuttle use at UND. Research shows that an individual's prior experience with public transit influences their propensity to start or continue to use public transit.

The relatively lower gas prices since 2008 may also have had impact on student's propensity to use the UND campus shuttle system. However, for this point to be fully substantiated separate analysis is required.

Additional reasons for the net decreases in passenger trips on the Campus Shuttle Service and the Night Shuttle Service routes may stem from other factors. The survey that was administered to the UND student body reveals some information that may point to such potential reasons.

The information collected through the survey provided some deeper insight into probable causes for decreased campus shuttle passenger trips. An important fact to point out before delving into specific aspects of survey-generated information is that 85.5% of all UND students responding to the survey stated that they had access to a vehicle while attending school. This high rate of access to vehicles coupled with the fact that generally between 67% and 69% of all UND students live off-campus on an annual basis, results in a scenario that does not encourage the use of the campus shuttle system. Further, in all seasons of the year automobile was the primary mode of choice by students, accounting for between 72% and 75% of respondents' most frequently used mode. Conversely, the campus shuttle system accounted for between 13.2% and 43.2% of respondents' most frequently used mode according to season while the CAT system, accounted for between 7.5% and 11.7%. Other identified modes of frequent use are walking at 44.2% to 58.9% and car pooling at 15% to 22%. It is both interesting and important to note that for all seasons of the year walking was the second highest utilized transportation mode at UND.

Various factors may induce a shift of modal choice among students. Students must both perceive and experience the benefits of the shuttle system to increase their use of it. When asked to list the factors that most affected their mode choice, the top three factors were convenience of service, weather, and the timeliness of service. In identifying what they believed to be the service characteristics of a campus shuttle system they believed most beneficial, three particular benefits received substantially higher ratings than others – convenience, the bus being on-time, and the reliability of the service. These three characteristics give insight into what students value. In regard to convenience, students have preference toward a service that is useful based on their schedules, that is easily accessible, and that is easily understood. In listing on-time service as a priority, the utility of time is identified as being significantly important. In communicating a high preference for dependability, which in the case of public transportation is inextricably linked to bus on-time performance, students convey the importance of being able to depend on the service.

The importance and utility of time to students was further emphasized in expressing their preferred bus waiting times. Only 10.7% of students are willing to wait more than 10 minutes for a bus on campus. The most preferred waiting time was less than 10 minutes with 61.2% of respondents listing that as ideal. Those willing to wait up to ten minutes represented 28.1% of respondents. Waiting any longer than 10 minutes, students say, defeats the purpose of taking the campus shuttle because by that time they stand the chance of getting to class late.

With respect to students' stated perceptions and experiences with service characteristics, two points are important to note. First, the frequencies of service for the Campus Shuttle Service routes are between 15 and 20 minutes, both over the preferred waiting time by 5 and 10 minutes respectively. The frequency of the Night Shuttle is 30 minutes. Second, and of extreme importance, are respondents' comments concerning shuttle service convenience and on-time performance. With respect to convenience, numerous respondents stated they were not fully aware of the shuttle services' schedules and not having any access to printed information at specific times deters them from using the shuttle services. Also in the area of convenience, some respondents commented that the time spent both waiting for the bus and in making the trip renders the shuttle service a slower alternative to walking. This leads to the issue of on-time performance, for which various respondents indicated that the buses are frequently not on time which, in their opinion, renders the service unreliable.

In reference to respondents' continuous mentions of shuttle buses being late and service not being reliable, an important point must be noted. One of the potential reasons for late buses and the perceived unreliability of service, as experienced at other college and university campus shuttle systems, is the fact that the shuttle system employs student drivers. As noted by the UND Transportation management, it is difficult to develop a dependable driver roster given that a great percentage of the drivers are students.

An interesting comment was made on several occasions: some students believed there was little benefit in using the campus shuttle system when they are "forced" to pay for campus parking. This suggestion highlights the dynamic between parking and its effects on someone's propensity to utilize available transit services, even if free. Another area that was mentioned, though less frequently than that of bus waiting-time or inadequate service frequency, was that of drivers' attitudes. Several students commented that drivers should have more welcoming and friendlier attitudes.

Students identified several benefits of the campus shuttle service. They said it provides a warmer option in winter. They recognize that there is no cost to use the service. They also note that it is a safe mobility option, especially at night. The value of the service to those without vehicles who desire to go to locations within the shuttle's services area was also identified as a benefit. Finally, they acknowledged the value of the system to aviation students as opposed to them having to walk to the aviation facilities. Despite these perceptions of the benefits of the shuttle system, the perception of the service being unreliable and experiences with it not running on-time may be a reason for passenger trip reductions over the past few years.

Various points pertaining to the campus shuttle system's operations are worth discussing. UND Transportation experiences cost savings given it does not have to provide the capital funding to purchase the shuttle buses in its fleet. Cost savings are also realized by UND Transportation given that NDSFS owns, insures, and maintains its shuttle bus fleet. These cost savings may be recognized in the per hour rate that NDSFS is able to charge UND. NDSFS is most likely able to provide a lower rate to UND due to the fact that it can spread some of its costs over statewide operations.

However, there are challenges in this arrangement. UND Transportation schedules shuttle bus refurbishing for summer which does not coincide with the state's budgetary cycle. This can at times result in limited funding for UND shuttle buses which can in turn impact riders' travelling experience.

Using vehicles owned, insured, and maintained by NDSFS can pose additional challenges as well. As mentioned by survey respondents, the types of vehicles used in the delivery of public transportation services may have profound effects on both passengers' ride experience and passengers' perception of the service. Both of these factors substantially influence ridership levels, particularly when the potential riders have various other alternatives and are not entirely dependent on the service. Further, and with allusion to UND sustainability goals and initiatives, various student respondents indicated a desire to see alternatively fueled buses in the university's shuttle bus fleet. While this has also been an expressed desire of UND Transportation's management, NDSFS is only able to purchase such vehicles if budgets allow. Taking into account the present economic climate, as well as its effect on state transportation department budgets, the purchase of alternatively fueled vehicles for the UND shuttle bus fleet is not likely to occur in the near future.

It is commendable that 100% of UND's shuttle bus fleet is fully ADA compliant and wheel chair equipped. This bodes well, especially when a recent study, *TCRP Synthesis 78: Transit Systems in College and University Communities*, indicated that only 55% of responding university transit systems had every fleet vehicle wheelchair equipped. Not only is every vehicle in UND's shuttle bus vehicle equipped, but each vehicle has two wheel chair positions. Another finding of the TCRP study was that 65% of respondents actively recruited student drivers. This indicates UND Transportation's substantial use of student drivers and resulting scheduling problems are not unique. However, the use of student drivers has enabled UND to save on staff expenses – a very effective cost management tool employed by its management.

Another interesting, but not impressive, finding of the TCRP study was that only 26% of universities and colleges responding to the study survey communicated having established definitive ridership goals for service routes. If that is the case at UND, steps should be taken to establish such goals. Route ridership goals are not the only area in which improvements can be made to UND Transportation's shuttle service system. Additional potential shuttle system and service actions and recommendations are identified in a subsequent section. Before delving into these, another important facet of student mobility is worth discussing: the role of CAT in serving campus student mobility demand.

The way that CAT's services are evaluated by students is of importance in this study. Given the proportion of UND students residing off-campus, and hence outside the service area coverage of the campus shuttle system, there are opportunities to increase ridership for CAT. This potential however, is contingent on students' perceptions of and experience with CAT service.

Numerous students mentioned a lack of access to and awareness of information on CAT's routes and services. This was submitted as one of the major reasons for their reluctance to use the service. Similar to the campus shuttle system, students found the waiting time for CAT buses to be too long. Some respondents suggested that the trips from where they lived to campus took too much time due to the numerous stops the bus had to make. This, respondents communicate, makes reaching campus on-time a concern. Mentions, though significantly less frequent, were made surrounding respondents' concern for their safety when riding the CAT bus system.

Interestingly, respondents mentioned their hesitance to utilize CAT service due to them opting instead to drive to campus in order to make use of the parking permit for which they paid. This again highlights the influence of parking policy on students' travel behavior.

Another important CAT-related point is the fact that though the UND Student Government has an agreement with CAT that results in students being able to ride the bus anywhere in the city for free, 69.6% of students reported that had not received the card that permits them to do so.

5.2 Recommended Actions

After evaluating the study findings, various actions that UND Transportation can take to improve campus shuttle services were identified. These actions can be classified as being either long-term actions or short-term actions. Long-term actions, while recommended and feasible over a longer time period, may not be the best immediate courses of action to embark on for reasons that include present school policy, student and faculty travel behavior, the school's present building and facility spatial distribution, and present budgetary constraints. The short-term recommendations are more feasible over the short term given they do not require immediate changes in school policy, are congruent with the school's present building and facility spatial distribution, and are not as cost-intensive. Both the long-term and short-term recommended actions are based on study and survey findings, UND policies and goals, and college and university campus transit best-practices.

5.2.1 Short-Term Recommended Actions

Four short-term actions UND Transportation can take to improve the service offered by the campus shuttle system are suggested. These include improving on shuttle customer service; improving data collection processes, methods and reporting to facilitate continuous shuttle service performance measurement and monitoring; focusing on increasing the coverage of intra-campus shuttle service; and increasing service frequency and service on-time performance. These four areas do not require changes in campus policy nor do they demand huge capital funding outlays but may significantly increase shuttle ridership.

Improving Shuttle Customer Service

To improve the customer service of the UND campus shuttle system, focus should be in three areas. These areas are increasing access to service information and improved marketing of shuttle services; the continuous collection of students' perceptions of the service; and working on improving driver attitudes.

1. To increase access to service information and improve marketing of shuttle services, the following actions can be taken:
 - a. Re-introduce printed schedules and service information.
 - b. Use on-line schedules to market the service more pervasively across the school's website i.e. on various school web pages, not just UND Transportation's. *TCRP Synthesis 78: Transit Systems in College and University Communities* indicates that 92% of campuses that provide student transit services advertise at freshman orientation and prematriculation. Further, 84% of these universities use brochures and 81% use the school's website. Note that of those that use the school's website to make maps and schedules available, 83% report also utilize online advertising across the school's website to market the service. Merely placing maps and schedules on the Internet does not suffice.

- c. Improve distribution of free ride cards to students. While the UND Student Government's agreement with CAT has the potential to be very beneficial to students, a substantial proportion of survey respondents never received the card. While the current "modus operandi" dictates that students must collect the free ride cards at the student government office, this may prove to require too much effort for students that are not enthused about public transit in the first place. Another approach may be to deliver the cards to students each year through mail or in some form of welcome packet to freshmen.
2. To facilitate the continuous collection of students' perception of the shuttle services, the following actions can be taken:
 - a. Make on-board service comment sheets available.
 - b. Administer annual customer satisfaction surveys online using an on-line survey tool, e.g. Survey Monkey.
 - c. Make comment and suggestion sheets available at various buildings across campus to get an idea of the variations in perception of the shuttle services.
 - d. Make a phone number available for students to call and make suggestions.
3. To improve driver attitudes, the following actions can be taken:
 - a. Emphasize in training for new drivers the importance of professionalism and unceasing courtesy in public transportation.
 - b. Introduce on-board feedback sheets where space is provided to comment on driver attitude.
 - c. Make a contact number available on-board for instantaneously reporting driver attitude.
 - d. Introduce an incentive program to encourage "extra courtesy" towards passengers, e.g. passengers voting for the friendliest driver of the month where the prize can be extra hours of work, school-related fee payment, or some prize that would influence driver behavior.

Improving Shuttle Service Data Collection Processes, Methods, and Reporting

Improving shuttle service data collection processes and methods should focus on four areas. These areas include developing an extensive list of performance measures and the data needed to calculate them, collecting readily accessible data for all services provided by the campus shuttle system, including shuttle system route performance measures in the annual report, and determining the best tools to accomplish data collection.

To develop an extensive list of shuttle system performance measures the following can be done:

1. Determine the types of measures that can be calculated and that can offer a basis for comparing shuttle services and routes on a year to year, or period to period, basis. Such performance measures should include:
 - a. Passenger trips per service mile (one-way passenger trips and route service miles needed)
 - b. Passenger trips per service hour (one-way passenger trips and route service hours needed)
 - c. Operating cost per service mile (route operating cost and route service miles needed)
 - d. Operating cost per service hour (route operating cost and route service hours needed)
 - e. Operating cost per passenger trip (route operating cost and one-way passenger trips needed)
 - f. On-time performance (stop location data)
 - g. Number of non-policy related complaints (make comment medium available)
2. To make data available for all service routes, the following should be done:
 - a. All types of data collected for the Campus Shuttle Service and the Night Shuttle Service should also be collected, as much possible, for all the other services provided through the campus shuttle system. This will facilitate more definitive analysis of shuttle system service performance in the future.
3. In including shuttle system route performance measures in the annual report the following should be done:
 - a. All of the performance measures identified in (1) above should be provided for each shuttle service, and its component routes, on a yearly basis. These can be provided in the UND Transportation Annual Report or any other document reporting on the shuttle system. This will facilitate internal monitoring of the shuttle system's performance and allow benchmarking from year to year. This will also assist UND Transportation's management in establishing shuttle service goals for the coming year.
4. To determine the most appropriate tools with which to collect and process shuttle service and route data the following should be done:
 - a. Determine the budget available to pursue this task. The available budget will determine the sophistication of the tool acquired and utilized, e.g. an internally developed

spreadsheet and database management system using the Microsoft Office Suite versus a customized software solution provided by a vendor utilizing more advanced technologies.

- b. Identify and determine the human resources available and able to be dedicated to this ongoing task and commit to this task.

Increasing the Coverage of Intra-Campus Shuttle Service

This particular short-term action is important for various reasons. First, while conducting the study, survey responses to two questions identified underserved student mobility needs. These questions asked respondents to identify additional stops they would like the campus shuttle system to add and to identify particular origin and destination trips for which they consider the walking distances to be too long. While the former of these questions provides definite potential stops, the latter provides information on potential service route changes or additions. The second reason this action is important is that in contributing to UND's sustainability goals and initiatives, increasing the coverage of service within the campus should result in the displacement of auto trips. According to UND's Climate Action Plan 2010, UND intends to purchase additional shuttle buses, increase appropriated funding for shuttle services, and to improve bus shelters. These actions will all contribute to the increased feasibility of increasing the coverage of intra-campus shuttle service.

Increasing the coverage of intra-campus shuttle service will require a focus on two areas: determining the underserved intra-campus student mobility needs and identifying the appropriate route and service design to adequately meet those needs.

1. To determine the underserved intra-campus student mobility needs, the following should be done:
 - a. Conduct a student-based study to determine underserved intra-campus mobility needs. This step has already been accomplished through various aspects of the survey instrument used in this study. As mentioned, the two specific survey questions facilitating the collection of information for this task involved:
 - i. Students identifying additional on-campus stop locations
 - ii. Students identifying origin destination on-campus trips for which they consider walking distances to be too long

Though each of these questions generated scores of answers, the responses were filtered for duplicates and high-frequency responses. Table 23 displays the additional bus stop locations suggested by survey respondents. Figure 46 shows the most-mentioned additional shuttle service stop locations, many of which are on campus. The implications of the mentioned stops that are off-campus on service planning are addressed in the long-term recommended action section that follows. A table identifying all of the on-campus origin-destination trips that respondents found too long to complete by walking is included in the appendix because of its length.

As seen in Figure 46, although the existing campus shuttle services cover a large area of the UND campus, their routes do not provide coverage to various locations within their route service areas.

2. To identify the appropriate route and service design to adequately meet intra-campus mobility needs the following should be done:
 - a. Examine routes for duplicity and eliminate identified aspects so resources can be shifted to provide more routes that run in various directions across the campus.
 - b. In tandem with (a), conduct a more in-depth route and service design study. Such a study would analyze latent demand and underserved student sub-groups and restructure routes to capture as many riders as possible. While the present routes of the campus shuttle services are circulatory or loop routes, new campus shuttle system route designs can include the following types of routes:
 - i. Linear routes
 - ii. Through routes
 - iii. Split routes
 - iv. Express routes

Table 23 Desired Additional Campus Shuttle System Stop Locations

Desired Stop Locations	Survey Respondents' Additional Desired Shuttle Service Stops
	Mall, Target.
	6 th Ave and 43 rd St.
	N. 43rd St./6th street intersection
	McEnroe Apartments/ Alerus Center, Campus Place Apartments and Shakespeare Apartments.
	Near the Pines Apartments
	Resume the stop by the apartments north west of the campus.
	Twamley
	Skalicky Tech Incubator/Ryan Hall.
	Dakota Residence Hall.
	The medical school.
	On 4th or 5th Ave between the med school and University Park.
	By the apartments around the Red Pepper.
	Stanford Manor.
	EERC.
	Both directions in front of Library (Chester Fritz).
	Betty Engelstad Sioux Center.
	Further East down University Avenue.
	3404 university drive.
	Somewhere around Memorial field.
	Between International Center and Squires.
	O'Kelly and Merrifield.
	Loaf and Jug stop.
	South Grand Forks.
	Garden View Drive.
	The Aviation Shuttle should at least stop at Wilkerson on the weekends, if not the Union.
	Downtown transit center.
	Stops along Centennial or closer to the Quad.
	University Station.
	Closer to dorms.
	Further into the "off-campus" apartments rather than staying on the main streets.

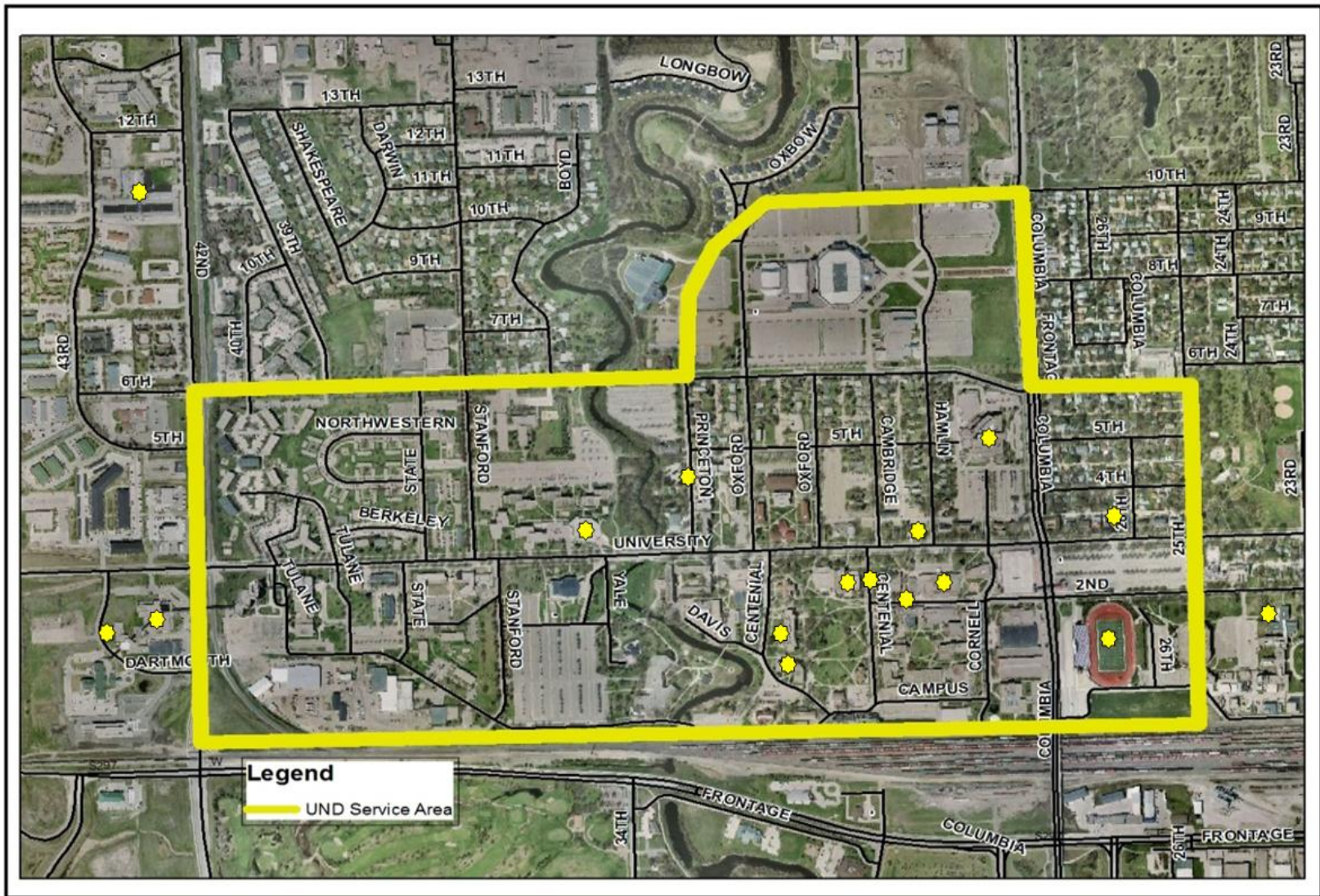


Figure 46 Identified Additional Campus Shuttle System Bus Stop Locations

Increasing Service Frequency and Improving Service On-Time Performance

Based on responses from survey participants, the perceived inadequacy of service frequency and high rates of late shuttle bus arrivals were primary reasons the service was deemed unreliable. This perception can have adverse effects on shuttle system ridership levels, particularly if more convenient alternatives are available, e.g. automobile, the most frequently used mode; or walking, facilitated by the extensive university indoor walkway network. To increase shuttle system ridership levels, focus must be concentrated on two areas – increasing service frequency and improving on-time performance.

1. To increase service frequency, the following can be done:
 - a. Routes can be split and made shorter. While the same service area is covered, this strategy suggests doing so with more routes. This strategy is contingent upon the ability to add shuttle buses in the shuttle system. This is proposed by UND as communicated in its 2010 Climate Action Plan.
 - b. Given the intent to purchase additional shuttle buses, another strategy UND Transportation can employ to increase service frequency is to add buses to each route without changing the routes' lengths as suggested in (a) above. This strategy can be used to increase both service frequency (the number of times a buses services the same stop in a given time period, e.g. an hour) and vehicle headways (the time period between each bus on a route).
2. To improve on-time performance, the following can be done:
 - a. Eliminate excessive stops along any of the shuttle service's routes. The optimal walking distances students are willing to walk should be determined (this information is provided by this study and can be found in section 3) and stop locations should be adjusted accordingly. In the survey, some students said the shuttle buses stop too frequently, causing them to be late to their destinations.
 - b. Adjust route schedules to account for congested travel corridors (roads or streets at specific times) of day.
 - c. Develop more dependable student-driver schedules. This can be achieved in a two-step process. First, reiterate to student drivers the importance of committing to assigned times. Second, upon getting these guaranteed commitments, use available software to develop a driver schedule that incorporates various constraints. This can be achieved by developing a linear program using Microsoft Excel, or other software programs, e.g. Lindo or Lingo. The challenge of this particular task is to ensure the commitment of student drivers who themselves are at times subject to unpredictable class dynamics.

Figure 47 displays the short-term recommended actions for the UND campus shuttle system services.

Improving Shuttle Customer Service	Improving Shuttle Service Data Collection Processes, Methods, and Reporting	Increasing the Coverage of Intra-Campus Shuttle Service	Increasing Service Frequency and Improving Service On-Time Performance
<ul style="list-style-type: none"> • Increasing access to service information and improved marketing of shuttle services • Continuous collection of customer perception of the service • Working on improving driver attitudes. 	<ul style="list-style-type: none"> • Developing performance measures • Including shuttle system route performance measures in the annual report • Determining the best tools to accomplish data collection. 	<ul style="list-style-type: none"> • Determining the intra-campus student mobility needs • Identifying the appropriate route and service design to adequately meet those needs 	<ul style="list-style-type: none"> • Increasing service frequency • Improving service on-time performance.

Figure 47 Recommended Short-Term Actions for UND Campus Shuttle System Services

5.2.2 Long-Term Recommended Actions

In developing the long-term recommended actions for the UND campus shuttle system services, various macro factors were taken into consideration. These factors included the expressed travel behavior of survey respondents, the transportation alternatives available within and surrounding the campus community, the communicated goals and objectives of UND, and the fact that transport systems are complex, large, open, and integrated systems (CLIOS) and should be analyzed as such where possible.

In terms of student behavior, various points of information provided input in devising long-term plans of action. These included that most UND students come from off-campus housing locations, 67% to 69% on a yearly basis; that 85.5% of respondents said they had access to a vehicle while attending school; that approximately 55% of all respondents live at least 1½ or more miles away from campus; and that students did not want to wait long for buses or to travel on routes that took excessively long to get to school. Additionally, respondents identified numerous off-campus locations that they would like to see receive shuttle services. Figure 48 shows the most frequently suggested of these locations.

Compounding the issue was the fact that 61.8% of respondents had student parking permits, 3.9% had student ramp permits, and 35.5% of students had no parking permit whatsoever. The general consensus was displeasure with campus parking policy and practice. Further, while 40.8% of respondents rated campus parking as being fair, 29% rated as being poor and 16.1% of respondents rated it as being very poor. Only 13.9% of respondents found campus parking to be either good or very good. Interestingly, park and ride permits account for less than 1% of the type of parking permit obtained by students. This has significant influence on the shuttle system's potential ridership. The increased availability of park and ride lots in strategic locations may increase student's propensity to purchase park and ride permits.

The fact that more than 85.5% of respondents had access to an automobile while attending school reduces students' desire to use the campus transit service. Additionally, students with "S" permits are allowed to park in various locations across the campus which, from a convenience perspective, makes the campus shuttle less competitive.

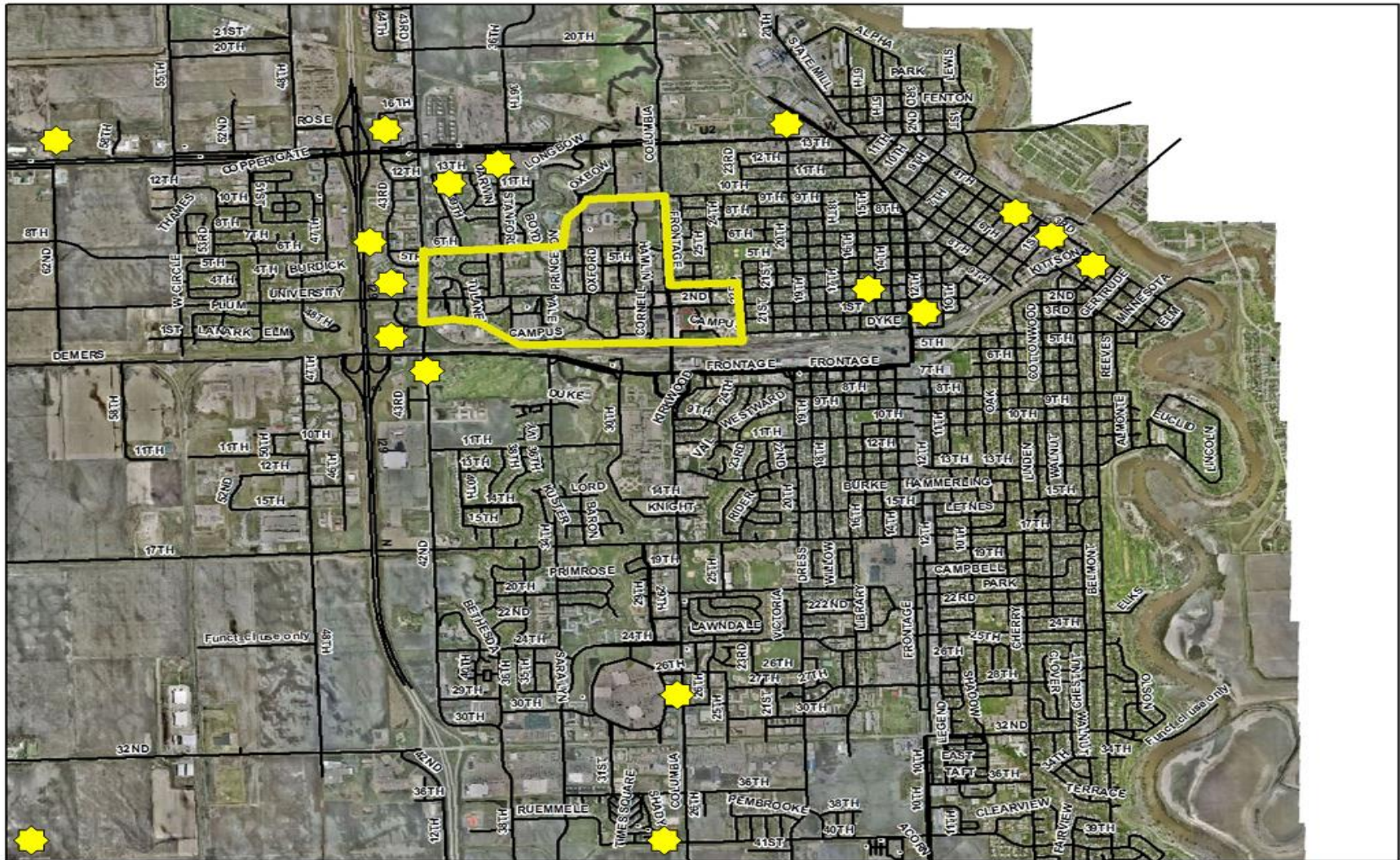


Figure 48 Desired Off-Campus Locations for Campus Shuttle System Services

The relatively high rates of walking and car pooling were very interesting observations. Walking maintained a rate of between 44.2% and 58.9% through all seasons of the year, and car pooling had rates of between 15.3% and 22% year round. The apparent potential of these modes to become mainstay alternatives must be leveraged, and included, in any long-term mobility strategy at UND, especially in context of its commitment to sustainability. Additionally, the existence of CAT must be taken into account and plans to increase its usage among students must be included in any long-term sustainable mobility strategy.

The recommended long-term actions were also devised with the framework of compliance to the university's expressed transportation plans, as put forth in its 2010 Climate Action Plan. Specifically, two components of the plan were the expansion of shuttle services and the displacing of excess automobile trips. These goals were guiding concepts in developing long-term action recommendations.

Five long-term actions were recommended. These included UND providing shuttle services in areas not served by CAT, providing shuttle services in areas served by CAT but where CAT's service frequencies and vehicle headways do not facilitate convenient service for UND students and faculty, developing a vehicle pooling program, developing a partnership with CAT, and implementing university class schedules that facilitate increased usage of the campus shuttle system's services.

Provide Shuttle Services in Areas Not Served by CAT

In the survey, numerous comments indicated off-campus locations from which students desire public transportation services. This provides an opportunity for UND's Campus Shuttle System's services to meet an underserved demand. Benefits include the potential for faculty and staff to use the service to get to and from campus and the fact that the rider market being served represents the majority of students – approximately 70% of students live off-campus. Opportunities also exist to develop carefully designed express routes. Deterrents to this action mainly involve the increased capital and operating costs involved in expanding services.

Provide Shuttle Services in Areas That are Underserved by CAT

This particular action would focus on improving faculty, staff, and student travel experience along corridors where CAT's service frequency and vehicle headways are not convenient relative to class dynamics at the university. Numerous survey respondents highlighted that their low usage rate of CAT was due to the fact that many of CAT's routes have service frequencies of one vehicle per hour.. Enhancing CAT service with shuttle services improves service in two ways. UND can provide a service with increased frequencies that induce ridership or, leveraging the already existing service frequencies of CAT, compliment the service and thus, still increase service frequency for passengers. Benefits include reductions in travel and waiting times for faculty, staff, and students, and the potential to increase faculty and staff use of the shuttle system. Deterrents to this action mainly include the increased capital and operating costs involved in expanding services.

Develop a Vehicle Pooling Program

Given the propensity of students to rideshare as expressed in their survey responses and UND's intention to investigate the establishment of a vehicle pooling program, the development of such a program can be beneficial if planned as a long-term action. Unlike the previous two recommended long-term actions, a vehicle pooling program would not require any staffing costs because passengers themselves do the driving. Also, because the vehicles being used will more likely than not be smaller than buses, a sense of privacy may exist that makes this alternative more attractive to potential riders. A very important benefit lays in the fact that, according to UND's Green House Gas Inventory Report published in January 2009, much of UND's transportation generated emissions originate from faculty, staff, and student commuting, which combined accounts for 42% of the university's total transportation emissions. Conversely, the school's various fleets account for only 7% of emissions. The shuttle bus fleet only accounts for a percentage of vehicles in the school's entire fleet. This information dictates that any serious transportation-focused emissions reduction plan embarked on by UND must seek to displace as many auto commuter trips as possible. A well-planned and executed vehicle or vanpooling program stands to be an effective solution. As with both the long-term recommendations, the increased capital and operating costs involved in developing such a program can be an issue.

Develop a Partnership with CAT

As practiced among numerous colleges and universities around the nation, a cost-effective way of expanding services for faculty, staff, and students while managing costs is to partner with a local public transportation provider. In the case of UND, CAT is an extremely viable potential partner. However, this strategy requires the development of a partnership in which many details will have to be considered. Primary among these is the cost to UND of contracting with CAT as opposed to providing its own service. Additionally, the ability of CAT to dedicate resources exclusively to the entire university population's mobility needs is contingent on both its ability to do so and on UND's willingness to pay the cost, which CAT calculates based on a federally developed formula. A more detailed analysis investigating the cost-service trade-offs for both parties is necessary to arrive at the optimal structure of such a partnership.

Implement Class Time Schedules that Facilitate Increased Shuttle System Levels of Service

This particular long-term action involves UND leadership developing class time schedules that influence travel behavior. From the perspective of the shuttle system, this may be accomplished by determining courses of study and classes with high enrollment, and adjusting class schedules to facilitate improved student access to and awareness of campus shuttle services. This is a strategy that has been used by other universities and can be used by UND to maximize potential shuttle system ridership. Although this strategy does not require substantial funding, it is equally, if not more, challenging to implement.

Figure 49 displays the long-term recommended actions for the UND campus shuttle system services.

Provide Shuttle Services in Areas Not Served by CAT	Provide Shuttle Services in Areas That are Underserved by CAT	Develop a Vehicle Pooling Program	Develop a Partnership with CAT	Redesign Class Time Schedules

Figure 49 Recommended Long-Term Actions for UND Campus Shuttle System Service

6 CONCLUSION

Like most college and university campus shuttle systems, the system at the University of North Dakota is operated with the intent of providing the best service possible to its faculty, staff, and students. In doing so, various core competencies have been developed. However, opportunities for growth and improvement exist in other areas.

In the case of UND's campus shuttle system, various aspects of service and operations are not only on par with peers, but in some instances, they exceed them. UND Transportation's management has ensured that all vehicles of its fleet are accessible, with each of its vehicles having two wheel chair positions. Also, UND Transportation has consistently operated within its budget and has done so by instituting practices that include the extensive use of student drivers, a cautious approach to route alterations and expansions, and by leasing its fleet instead of owning it.

However, in other areas, some of which ironically find their origin in the very facets of the operation that seem to be advantageous, there remain opportunities for improvement. Two such areas are service coverage and service on-time performance. The existence of these problems may be factors influencing the decline in ridership across all routes of the campus's shuttle system from FY 2006 to FY 2010. While service coverage and on-time performance definitely have played a role in a decline in shuttle service usage, various other factors have had significant contributions as well. These include student auto ownership rates, the university's parking system, the extensive covered walkway and tunnel system, and the spatial distribution of the university's buildings and facilities.

As with most studies, the approach used in conducting this study was analytical and objective. Therefore, account must be given to the fact that the authors may not be privy to information and knowledge possessed by the UND Transportation management and staff. This knowledge of the system, gained only through experience running and working at the campus shuttle system, may prove invaluable in interpreting and implementing any of the study's short-term and long-term actions. As such, it is the authors' view that not all aspects of the shuttle system's operating performance and ridership levels can be attributable to management. Many factors that influence shuttle ridership and service dynamics are out of the sphere of influence of the Transportation Department's management.

However, opportunities for improvement do exist. And these opportunities should be pursued with as many resources as can be allocated to them. In addition, valuable benefits can be gained by the university from pursuing the following projects to further guide critical decision-making going forward:

Campus Shuttle Service Routing and Service Re-Design Study (Facilitate Short-Term Actions)

Car-Share and Vanpool Feasibility Study (Facilitate Long-Term Actions)

UND and CAT Partnership Feasibility Study: Potential for a UPASS Program – Costs and Benefits (Facilitate Long-Term Actions)

REFERENCES

- Kittleson & Associates. *TCRP Report 88: A Guidebook for Developing a Transit Performance-Measurement System*. Washington, D.C.: Transportation Research Board, 2003.
- Grand Forks-East Grand Forks Metropolitan Planning Organization. "University Avenue Traffic Calming Study." 2002.
- Miller, J.H. *TCRP Synthesis 39: Transportation on College and University Campuses*. Washington, D.C.: Transportation Research Board, 2001.
- Nelson Nygaard Consulting Associates. *TCRP Synthesis 78: Transit Systems in College and University Communities*. Washington, D.C.: Transportation Research Board, 2008.
- North Dakota State Fleet Services. *North Dakota State Fleet Services Policy Manual*. North Dakota Department of Transportation.
- Spielberg, F. *TCRP Web-Only Document 49: Methods for Forecasting Demand and Quantifying Need for Rural Passenger Transportation*. Washington, D.C.: Transportation Research Board, 2009.
- University of North Dakota. "Climate Action Plan Volume 1." 2010.
- University of North Dakota. "Greenhouse Gas Inventory Report 1993 to 2007." 2009.
- University of North Dakota- Transportation Department . *Annual Report 2008-2009*. Grand Forks: University of North Dakota, 2009.
- Vuchic, V.R. *Urban Transit: Operations, Planning, and Economics*. John Wiley & Sons Inc.: Hoboken, 2005.

LIST OF ACRONYMS AND ABBREVIATIONS

CAT	Cities Area Transit
SURTC	Small Urban & Rural Transit Center
USDOT	United States Department of Transportation
NDSFS	North Dakota State Fleet Services
NDDOT	North Dakota Department of Transportation
UND	University of North Dakota
UGPTI	Upper Great Plains Transportation Institute

APPENDIX A. RESPONDENT TRIPS TOO FAR TO WALK

The following provides information provided by survey respondents when asked about origin to destination trips on campus which they consider too far to walk to.

Origin (From)	Destination (To)
42nd	Hyslop Sports Center
Abbott Hall	Odegard Hall
Abbott Hall	Clifford Hall
Abbott Hall	Aerospace buildings
Abbott Hall	Hughes Fine Arts Center (Art, Music)
Abbott Hall	Gamble hall
Abbott Hall	Parking lots
Aerospace	The main part of the campus
Aerospace buildings	Other academic buildings
Aerospace buildings	Starcher Hall (Biology, Technology Department)
Aerospace buildings	Hyslop Sports Center
Aerospace buildings	East of the bridge
Apartments	Health services
Apartments	Memorial Union
Apartments	Twamley Hall
Apartments by Dakota Hall	Any building on campus
Aviation buildings	Greek housing
Aviation buildings	Aviation buildings
Aviation buildings	Hyslop Sports Center
Aviation buildings	Main part of campus
Aviation buildings	Starcher Hall (Biology, Technology Department)
Aviation buildings	Witmer Hall (Mathematics, Physics)
Between aerospace	The main campus
Bookstore	Twamley Hall
Bookstore	Chester Fritz Library
Brannon Hall	Abbott Hall
Brannon Hall	Hyslop Sports Center
Campus apartments	Medical School
Central Campus	Ida Mae Rude Center
Chester Fritz Library	Aerospace buildings
Chester Fritz Library	Memorial Union
Clifford	Memorial Union
Columbia Rd S buildings (Memorial Union)	42nd St buildings (Aerospace)
Computer Science	Witmer Hall (Mathematics, Physics)
Computer Science	Other academic buildings
Computer Science	Hyslop Sports Center

Computer Science	Stracher Hall
Dakota Hall	Memorial Union
East of the bridge	Aerospace buildings
Engelstad (Ralph) Arena, (hockey, basketball)	Aviation buildings
From the math buildings on the East campus	Aviation buildings on the west side of campus
Gamble Hall	Hyslop Sports Center
Gamble Hall	Streibel Hall
Gamble Hall	Upton Hall
Gamble Hall	Witmer Hall (Mathematics, Physics)
Gamble Hall	Aerospace buildings
Gamble Hall	Odegard Hall
Hamline	Hughes Fine Arts Center (Art, Music)
Hancock Hall	School of Medicine Building
Honors building	Harrington Hall
Honors building	Witmer Hall (Mathematics, Physics)
Hughes Fine Arts Center (Art, Music)	Leonard Hall, (Geology and Geological Engineering)
Hughes Fine Arts Center (Art, Music)	Further from Leonard Hall
Hughes Fine Arts Center (Art, Music)	Witmer Hall (Mathematics, Physics)
Hughes Fine Arts Center (Art, Music)	Starcher Hall (Biology, Technology Department)
Hughes Fine Arts Center (Art, Music)	O'Kelly Hall
Hughes Fine Arts Center (Art, Music)	Ireland Hall
Hughes Fine Arts Center (Art, Music)	Medical School
Hughes Fine Arts Center (Art, Music)	Memorial Union
Hughes Fine Arts Center (Art, Music)	Other places on campus
Hughes Fine Arts Center (Art, Music)	Odegard Hall
Hughes Fine Arts Center (Art, Music)	Hyslop Sports Center
Hughes Fine Arts Center (Art, Music)	Ralph Engelstad Arena
Hyslop Sports Center	Clifford Hall
Hyslop Sports Center	Ryan Hall
Hyslop Sports Center	Odegard Hall
Hyslop Sports Center	Aerospace buildings
Hyslop Sports Center	Streibel Hall
Hyslop Sports Center	Hughes Fine Arts Center (Art, Music)
Law School	Aviation complex.
Leonard Hall, (Geology and Geological Engineering)	Aviation buildings
Leonard Hall, (Geology and Geological Engineering)	Clifford Hall
Leonard Hall, (Geology and Geological Engineering)	Odegard Hall

Leonard Hall, (Geology and Geological Engineering)	Aerospace buildings
Leonard Hall, (Geology and Geological Engineering)	Hughes Fine Arts Center (Art, Music)
Leonard Hall, (Geology and Geological Engineering)	Wellness Center
Leonard Hall, (Geology and Geological Engineering)	Gamble Hall
Life Sciences/Advanced Tech Research Center	Hughes Fine Arts Center (Art, Music)
Main campus	Odegard Hall
Main campus	Aviation buildings
Main campus	Computer Science
Main campus	Streibel Hall
Main campus	Medical School
McVey Hall, residence hall	Witmer Hall (Mathematics, Physics)
McVey Hall, residence hall	Leonard Hall, (Geology and Geological Engineering)
McVey Hall, residence hall	Starcher Hall (Biology, Technology Department)
McVey Hall, residence hall	Hyslop Sports Center
McVey Hall, residence hall	Memorial Union
McVey Hall, residence hall	Wellness Center
Medical School	Hughes Fine Arts Center (Art, Music)
Medical School	Gallery Apartments
Memorial Union	Aviation buildings
Memorial Union	Odegard Hall
Memorial Union	Ryan Hall
Memorial Union	Chester Fritz Library
Memorial Union	Wellness Center
Memorial Union	Aerospace buildings
Memorial Union	Wilkerson Hall
Memorial Union	Starcher Hall (Biology, Technology Department)
Memorial Union	Clifford Hall
Memorial Union	Hughes Fine Arts Center (Art, Music)
Memorial Union	Streibel Hall
Noren Hall, residence hall	Witmer Hall (Mathematics, Physics)
Noren Hall, residence hall	Leonard Hall, (Geology and Geological Engineering)
Noren Hall, residence hall	Starcher Hall (Biology, Technology Department)
O'Kelly Hall	Clifford Hall
O'Kelly Hall	Aerospace buildings
Odegard Hall	Football stadium
Odegard Hall	Starcher Hall (Biology, Technology Department)
Odegard Hall	The buildings near the Hyslop Sports Center

Odegard Hall	Memorial Union
Odegard Hall	O'Kelly Hall
Odegard Hall	Gillette Hall
Odegard Hall	Hyslop Sports Center
Odegard Hall	Upson Hall
Odegard Hall	Leonard Hall, (Geology and Geological Engineering)
Odegard Hall	Witmer Hall (Mathematics, Physics)
Odegard Hall	Upson Hall I
Odegard Hall	Upson Hall II
Odegard Hall	Wellness Center
Odegard Hall	Abbott Hall
Odegard Hall	Merrifield Hall
Odegard Hall	Hughes Fine Arts Center (Art, Music)
Odegard Hall	Gillette
O'Kelly Hall	Odegard Hall
On campus apartments	Witmer Hall (Mathematics, Physics)
On-campus apartments	Witmer Hall (Mathematics, Physics)
One side of the campus	Other side of the campus
Parking at the Ralph	The other side of the campus
Parking lots	Outskirt of campus
Parking on the street	Gillette Hall
Parking ramp	Hughes Fine Arts Center (Art, Music)
Parking ramp	Gamble Hall
Parking ramp	Most west-end buildings
Pi Kappa Alpha	Odegard Hall
Ralph Engelstad Arena	Memorial Union
Ralph Engelstad Arena	Merrifield Hall
Ralph Engelstad Arena	Gamble Hall
Residence halls	Aerospace buildings
Residence Halls	Hyslop Sports Center
Residence Halls	Starcher Hall (Biology, Technology Department)
Ryan Hall	Memorial Union
Ryan Hall	O'Kelly Hall
Ryan Hall	Gillette Hall
Ryan Hall	Hyslop Sports Center
Ryan Hall	Witmer Hall (Mathematics, Physics)
Ryan Hall	Aviation buildings

Ryan Hall	Merrifield Hall
Ryan Hall	The East side of the campus
Ryan Hall	Main campus
S parking by the Bookstore	campus buildings
S parking by the Bookstore	Wellness Center
Some of the science buildings	Merrifield Hall
Some of the science buildings	Gamble Hall
Starcher Hall (Biology, Technology Department)	Aviation buildings
Starcher Hall (Biology, Technology Department)	Gamble Hall
Starcher Hall (Biology, Technology Department)	Hughes Fine Arts Center (Art, Music)
Starcher Hall (Biology, Technology Department)	Aerospace buildings
Starcher Hall (Biology, Technology Department)	Clifford Hall
Starcher Hall (Biology, Technology Department)	Odegard Hall
Starcher Hall (Biology, Technology Department)	Ryan Hall
Starcher Hall (Biology, Technology Department)	Corwin-Larimore Hall
Starcher Hall (Biology, Technology Department)	Any building by the memorial union
Streibel Hall	Gamble Hall
Streibel Hall	Hyslop Sports Center
Streibel Hall	O'Kelly Hall
Streible Hall	Witmer Hall (Mathematics, Physics)
Swanson Hall, residence hall	Gamble Hall
Swanson Hall, residence hall	Wilkerson Hall
Swanson Hall, residence hall	Parking ramp
Swanson Hall, residence hall	Odegard Hall
The aviation buildings	Memorial Union
The Bookstore parking lot	The quad
The bus stop at Memorial Union	The bus stop by the subway
The Chester Fritz Parking Lot	Anywhere in the campus
The Clinical Education Center	Gamble Hall
The East side of the campus	Aerospace buildings
The East side of the campus	Hughes Fine Arts Center (Art, Music)
The far East parking lot	The majority of the campus
The Med school	Merrifield Hall
The parking garage	Merrifield Hall
The student parking lot	Gamble Hall
The student parking lot	Columbia Rd.
The town houses	The Harley French Lib

Tulane Court Townhouse apartments	Engineering
Tulane Drive 23- and 24-Plex apartments	Medical School
University apartments	Memorial Union
University apartments	Bookstore
University Park area	Merrifield Hall
University Place, residence hall	Leonard Hall, (Geology and Geological Engineering)
University Place, residence hall	Starcher Hall (Biology, Technology Department)
University Place, residence hall	Law School
University Place, residence hall	Memorial Union
University Place, residence hall	Swanson Hall, residence hall
University Place, residence hall	O'Kelly Hall
University Place, residence hall	McCannel Hall
University Place, residence hall	Gillette Hall
University Place, residence hall	Witmer Hall (Mathematics, Physics)
University Place, residence hall	Abbott Hall
University Place, residence hall	Education building
University Place, residence hall	Harrington Hall
University Place, residence hall	Upton Hall I
University Place, residence hall	Upton Hall II
University Place, residence hall	Gamble Hall
University Place, residence hall	Hyslop Sports Center
University Place, residence hall	Wellness Center
University Place, residence hall	Medical School
University Place, residence hall	Odegard Hall
University Place, residence hall	Aerospace buildings
University Place, residence hall	Hughes Fine Arts Center (Art, Music)
Upton Hall	Streibel Hall
Wellness Center	Classes
Wellness Center	Residence Halls
West part of campus	East side of the campus
Wilkerson Hall	Starcher Hall (Biology, Technology Department)
Wilkerson Hall	Ryan Hall
Wilkerson Hall	Hyslop Sports Center
Wilkerson Hall	Most of the academic buildings
Wilkerson Hall	Greek houses
Wilkerson Hall	Stracher Hall
Witmer Hall (Mathematics, Physics)	Aviation buildings

Witmer Hall (Mathematics, Physics)	Clifford Hall
Witmer Hall (Mathematics, Physics)	Hughes Fine Arts Center (Art, Music)
Witmer Hall (Mathematics, Physics)	Odegard Hall
Witmer Hall (Mathematics, Physics)	Aerospace buildings
Witmer Hall (Mathematics, Physics)	Gamble Hall
Witmer Hall (Mathematics, Physics)	Streibel Hall

APPENDIX B. SURVEY

The following survey was developed by SURTC and administered at the study location – University of North Dakota. The survey was administered electronically and all respondents were given an identical survey.

Please tell us about yourself. (Be sure to include this information to be eligible for prizes)

Name

Age

Phone number

Email

Gender

☐ Male

☐ Female

What is your current address while attending UND?

Street, Apt#

City, State, Zip code

Country

Is your permanent address the same as above?

☐ Yes

☐ No

Permanent address:

Street, Apt#

City, State, Zip code

Country

What is your student classification?

- ☐ Freshman
- ☐ Sophomore
- ☐ Junior
- ☐ Senior
- ☐ Distance learning
- ☐ Graduate student
- ☐ Law school
- ☐ Medical school
- ☐ Non-degree student taking classes

How many semesters have you been at UND?

- ☐ 0 - 2
- ☐ 3 - 4
- ☐ 5 - 6
- ☐ 7 - 8
- ☐ 9 +

What is your student status?

- ☐ Full-time student
- ☐ Part-time student

Do you work on-campus/off-campus?

- ☐ On-campus
- ☐ Off-campus
- ☐ On- and off-campus
- ☐ Currently unemployed

Do you live on-campus/off-campus?

- ☐ Off-campus
- ☐ On-campus apartment
- ☐ Greek housing
- ☐ On-campus residence hall

Section 2 – Off-Campus Students (On-campus students skip to section 3)

How far do you live from campus?

- ☐ ½ mile (6 blocks or less)
- ☐ 1 mile (7 to 12 blocks)
- ☐ 1½ miles (12 to 18 blocks)
- ☐ more than 1½ miles (19 blocks or more)

Which days do you most frequently spend on campus this semester?

- ☐ Monday
- ☐ Tuesday
- ☐ Wednesday
- ☐ Thursday
- ☐ Friday
- ☐ Saturday
- ☐ Sunday

What time periods do you most frequently spend on campus in the above mentioned days?

- ☐ 08 am – 10 am
- ☐ 10 am – 12 pm
- ☐ 12 pm – 02 pm
- ☐ 02 pm – 04 pm
- ☐ 04 pm – 06 pm
- ☐ 06 pm – 08 pm
- ☐ Other (please specify)

When traveling to campus, what location do you most frequently travel from?

☐ Home

☐ Place of work

☐ Airport

☐ Child care location

☐ Shopping

☐ Other (please specify)

**How many one-way trips do you make to and from campus per day?
(e.g. to and from campus would be 2 trips)**

Section 3 – All Students

Do you have access to a vehicle while attending school?

☐ Yes

☐ No

What type of parking permit do you have?

☐ Student

☐ Student Ramp

☐ PM (evening)

☐ Perimeter/Park and Ride

☐ Temporary Permit (Daily)

☐ Temporary Permit (Weekly)

☐ Do not have parking permit

How do you rate parking on campus?

☐ Very Poor

☐ Poor

☐ Fair

☐ Good

☐ Very Good

What transportation modes do you use during FALL?

☐ Auto

☐ Car pool

☐ Motorcycle

☐ Scooter

☐ Bicycle

☐ Walk

☐ City bus – CAT

☐ Campus shuttle

☐ Other (please specify)

What transportation modes do you use during WINTER?

- ☐ Auto
- ☐ Car pool
- ☐ Motorcycle
- ☐ Scooter
- ☐ Bicycle
- ☐ Walk
- ☐ City bus – CAT
- ☐ Campus shuttle
- ☐ Other (please specify)

What transportation modes do you use during SPRING?

- ☐ Auto
- ☐ Car pool
- ☐ Motorcycle
- ☐ Scooter
- ☐ Bicycle
- ☐ Walk
- ☐ City bus – CAT
- ☐ Campus shuttle
- ☐ Other (please specify)

What transportation modes do you use during SUMMER?

- ☐ Auto
- ☐ Car pool
- ☐ Motorcycle
- ☐ Scooter
- ☐ Bicycle
- ☐ Walk
- ☐ City bus – CAT
- ☐ Campus shuttle
- ☐ Other (please specify)

When deciding on a mode of transportation; what are the most important factors? (Please check all that apply)

- ☐ Convenience
- ☐ Accessibility
- ☐ Cost of vehicle
- ☐ Cost of parking
- ☐ Weather
- ☐ Parking availability
- ☐ Time
- ☐ Other (please specify)

If you had to walk daily, what would you consider a reasonable walking distance when the temperature is:

	Less than two city blocks	Two city blocks	Four city blocks	Six city blocks	Eight city blocks	Twelve city blocks (1 mile)
32° F and warmer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Colder than 32° F	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

In your opinion, are there any locations on campus too far to walk in a reasonable time?

☐ Yes

☐ No

If yes, please identify those locations:

Why do you most often leave campus?

☐ Home

☐ Work

☐ Grocery shopping

☐ Entertainment at various locations

☐ Going to a restaurant

☐ Going to movie theater

☐ Retail shopping at Columbia mall

☐ Other (please specify)

Are you aware of the campus shuttle?

☐ Yes

☐ No

Do you use the campus shuttle?

☐ Yes

☐ No

If no, why not?

If you ride the campus shuttle, what characteristics of the system do you value?

- ☐ Driver friendliness
- ☐ Comfort
- ☐ Reliability
- ☐ Convenience
- ☐ Bus on scheduled time
- ☐ Other (please explain)

What do you think are the benefits of shuttle system here on campus? (Please check all that apply)

- ☐ Lower traffic congestion
- ☐ Safety
- ☐ Convenience
- ☐ Reduce green house gas
- ☐ Save time
- ☐ Save money
- ☐ Reduce parking demand
- ☐ No opinion
- ☐ Other (please specify)

Are there additional stops/locations that you would like the campus shuttle to cover?

- ☐ Yes
- ☐ No

If yes, please list locations:

If you miss the campus shuttle, how long are you willing to wait for the next bus?

- ☐ Less than 10 minutes

- ☐ 10 Minutes
- ☐ 15 Minutes
- ☐ 20 Minutes
- ☐ 30 Minutes

Would you consider using the city bus, Cities Area Transit (CAT), which serves the Grand Forks area, for the following: (Please check all that apply)

- ☐ To get around campus
- ☐ To get to and from campus
- ☐ To get East side of campus (Memorial Union, Hyslop Club)
- ☐ To get West side of campus (Aerospace Complex, 42st. & University)
- ☐ To get to and from work
- ☐ To get to Northland Community and Technical College
- ☐ Other (please specify)

As a student, did you receive a card from UND Student Government to ride the CAT bus free anywhere in the Grand Forks area?

- ☐ Yes
- ☐ No

What do you think are the benefits of CAT system here on campus? (Please check all that apply)

- ☐ Lower traffic congestion
- ☐ Safety
- ☐ Convenience
- ☐ Reduce green house gas
- ☐ Save time
- ☐ Save money
- ☐ Reduce parking demand
- ☐ No opinion
- ☐ Other (please specify)

Have you used the CAT system?

- ☐ Yes
- ☐ No

If you ride CAT, what characteristics of the system do you value?

- ☐ Driver friendliness
- ☐ Comfort
- ☐ Reliability
- ☐ Convenience
- ☐ Bus on scheduled time

Other(please explain)

If you miss the CAT, how long are you willing to wait for the next bus?

- ☐ 10 Minutes
- ☐ 15 Minutes
- ☐ 20 Minutes
- ☐ 30 Minutes

If you are not using CAT buses, what factors are keeping you from using the bus service ?

- ☐ Lack of information
- ☐ Lack of service (Routes)
- ☐ Bus not on schedule
- ☐ Ride is too long
- ☐ Bus stops too frequently
- ☐ Long waits at transfer station
- ☐ Inconvenient
- ☐ Not cool
- ☐ Other (please specify)

What is the best way to notify you if bus will be late?

- ☐ Email
- ☐ Cell phone
- ☐ Text message
- ☐ Face book
- ☐ Twitter
- ☐ Blogs
- ☐ Other (please specify)

Comments:

Thank you

Thank you for participating in this survey.