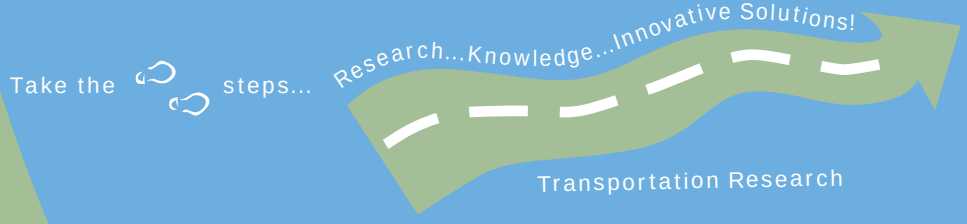
RESEARCH

2008-43

Improving Carsharing and Transit Service with ITS



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16. Abstract (Limit: 200 words)

This report examines Intelligent Transportation Systems (ITS) as they apply to carsharing and transit. Two modes that provide mobility to those who do not own a car.

In the first study, researchers developed and administered a survey to members of HOURCAR, a local not-for-profit carsharing organization (CSO), and a randomly selected control group. The data reveals that (1) each HOURCAR removes 2.5 other vehicles; (2) HOURCAR members demonstrate an interest in deciding whether a car is their most efficient option for their trip, (3) HOURCAR respondents were not significantly different from the control group in terms of household size, income, age or housing type; and (4) most members indicated convenience and financial considerations were key to joining.

The second study seeks to understand how citizen perceptions of trust and confidence in an agency, and its services, are impacted by the use of advanced traveler information systems (ATIS), specifically, an online trip planner developed and maintained by MetroTransit. A survey and focus group indicate connections between online use and perceptions about the agency. Notably, a strong positive view of the trip planner was associated with trust in the agency to perform the service.

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Improving Carsharing and Transit Service with ITS

Final Report

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Executive Summary

This report examines Intelligent Transportation Systems (ITS) as they apply to two alternative modes of transportation: Carsharing and transit. While they at first appear to be direct competitors, the two modes are actually complementary, as they both provide mobility to those who do not own a car.

The first study evaluates the impact of the arrival of Carsharing in Minneapolis and St. Paul. Researchers at the State and Local Policy Program at the Humphrey Institute of Public Affairs developed and administered a survey to members of HOURCAR, a local not-for-profit carsharing organization (CSO), and a randomly selected control group. Data was collected from the statistical controls and the CSO members group during the same three-week period spanning from September into October 2007. This research attempts to emulate prior research completed in San Francisco which found that the introduction of carsharing briefly induced travel among certain demographic groups before leading to an ultimate reduction in trips across all user groups.

Data collection and analysis focused on the travel behavior of HOURCAR members and their car ownership trends. The data collected reveals the following:

Each HOURCAR removes 2.5 other vehicles The data collected in this study show a net reduction of 18 vehicles among the 186 HOURCAR respondents, or roughly 1 car for every 10 members. Extrapolating 400 members as of the time of the survey yields 40 cars removed. Then, applying the final part of our equation and dividing 40 by 16 low-emissions, high-mileage cars in HOURCAR's fleet, equals 2.5 vehicles removed for each HOURCAR.

HOURCAR Members demonstrate "judicious automobility" Previous research noted evidence of "judicious automobility," where users demonstrate an interest in deciding whether a car would be their most efficient option for a particular trip. Results for HOURCAR show that even though only five percent of all member trips were made in HOURCAR vehicles, members used their own private vehicle half as often as the control group. However, since members showed a similarly low level of single occupant vehicle (SOV) use both before and after joining HOURCAR it is difficult to conclude that joining HOURCAR caused their "judicious automobility," or adding HOURCAR to their travel options merely fit their existing patterns very well.

HOURCAR's Greatest Membership Hurdle is Attitudinal A demographic comparison with the control group shows that other than travel behavior, HOURCAR respondents were not significantly different from their counterparts in the control group in terms of household size, income, age or housing type.

This discovery is likely good news for HOURCAR. While it is counter-intuitive, and suggests that HOURCAR members may be self-selected due to existing travel preferences, the recent rapid increases in gasoline prices will likely increase judicious automobility for everyone.

Convenience and Finances are Motivators for Joining, although the Environment is also a Consideration The data indicate that environmental considerations are not the key driver for HOURCAR members to join. Most members indicated they were weighing convenience and financial considerations when joining. With the increasing cost of gasoline raising the variable cost of all travel, the more predictable costs of carsharing, combined with its nearly negligible capital costs, HOURCAR should become increasingly attractive to those who live near hubs.

The second study seeks to understand how citizen perceptions of trust and confidence in an agency, and its services, are affected by the use of advanced traveler information systems (ATIS), specifically, an online trip planner developed and maintained by MetroTransit, the largest transit provider in Minneapolis and St. Paul. A survey and focus group findings indicate there are clear relationships that demonstrate connections between online use and perceptions about the agency. Notably, there is a strong positive view of the trip planner and this is associated with trust in the agency to perform the service as well as generally positive responses to new features.

Certain user groups strongly believe that Metro Transit is honest and trustworthy. These groups include those who are under 35 years of age, students, and advanced computer users. For example, many of these individuals feel that their privacy is respected by the agency and have indicated that they use the website frequently and will continue to use the online trip planner in the future. However, not all groups of individuals have such a positive impression. There are indications that show that highly literate individuals and extensive users of the Internet believe Metro Transit does not have knowledge and resources to provide advanced information services, and have unfavorable impressions about the reputation of Metro Transit, respectively. Unemployed, elderly, and low-income individuals were also more hesitant, indicating a preference to avoid new technologies. Thus, it is worth considering if the needs of these groups should be better understood when thinking of future improvements.

The focus group discussions provided valuable context demonstrating the hybrid nature of trust in a public organization that provides an online service. On the one hand, participants felt the website functioned well and stood as a symbol of Metro Transit's good will towards citizens. On the other hand, the selected negative experiences described by participants, including bus driver behavior and attitudes, customer service functions, and bus and bus stop cleanliness, negatively affected participant perceptions of trust and confidence in the organization. The potential for utilizing additional Web-based, mobile, and on-board technologies could help mitigate some of these service concerns. Taken together, this study provides support for the notion that public agencies can impact citizen perceptions by implementing quality, well-designed, online e-government applications. For this study, an online transit trip planner, appreciated by citizens, provided a means for improving perceptions of trust and confidence, potentially mitigating other frustrating aspects common among transit systems.

Chapter 1
Carsharing in the Twin Cities:
Measuring Impacts on Travel Behavior and Automobile Ownership

Introduction

Carsharing, a model of car rental where people rent cars for short time periods, usually by the hour, has grown quickly in the United States over the past 10 years, as shown in Table 1.1[1].

Table 1.1: Carsharing growth

	Members		**Vehicles**	
Year	*Number*	*% Increase*	*Number*	*% Increase*
1998	69		10	
1999	214	210%	16	60%
2000	422	97%	26	63%
2001	5,377	1174%	280	977%
2002	12,098	125%	455	63%
2003	25,640	112%	696	53%
2004	52,347	104%	907	30%
2005	76,420	46%	1,192	31%
2007	134,094	75%	3,637	205%

Much of this growth, however, has been in major metropolitan areas on the east and west coasts, with a few examples operating in between. One example is HOURCAR, a non-profit car-sharing organization (CSO) in the Twin Cities of Minneapolis and St. Paul. HOURCAR began in 2005, and has grown, as shown in Figure 1.1, to nearly 450 members as of Spring 2008 [2].

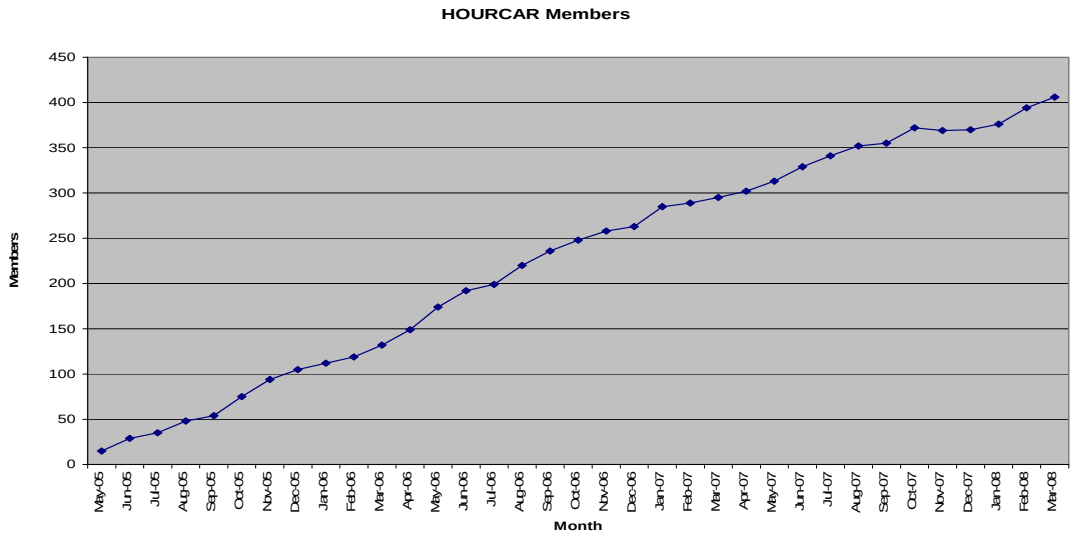

Figure 1.1: HOURCAR membership growth

While HOURCAR is similar to many CSO's, in that it is set up as a nonprofit, some CSO's, including the largest, ZipCar, are set up to be profit-making operations. Regardless, all have shown the need for outside financing to begin operations. This has led to initial questions of what benefits car-sharing can bring. In addition to possible return on investment, car-sharing operations have suggested that they can produce environmental benefits, as well as more efficient travel than the basic model of each person purchasing their own car.

As these efficiency claims are based on reducing the fixed costs while increasing the variable costs of a trip, similar to congestion pricing, car-sharing has caught the attention of the academic research community as well. Several studies have been completed on the impacts of car sharing on the auto ownership and travel behavior of CSO members. However, like most CSO's, the research has been focused on CSO members in larger coastal cities. This paper will examine the behavior of HOURCAR members, to see if the impacts of car-sharing are similar in a less-densely populated metropolitan area in the upper Midwest.

The next section of this paper will review the findings of the earlier studies, and point out questions that are raised for this work. The third section will then show how the methodology for this study was developed based upon the previous research, and the fourth section will discuss the research hypotheses developed as a result. Finally, the fifth section will discuss our findings, which are followed by some conclusions and suggestions for further study.

Literature Review

Carsharing advocates claim that carsharing should be considered a type of congestion pricing, as it forces travelers to better understand the marginal costs of each trip they take [3]. In traditional auto ownership, most of the costs are covered in the purchase of the vehicle. While the operational, or variable costs of insurance, maintenance and gas are not insignificant, they are small in comparison to the purchase cost, creating an incentive for the purchaser to use the car as much as possible, in order to reduce the overall cost per mile or per trip. The result of this behavior, of course, is over-reliance on the single-occupant vehicle, congestion, and the need to accommodate cars in nearly every development, regardless of whether the area was initially designed to handle cars or not (as many older downtown areas were not). CSO membership turns this equation around by the fact that they pay the same amount for each trip, with little up-front cost, other than possibly a nominal one-time membership fee. This creates an incentive structure where users have an interest in deciding whether a car would be their most efficient option for a particular trip, which University of California Planning Professor has termed "judicious automobility"[4]. Similar to congestion pricing, which basically calls for increasing fees for use of roads during high-demand periods, and therefore forcing users to consider how and when they might travel [5], carsharing could also contribute to an increasingly multi-modal society, with reduced reliance on the single-occupant vehicles and the resulting negative externalities that are mentioned above.

The most comprehensive contributions to the carsharing literature have been delivered through a longitudinal series of papers by Cervero. Cervero's work focuses on the impacts of membership with City CarShare, a San Francisco based nonprofit CSO, on travel behavior and automobile ownership. In the first of his papers, Cervero suggests that two distinct points of view exist

when it comes to discussing the net travel impacts of carsharing membership. [4] On the one hand, many believe the sharing cars will result in a reduction of travel by those who share them. On the other hand, others argue that carsharing membership will unintentionally induce automobile travel because members have easier access to a car. This would particularly be true for those who did not own an automobile at the time of joining a CSO [4]. This school of thought further argues that this demographic, based on the increased automobile access, will use a car to make trips they previously took by transit, bicycle, or on foot, essentially increasing single-occupant vehicle use.

To analyze travel demand and auto ownership, Cervero used a matched-pair analysis, surveying a panel of City CarShare members and non-members at 3 different times spanning both before and after the arrival of the CSO in March 2001. To control for the effects of gas prices, weather and other exogenous factors, Cervero's control group was compiled of people who had expressed an interest in carsharing, but did not join, thus hopefully accessing a group of people most similarly-situated to members, except for the decision to join.

The first of Cervero's studies focused on the impacts of carsharing roughly 9 months after the introduction of carsharing in San Francisco. The research found that after arrival of City CarShare, more than 7 percent of members trips were by a carsharing vehicle. Evidence suggested that membership in the CSO was stimulating travel, but one possible reason for this is that many of these very "green" early joiners did not own automobiles in the first place, leaving their VMT measurements to go nowhere but up. Trip purpose was found largely to be for non-essential purposes such as recreation or personal business.

Cervero did a follow-up paper 2 years after City CarShare began, and the effect of "judicious automobility" began to become clear. [6] Members were traveling largely during off-peak with Saturday being the most popular day for reservations. The research found that carsharing made up 6.5% of member's total trips, which was up from the 3 month mark but down from the 9 month mark, suggesting the novelty had worn off. Regarding automobile ownership, the study found that 29 percent of carsharing members shed an automobile while only 8 percent in the control group did so. Regarding travel behavior, after two years there was strong evidence of travel suppression and that automobile reduction was a primary reason. The time frame of this research submission is particularly important to this work as HOURCAR had been operating for roughly 2 years as of the time of our survey.

In Cervero's most recent paper, written about four years after the first, the longer-term impacts of carsharing membership in San Francisco are presented. [7] The program had grown and expanded substantially at this point in terms of reservations, members and vehicles. However, by the end of the fourth year carsharing made up only 4.8 percent of members' total trips, down from 6.5 percent after two years. Regarding automobile ownership, the trend of shedding appears to have been tempered as well. Nevertheless, in this paper, Cervero concludes that the three studies, taken together, conclusively show that CSO membership did lead to a net reduction in VMT. Mean travel times fell consistently for members over the course of the several surveys as well.

Clayton Lane, one of the founders of PhillyCarShare, a CSO in Philadelphia that began operations in November of 2002, has also written a paper on the vehicle ownership and VMT impacts of PhillyCarShare. [8] In this paper he presents evidence from user surveys and detailed usage data gathered one year after inception. The survey was administered online and via mail to 502 members during a three week period between October 22 and November 13, 2003. They had a 52 percent response rate on their survey which asked question about the environment, mobility impacts, and demographics.

Lane's paper departs from Cervero's offerings in two ways. First, methodologically, he did not use a control group, instead relying upon members' recollections of VMT and auto ownership before joining. His second difference is suggesting there were larger decreases in vehicle ownership and immediate VMT reductions in Philadelphia, focusing in particular on the automobile reduction aspect of carsharing, considering both getting rid of vehicles and the conscious action of avoiding the purchase of a vehicle in the future. Using this methodology, he calculates that each PhillyCarShare vehicle has removed an average of 22.8 cars from the roads. To get to this figure, Lane found that before joining, members owned 250 cars and 156 were seeking to acquire a vehicle. After joining they owned 110. Thus, by his method, 250 cars owned before, minus 110 still owned, plus 156 that otherwise would have been bought equals 296 total cars removed from the streets. Lane then divided the 296 cars by PhillyCarShare's 13 vehicles to arrive at a ratio of 22.8 vehicles removed per carsharing vehicle. [8]

Some research has also been done in Seattle and Portland, Oregon. In the former, Flexcar Seattle, a public-private partnership now owned by ZipCar, was studied by Robert Vance at the University of Washington [9]. Although this study did find FlexCar members were frequent users of transit and typically did not own cars, it was not as focused on travel behavior and vehicle ownership as other studies, and did not indicate if CSO membership was related to those trends. The latter focuses on one of the first successful CSO's in the US, Carsharing Portland. In 1999, about a year into its existence, Katzev [10] conducted before and after surveys, included a trip diary and a small control group (N=8). Although none of the results within the control group or members were statistically significant it did appear that the control group traveled more. Katzev concluded that, similar to what Cervero concluded in his short term analysis of City CarShare, members appeared to drive more at the end of their first year. Regarding automobile ownership, 26 percent reported selling a vehicle after joining CSP.

Finally, some preliminary research into the Twin Cities' potential carsharing market has also been preformed. Andrew and Douma [11] evaluated neighborhoods in the Twin Cities for their amenability to carsharing prior to HOURCAR's beginning operations. Based upon neighborhoods with successful CSO's in other cities, they concluded the following characteristics lend themselves to carsharing program success:

- A high density of individuals between 21 and 39 years of age
- High levels of transit and walking commuters
- Single person households
- Non-family households
- Renters
- Middle income households among a variety of incomes

- High education level

When HOURCAR did begin operations, it placed cars in many of the same neighborhoods identified by Andrew and Douma, indicating that these characteristics have largely held true in the Twin Cities as well. [2]

Context: Carsharing in the Twin Cities

Unlike most of the cities discussed in the previous studies, the Twin Cities metropolitan area is located in the middle of the United States with little physical constraints to growth, and relatively little pre-World War II development, when compared to its growth after World War II and the rise of auto-oriented suburbs. Consequently, it has lower residential density, congestion and parking constraints than many of the other cities where car-sharing has thrived.

Nevertheless, as of the fall of 2007, the time data was collected for this study, two CSO's were operating in the Twin Cities. HOURCAR was operating 15 neighborhood hubs in Minneapolis and St. Paul, with one or two cars at each hub (see Appendix C), and was enjoying steady growth, as shown previously in Figure 1.1. With the exception of one Toyota Yaris, HOURCAR's fleet is entirely Toyota Prius hybrid cars.

The second CSO operating was Zipcar, the for-profit CSO that has recently also taken over Flexcar. Zipcar operates three hubs in the Twin Cities, with 2 cars of various makes and models at each hub, all of which are located on the campus of and managed by the University of Minnesota. [12] While the two CSO's can be considered direct competitors, as of the time of this study, they were largely relying on two different markets: HOURCAR's membership largely followed the more traditional market outlined above, of younger professionals in denser neighborhoods while Zipcar's members were largely students, which became and even larger share in the fall of 2007 when it lowered its minimum membership age to 18. [11] While Zipcar was invited to participate in this study, and was included in initial discussions, it ultimately refused to cooperate at the time of data-collection, resulting in the focus of this study being on the impact of HOURCAR on its members.

Research Questions

The results of these previous studies are summarized in Table 1.2, below.

Table 1.2: Summary of previous research

	Location	Time since CSO began operation	Travel behavior impact	Auto ownership impact
Cervero 2003 [4]	San Francisco	9 months	Increase	Minimal
Cervero 2004 [6]	San Francisco	2 years	Decrease	Decrease
Cervero 2006 [7]	San Francisco	4 years	Decrease	Decrease
Lane [8]	Philadelphia	1 year	Decrease	Decrease
Vance [9]	Seattle	unclear	Decrease?	Unclear
Katzev [10]	Portland	1 year	Increase	Decrease

Combining these results with the suggestion that the carsharing audience in the Twin Cities could be somewhat self-selected provided the researchers with the following research questions, and expected answers:

Question 1: How have auto ownership rates of HOURCAR members changed since joining HOURCAR?

Expected answer: Given that auto ownership has declined in nearly all cases, a similar effect was expected in the case of HOURCAR

Question 2a: How does the travel behavior of HOURCAR members compare to that of a similarly-situated control group?

Question 2b: How does the travel behavior of HOURCAR members compare to that their self-reported travel behavior from before they joined?

Expected answer: This question stems from Cervero's research, but, recognizing that San Francisco has substantially denser neighborhoods, one cannot necessarily expect a similar result. Given that Cervero even noted an initial increase in trip-making before a decrease at 2 years, it would not be surprising to see some increase even after 2 years. On the other hand, given the overall trend towards "judicious automobility," one can safely expect that HOURCAR members would take fewer single-occupant vehicle trips than their counterparts in the control group.

Question 3: How does the HOURCAR membership compare demographically to the Control group?

Expected answer: Given the challenges less dense development patterns in the Twin Cities, it may take longer for carsharing to "mature" than it did in the other cities. Consequently, it can be expected that the HOURCAR members will still include a large group of environmentally-conscious people who own fewer cars to begin with. Also, given the demographic research of Andrew and Douma, it can be expected that HOURCAR members are younger, and from smaller households than a randomly-drawn control group.

Question 4: What motivates people in the Twin Cities to join a CSO?

Expected answer: As discussed above, given the relative newness of HOURCAR, environmental considerations should be a significant driver. However, gas prices had risen above $3.00 per gallon as of the time of this research, so some economic considerations may also come into play.

Methodology

This research was designed to build upon the previous research. Starting with Cervero's work, we developed a survey and travel diary instrument that would provide information about the travel behavior, automobile ownership and demographics of HOURCAR members as well as a closely-matched control group. Since we did not have a list of people who had considered, and ultimately declined, HOURCAR membership, however, we chose a control group of people

living in census tracts containing HOURCAR hubs. Please see Appendix A for a map of recipients and respondents. Consequently, while we did not know if they had ever considered membership, we did have a group that could take advantage of carsharing membership, if they were aware of the opportunity and chose to do so. (Due to the late drop-out of Zipcar, however, data was collected from University of Minnesota students as a control group. While this data is not discussed here, it is available for further analysis from the researchers.)

Similar to Lane's work, we also asked HOURCAR members to report on their travel behavior and vehicle ownership prior to joining the CSO. While we recognize the risks of bias and error in self-reporting travel behavior in the distant past, as opposed to within the past 24 hours as occurs with a diary, we were interested in seeing how this recalled longitudinal change would compare with the differences in behavior noted between HOURCAR members and the control group, as shown in the diaries. Further, we were confident that auto-ownership data would remain accurate, given the relative infrequency with which one sells or buys a new car, and felt this would be the most direct way to measure changes in auto-ownership, rather than trying to compare with the control group, whose car-ownership decisions could be affected by a number of factors outside of whether they were members of a CSO. Finally, however, we chose not to ask about the conscious action of avoiding the purchase of a vehicle in the future, as this is a statement that would almost be impossible to prove empirically.

The instrument was sent electronically to all HOURCAR members, as supplied by HOURCAR. An on-line survey administration software was used to manage dissemination and collection of the survey results. An electronic copy of the diary form was attached to the solicitation e-mail, with the request that the respondent fill it in for their trips on the weekday immediately preceding the day they completed the survey, and then return the completed diary via fax or separate e-mail. Respondents were asked to provide a unique password on both the survey and diary so that the two pieces could be linked for data collection without needing to use their name or other information that would otherwise be private, and not needed for data analysis.

Solicitation e-mails were sent in a staggered fashion starting Monday, September 17, 2007. On this day one-fifth of the HOURCAR members received an invitation e-mail. For the next four consecutive days another fifth of the member list received the invitation. By Friday, September 21, 2007, all members had been invited to participate. They were all asked to respond by Monday, October 8, 2007. The survey was released in a staggered fashion to ensure members were receiving and taking the survey on different days of the week (but not on weekends). This method was followed in an effort to collect travel behavior information that was not unduly influenced by factors such as weather or gas prices. During this time, no major disturbances (i.e. inclement weather or gas price surges) occurred that might have influenced travel.

Control group members were sent surveys and travel diaries assembled in one paper booklet sent by US mail in time to arrive on or around Monday, September 17, 2007. 1000 addresses were randomly selected from the above-mentioned census tracts, and a postage-paid envelope was included for respondents to return.

As incentives for participation, HOURCAR agreed to offer all who completed the survey a credit to their account worth two hours of drive time as compensation. In the alternative, recipients

could also opt for entry into a drawing for one of four $100 gift certificates to 20.21 Wolfgang Puck Bar and Restaurant located in the Walker Art Center. All control group respondents were also offered the opportunity to participate in the drawing.

The survey had 28 questions, not including travel log entries. Many of the questions were crafted to collect descriptive information, such as age, income, household size, motivation for joining, travel behavior and automobile ownership. A majority of the demographic and automobile-focused questions provided discrete response categories. For example, the question on age provided specific ranges into which respondents will fall (e.g. 18-25). There was one open-ended question: "what motivated you to join a carsharing program?" Finally, the travel behavior data was collected through a travel log, with the exception of the "before joining" trip-making question asked of HOURCAR members. This data was collected through a discrete choice question that asked for the number of trips made by mode on a "typical" weekday. The survey questions and travel diary are attached as Appendix B.

Results and Findings

Response Rate

Table 1.3 displays the response rates obtained, including the total number of surveys distributed, the total returned, and lastly, of those returned how many had usable travel log data. The control group had a moderately impressive response rate, but most useful was that everyone who returned it also completed the travel log. It should be noted that when the 157 bad addresses are removed from the N, the effective response rate is 18% (152 of 843).

The HOURCAR population had the most impressive response rate, with almost 50 percent of the existing members responding. This population did, however, have some level of difficulty with the travel log. Of the 186 respondents, only 45 percent returned usable travel logs. This was likely a function of the way the on-line survey and separate travel log information was administered. It was possible and much easier to complete the survey questions without completing the travel log.

Table 1.3: Response rate

	Control Group		**HOURCAR**	
	N	*%*	*N*	*%*
Surveys Distributed	1000	100%	415	100%
Surveys Completed	152	15%	186	45%
Usable Travel Logs	152	100%	121	65%

The map in Appendix A shows the spatial relationship between and the relative distribution of the control group and HOURCAR respondents. The map on the left shows a regional distribution of respondents while the one on the right presents a closer view of the largely Minneapolis-based respondents. The distribution is determined by the zip code which

respondents provided. The area from which all control group addresses were drawn is within the census tracts identified by the thick black line. Interestingly, some respondents from the control group provided zip codes that were not within the control census tracts. Also worth noting are the few outlying HOURCAR respondents, a phenomenon that will be addressed in further detail later in the paper.

Question 1: How have auto ownership rates of HOURCAR members changed since joining HOURCAR?

Figure 1.2 displays information regarding automobile ownership trends found in the census, the control group, HOURCAR members prior to joining, then the same members after joining the carsharing program. The census data comes for the question asking how many automobiles the respondent has available. This is contracted by the fact that our survey asked questions about vehicle ownership, not availability. According to the census over 70 percent of those living in the control area have one or more automobiles available. The results for the control group are quite similar, but even heavier on the automobile side. Almost 90 percent of the control group responded "yes" to the question regarding weather or not they owned a car. This suggests that automobile ownership is quite common in this area.

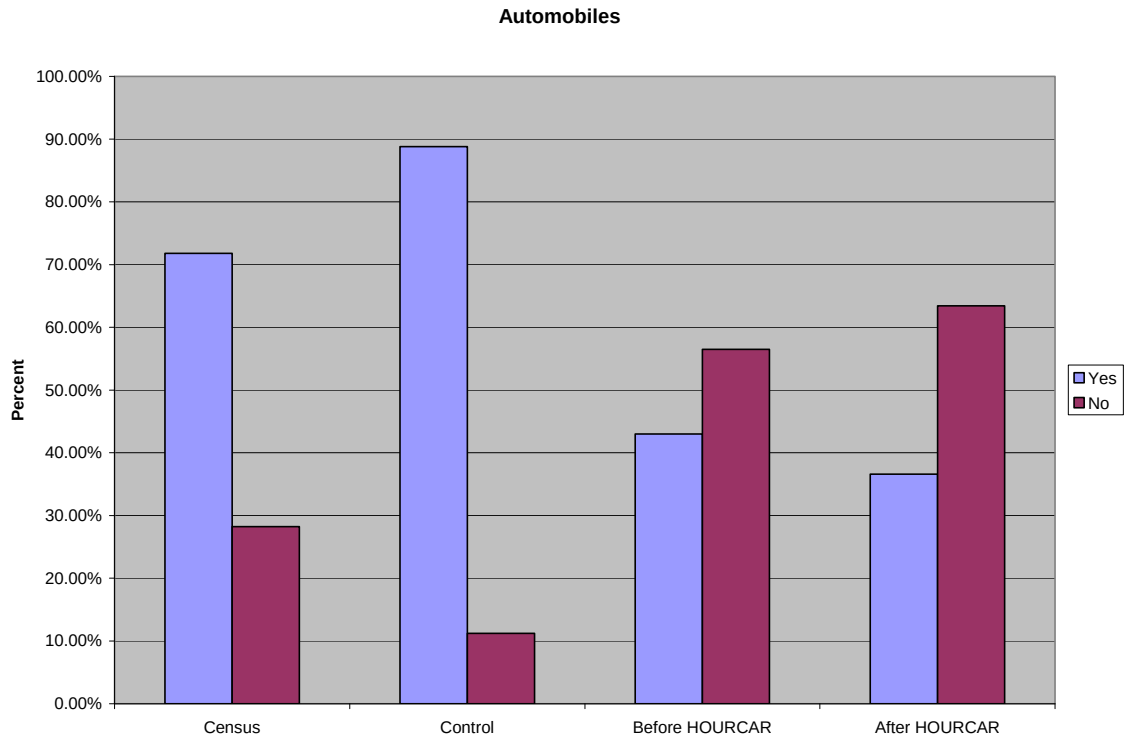

Figure 1.2: Automobile ownership

HOURCAR members were also asked questions regarding automobile (including 2-wheeled vehicles) ownership whether they owned an automobile before they joined HOURCAR and whether they owned an automobile after joining HOURCAR. The results also in Figure 1.2 highlight two points. First HOURCAR members were already quite different from the control

group in that, before even joining, the eventual HOURCAR members were already half as likely to own a vehicle (only 43 percent). Despite this, however, HOURCAR members appear to have shed vehicles after joining, dropping about 8 percent to about 36 percent, which is consistent with previous studies of CSOs in other geographic locations.

Figure 1.3 serves as supporting evidence for the previous chart, showing the actual numbers of vehicles owned by these groups. According to the survey, the control group owned almost 80 more vehicles that the HOURCAR members before joining. This suggests again that joining a carsharing program could lead to automobile reduction. In this case, it appears to have contributed to a reduction of 18 vehicles. These differences were found to be significant at the 95 percent confidence level.

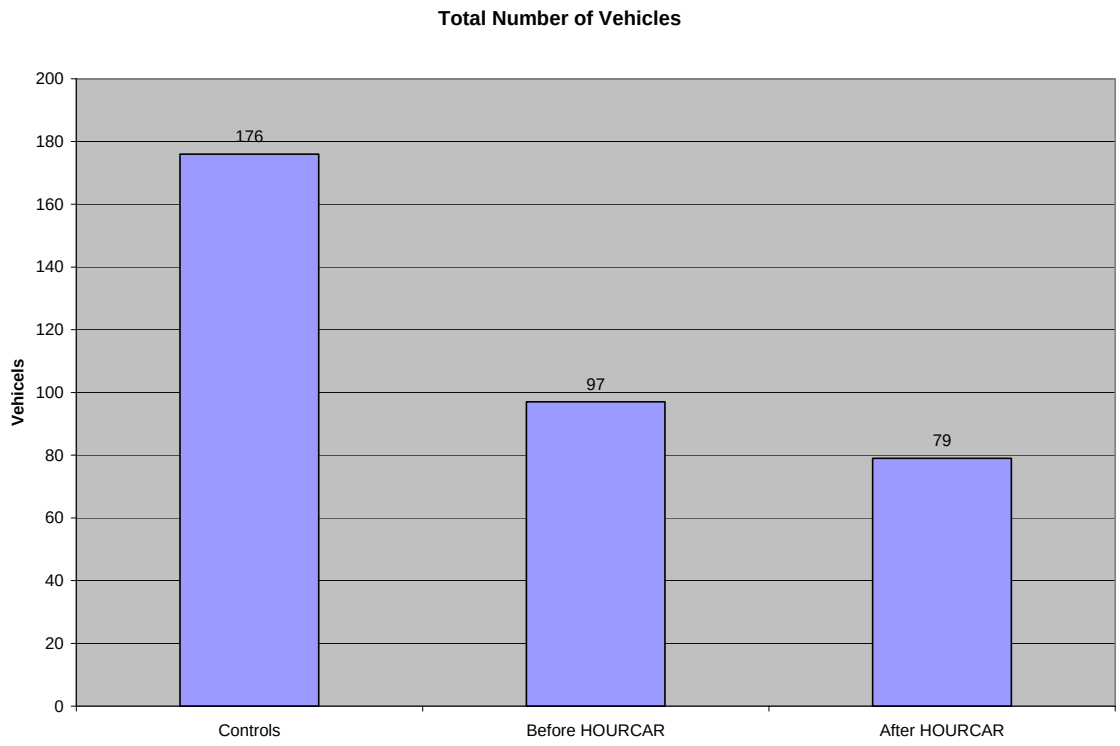

Figure 1.3: Total number of vehicles

The pie chart in Figure 1.4, below, displays the results of a question in the survey that was only in the surveys distributed to the HOURCAR members. It displays the results the survey question "since joining a carsharing program, have you acquired, replaced, or discarded a motorized vehicle (includes car, truck, SUV, van, motorcycle, moped, and scooter)?" As such, respondents were able to select only one of the following:

- I have acquired a vehicle
- I have replaced a vehicle
- I have discarded a vehicle
- I have made no changes in vehicle ownership

Results show that nearly 70 percent of HOURCAR members made no change in vehicle ownership since joining. Perhaps the most promising result in terms of impacts on automobile ownership is that more than 16 percent of respondents reported discarding a vehicle. In terms of net impact on vehicle ownership this translates to members getting rid of 34 vehicles (see Table 1.4 below). This is offset by the almost 9 percent who reported acquiring a total of 16 vehicles since joining the carsharing program, resulting in a net reduction of 18 vehicles.

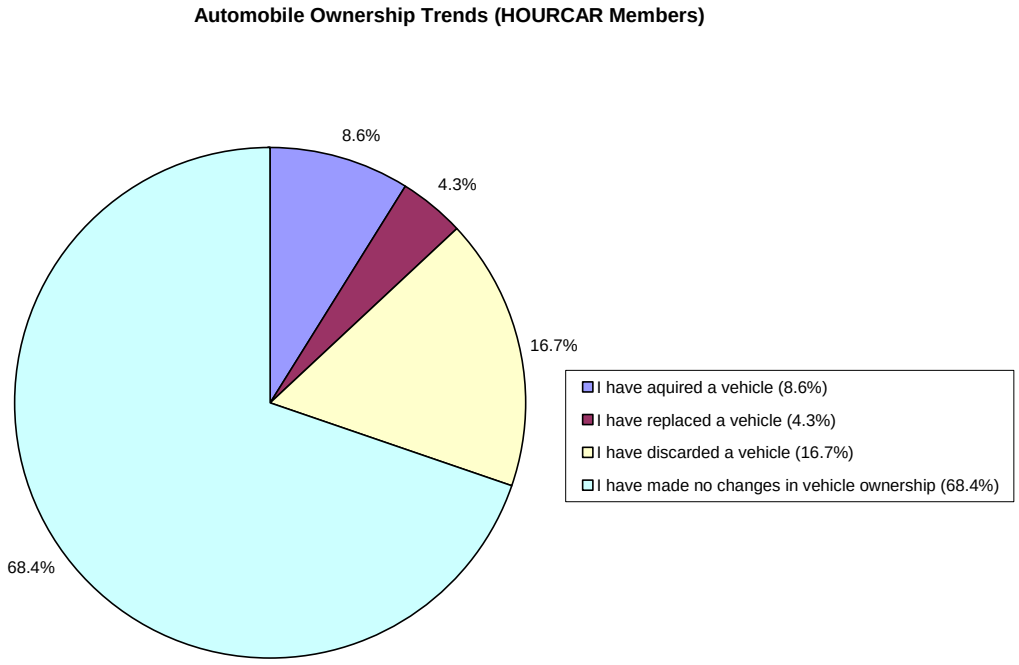

Figure 1.4: HOURCAR member automobile ownership trends

Table 1.4: Number of vehicles

Acquired Vehicles	16
Replaced Vehicles	8
Discarded Vehicles	34

In the middle are four percent who indicated they replaced eight vehicles. While that group is neutral in terms of total number of cars, it is worth examining the types of vehicles that were discarded, replaced or added. Table 1.5 shows that while overall results are mixed, it can be seen that most of the cars discarded were manufactured prior to 2000. When one considers HOURCAR's fleet of high-mileage and low-emissions Toyota Priuses, an environmental gain is obvious, even though a scientific analysis of specific reductions in gasoline or emissions was outside the scope of this study (see notes for further research). Tables 1.6 and 1.7 indicate that while the acquired and replaced vehicles may have a more neutral impact taken by themselves, which also means that those changes should only slightly diminish the gains demonstrated in Table 1.5.

Table 1.5: Vehicles discarded

Year manufactured	Vehicle Make	Vehicle Model
1985	Plymouth	Gran Fury
1989	Acura	Legend
1990	Pontiac	Bonneville (Sedan)
1990	Toyota	Corolla
1991	Acura	Integra
1991	Saturn	SL2
1991	Isuzu	Rodeo
1992	Subaru	Legacy (sedan 5 Spd.)
1992	Subaru	Legacy (Station Wagon 5 spd.)
1992		G20
1992	Nissan	Maxima
1992	Saab	900
1993	Ford	Tempo
1994	Nissan	Sentra
1995	Dodge	Neon
1996	Chevy	Cavalier
1996	Dodge	Caravan Sport
1991	Toyota	Camry
1996	(not reported)	(not reported)
1996	Mazda	Protege
1997	Dodge	Caravan
1998	Chevrolet	Lumina
1998	Toyota	Corolla
1999	Honda	Civic
1999	Saturn	S1 Wagon
1999	Mercury	Cougar
1999	Subaru	Legacy
1999	Subaru	Legacy
1999	Oldsmobile	Intrigue
2000	Mazda	626
2000	Saturn	SW2
2001	Chevy	Prizm
2002	Toyota	Prius
2004	Saturn	

(Blank cells occur where respondent did not provide the information.)

Table 1.6: Vehicles replaced

Year manufactured	Vehicle Make	Vehicle Model
1990	Cadillac	El Dorado
1997	Nissan	Altima
1997	Saturn	
1997	Toyota	Corolla
2000	Toyota	Echo
2000	Subaru	Legacy
2002	Toyota	Prius
2008	Honda	Fit

(Blank cells occur where respondent did not provide the information.)

Table 1.7: Vehicles acquired

Year manufactured	Vehicle Make	Vehicle Model
1983	Ford	Cobra RV
1990	Volvo	240DL Station Wagon
1991	Honda	Prelude
1992	Chevy	Lumina
1994	Toyota	
1994	Geo	Prizm
1999	Subaru	Legacy Outback
1999	Saturn	SC2
2000	Dodge	Stratus
2003	Honda	Civic Hybrid
2006	Hyundi	Sonata
2006	Jeep	Liberty
2007	Honda	Civic
2007	Toyota	Corolla
2007	Buddy	50 cc Scooter

(Blank cells occur where respondent did not provide the information.)

Question 2a: How does the travel behavior of HOURCAR members compare to that of a similarly-situated control group?

Travel behavior data for the HOURCAR and control group comparison came from the travel logs. In an effort to get consistent results in terms of the travel behavior data, respondents were prompted to think about what constitutes a trip in the following way: "A trip is defined as ONE-WAY travel between two distinct and separate destinations. For example, going from home to the grocery store, then to work, and then home again counts as three trips. On the other hand, going from your office at work to the office of a colleague on another floor of the same building should NOT count as a trip."

Table 1.8: Travel behavior (mode)

	HOURCAR		Control	
	Trips	Percent	Trips	Percent
Own Vehicle	132	29.33%	370	66.19%
Carshare	24	5.33%	0	0.00%
Carpool	15	3.33%	20	3.58%
Transit	98	21.78%	48	8.59%
Bicycle	71	15.78%	17	3.04%
Foot	110	24.44%	104	18.60%
Total	450	100%	559	100%

Table 1.8 shows that the difference in travel behavior between the two groups extends from auto ownership to their preferred mode of travel. Consider for example personal vehicle travel. Just over 66 percent of the trips reported by the control group were taken by personal vehicle while less than 30 percent of trips were by that mode for the HOURCAR members. For all other modes transit and bicycling, the control group had a considerably smaller share. The differences in these modes were statistically significant to the 95% level, although the differences between carpooling and foot trips were not.

Another notable item from Table 1.8 is that only 5 percent of trips by HOURCAR members were using the carsharing vehicle. While this is initially surprising, it is important to note that this pattern is consistent with the City CarShare results, where San Franciscans were also found to only use the carsharing vehicle 5 – 7 percent of the time, and still used their own vehicles more.

Question 2b: How does the travel behavior of HOURCAR members compare to their self-reported travel behavior from before they joined?

Table 1.9 shows the results of comparing diary results from HOURCAR members with their recollection of trip-making behavior before they joined. While these results were obtained through a method similar to that employed by Lane it is not a true longitudinal measurement, and is subject to bias for a couple reasons. First, the question requires respondents to make estimations about their travel habit in the past, and it is difficult to remember or understand what a typical day of travel might have been up to 2 years in the past. Second, it is possible respondents over or under reported certain trips based upon their current perception of social responsibility.

Table 1.9: Travel behavior (self-reported) mode

	HOURCAR (after)		HOURCAR (before)	
	Trips	Percent	Trips	Percent
Own Vehicle	132	29.33%	133	21.63%
Carshare	24	5.33%	0	0.00%
Carpool	15	3.33%	61	9.92%
Transit	98	21.78%	142	23.09%
Bicycle	71	15.78%	75	12.20%
Foot	110	24.44%	204	33.17%
Total	450	100%	615	100%

While bearing these limitations in mind, it is clear that the HOURCAR results are not consistent with those obtained by Philly CarShare, but more closely reflect the early responses of CityCarShare members. The results reveal that HOURCAR members increased their share of trips in their own vehicle by almost 7 percent after joining the program. Transit trips decreased for members after joining as did carpooling and foot trips. Bicycle trips increased, however.

Trip Comparison Finally, Table 1.10 aggregates the number of trips and trip duration between the control group, HOURCAR members trip diaries, and their reported data from before they joined. Values are not listed for the mean trip duration and total trip duration for before joining because this would have required respondents to essentially guess how long various trips were at some point in the past. Not only would it have been difficult to ask it would have been even more difficult for people to provide any kind of accurate figure.

Table 1.10: Travel behavior (trips)

	Controls	**Before HOURCAR**	**After HOURCAR**
Mean Trip Duration	18.38 Minutes	n/a	23.95 Minutes
Mean Number of Trips	3.92	5.69	4.22
Total Trips	560	609	456
N	143	108	108

Regarding mean trip duration, there is a marked difference between the control group and the carsharing members after joining. This statistic was calculated simply by taking the aggregate average of the reported trip lengths. The average trip duration increases form about 18.5 minutes to almost 24 minutes on average per trip. This is likely explained by the fact that the carsharers took considerably more trips by modes other than personal vehicle. These other modes, such as transit, walking, or biking, have the propensity to take considerably more time to complete a trip, on average. As such, while this population is spending more time traveling, they are doing so in a more diverse way.

Perhaps the most interesting statistic displayed in the table above is the mean number of trips. This shows that the control group took fewer trips per day, on average, than the HOURCAR

members both before and after joining. As for the carsharers, they reported taking an average of 5.69 trips per day before joining the program and 4.22 trips after joining, still more trips than the control group.

The increased trip duration, greater variety of modes, and drop in the number of trips made suggest that HOURCAR members have an increased awareness of the cost of each trip. They are thus more carefully planning their trips, for example, running all of their week's errands the same day in one large linked trip. In other words, joining HOURCAR has created, or at least increased, a sense of "judicious automobility" as described in Cervero's CityCarShare work.

Question 3: How does the HOURCAR membership compare demographically to the Control group?

Figure 1.5 shows the ages of HOURCAR members based on survey and HOURCAR actual data current as of April 11, 2008 (Gaug personal communication, A Ofsevit, HOURCAR, 4/11/2008). The results labeled HOURCAR Survey are those results that were obtained by the survey conducted for this research project. The results labeled HOURCAR Internal Survey are those that were obtained from an internal investigation of all existing HOURCAR members' dates of birth.

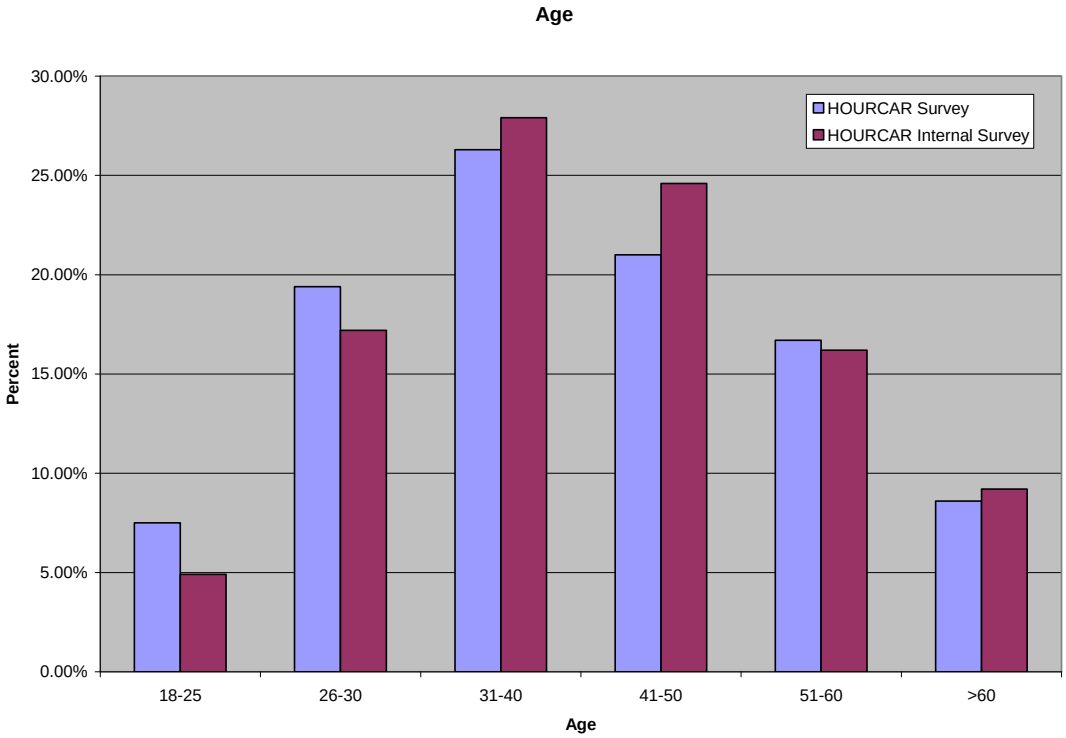

Figure 1.5: Age of HOURCAR members

In general, the results obtained from the survey track very closely with the actual ages of the carsharing members. Worth noting is that the lowest range shown for our survey is in reality probably only 20 to 25 year olds, given the HOURCAR age policy (members must have had a valid driver's license for 5 years). Our survey produced slightly higher numbers for those under thirty while for each age grouping over thirty our survey reported slightly lower percentage (except 51 – 60), but the discrepancy was never greater than about four percent.

These results are fairly close to what we would expect based on the literature, although we might have expected to see a greater overall percentage of users younger than forty. The 30 to 40 age range contained the highest percent of respondents for both groups. It is perhaps surprising, however, that there are more individuals greater than 60 with memberships than those less than 25.

In comparison, Figure 1.6 presents the results of the control group's response to the survey question regarding age. These results are presented next to the 2000 Census results for the exact census tracts from which the control addresses were randomly retrieved. See the map for the exact location of the census tracts from which those respondents came. It is important to note that because these two data sources had different break points in terms of age groups, similar to the previous graph, they should not be compared without considering the potential error. The census age ranges are listed above those of the survey results.

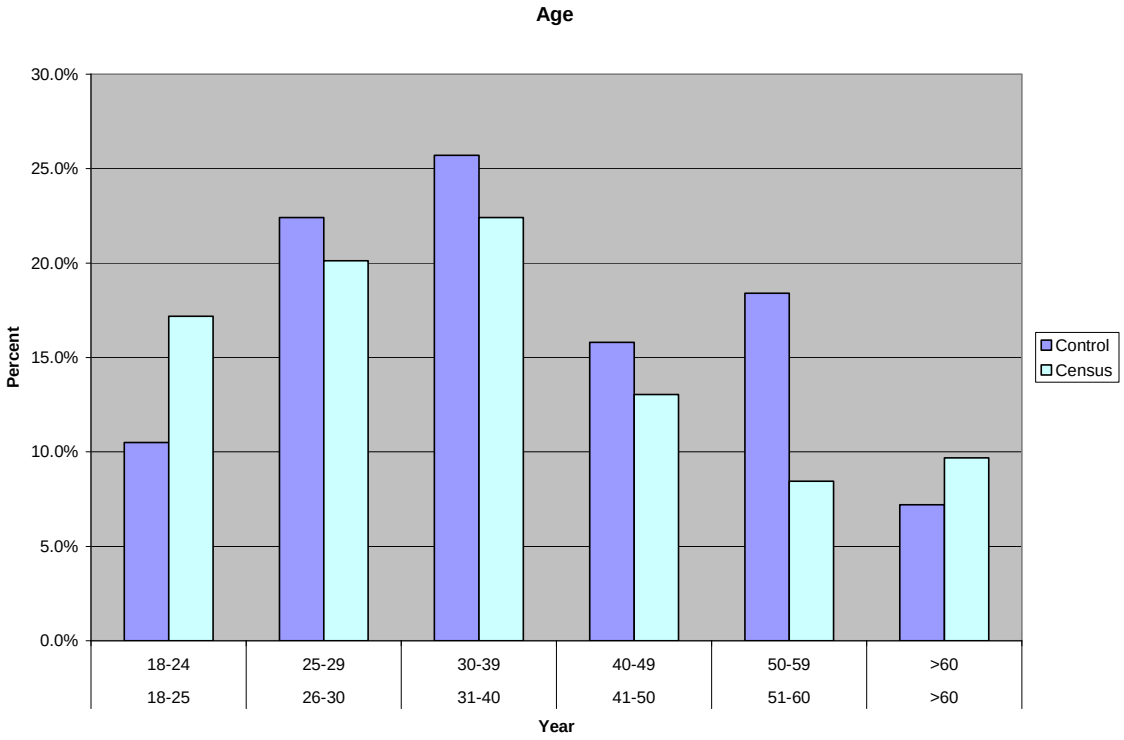

Figure 1.6: Age of control group vs average age in area surveyed (Census)

Both the control group and the census information from those tracts appear to follow a similar pattern. However, the discrepancies between the two data sources do exceed 5 percent in at least two of the age groups (18 – 24, 18 - 25 and 50 – 59, 51-60). In the latter age group, the discrepancy between the control and the census is quite significant with almost 20 percent of the control group falling within the age range but with the census reporting that in reality less than 10 percent of the people living there are actually between 50 and 59 years old.

When compared to the previous graph, it is clear that these two data sources are quite similar in terms of the distribution of the age groups. In all cases the largest percent of people are represented by the middle age group, 30 to 40.

Figure 1.7 displays graphically the average household size for the HOURCAR respondents, the control group respondents, and according to the census. As expected, the control group and the census report very similar average household sizes, about 1.6 people for each.

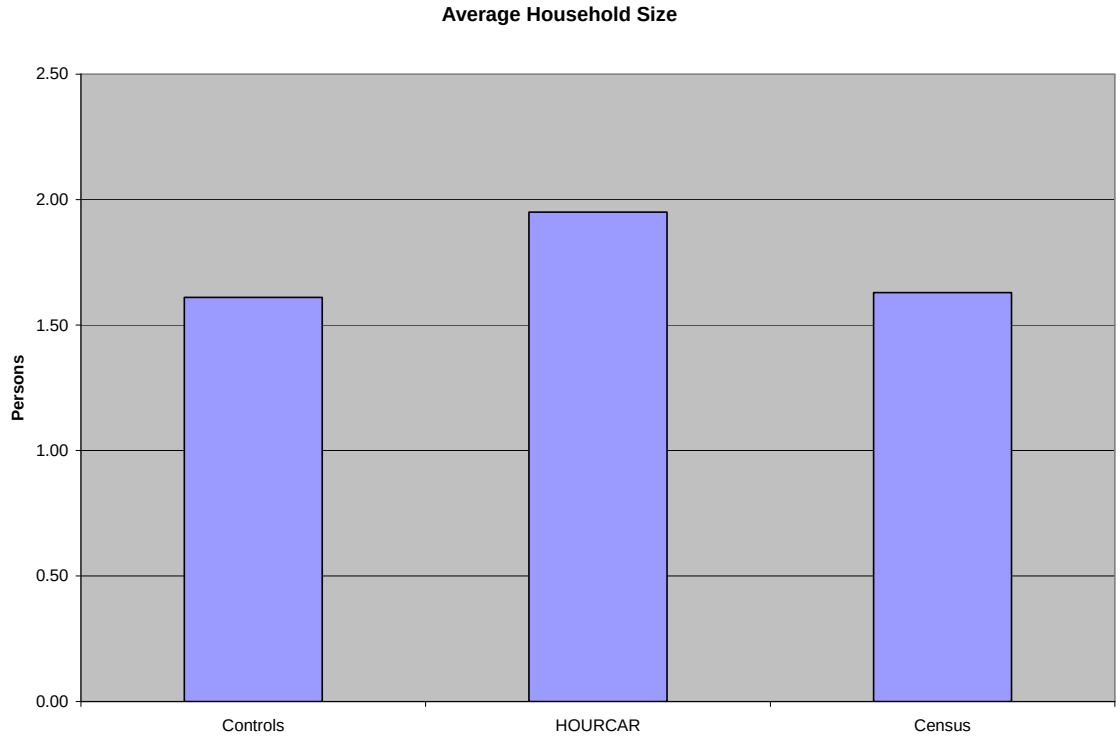

Figure 1.7: Average household size for survey respondents

Surprisingly, however, is that the HOURCAR respondents produced an average household size which was significantly larger than the control group. The average household size for the carsharers was nearly 2 (1.95). This result was unexpected and suggests that many families are actually joining the CSO. Generally, the literature suggests that mall households or single person households are more likely to join, not household of two or more.

Figure 1.8 then displays the housing characteristics of the carsharing population, the control group and the 2000 census. The census' housing tenure question is limited only to owner occupied or renter occupied and does not consider such categories as dorm, college owned, or other. As a result, there is no such data displayed for the census.

The three sources of data appear to reveal quite inconsistent results. For example, according to the census, almost 80 percent in the control area are renters while the remaining 20 percent own. The control group, which we would expect to reveal results similar to the census, indicated that only about 45 percent rent.

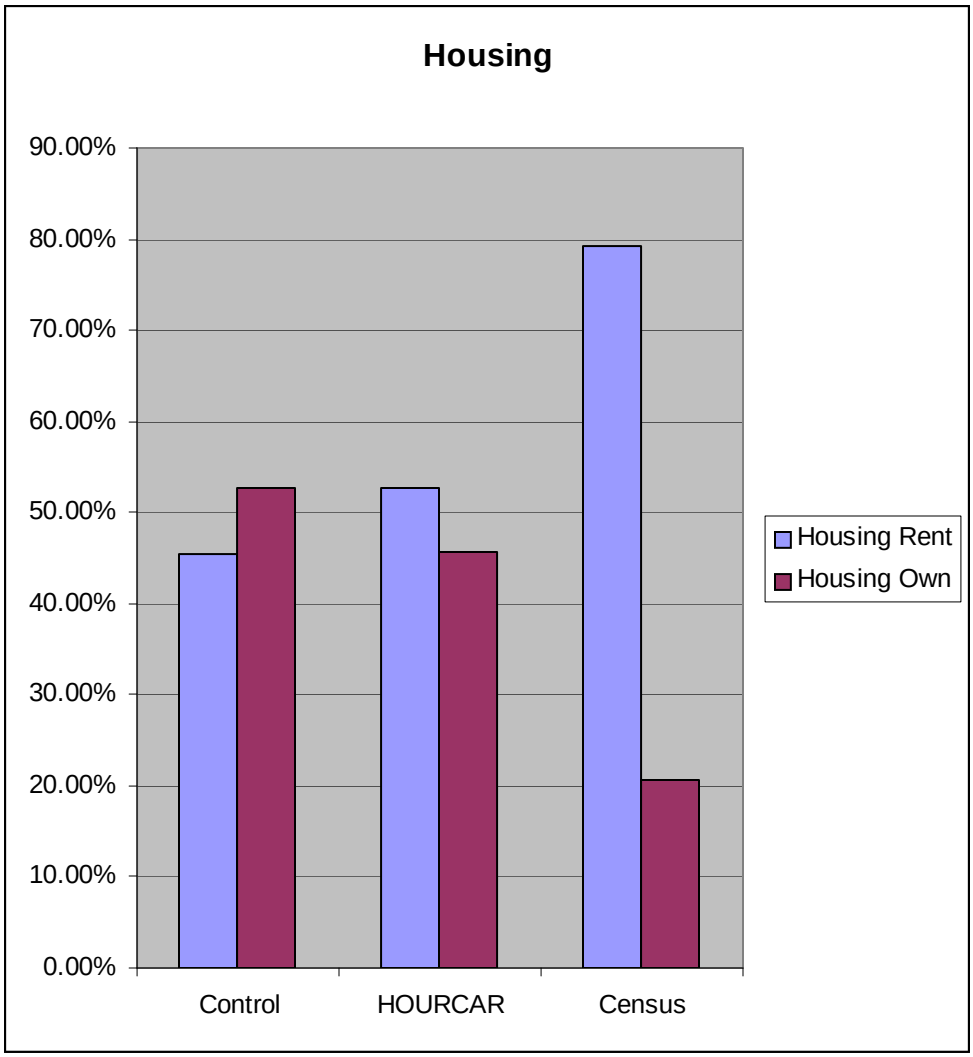

Figure 1.8: Type of housing (rent vs. own)

According to the two surveys we conducted, however, the HOURCAR members are more likely to rent while the control group was more likely to own. This is consistent to what we would expect - that the carsharing population is likely to consist of more renters. That said, however, it is worth noting that these difference are not great. The difference is about 7 percent in each case.

Next, in looking at income, Figure 1.9 compares the results of our survey with those of HOURCAR's internal survey. Because the income categories used in the two surveys were not the same, we had to collapse several of the ranges in order to get results that could be compared. The evidence found in this chart shows quite convincingly that the two surveys produced similar results. For each income range the results are nearly identical, particularly in the over $50,000 range. The bottom ranges shown are those used in our survey while the top come from the HOURCAR internal survey.

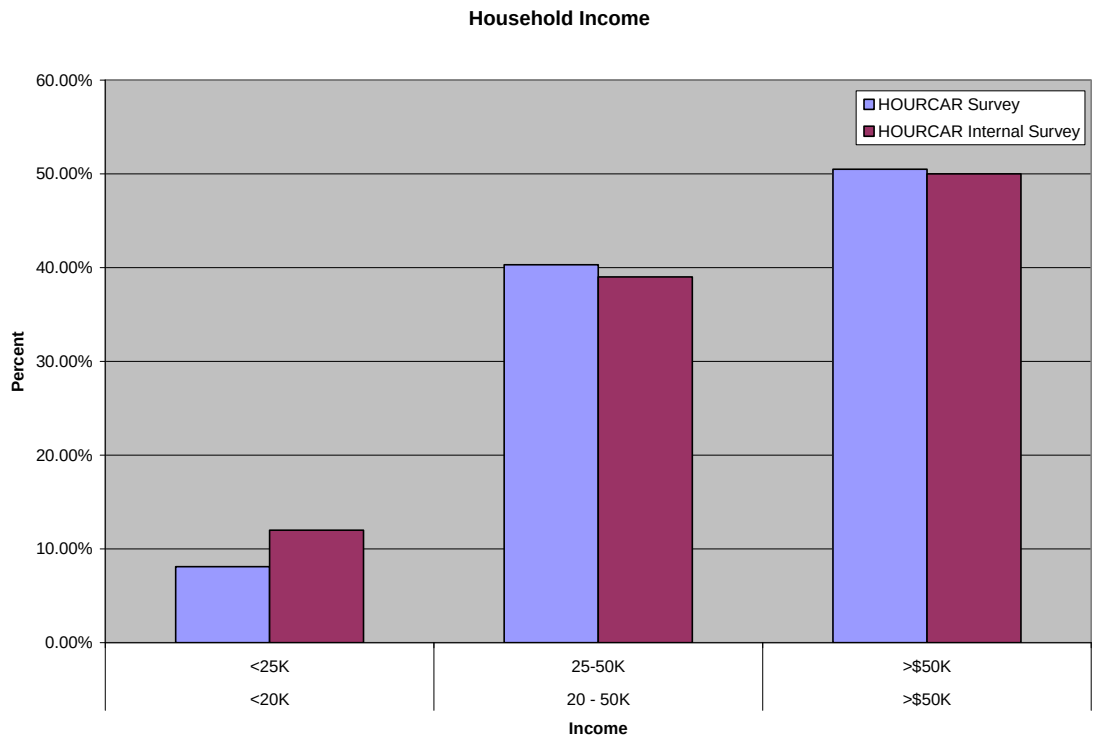

Figure 1.9: Household income for HOURCAR members

More generally, this chart shows that around 50 percent of HOURCAR customers are in households with incomes greater than $50,000, while just about 40 percent are part of households that earn between around $20,000 to $50,000 per year. We would have expected this latter category to have produced the largest percentage as we expected most HOURCAR users to belong to one person households, which as we noted above, is not the case. It is not entirely surprising that the smallest category, around 10 percent, goes to those who earn less than $25,000.

Similarly, Figure 1.10 compares our control group's income responses to the 2000 Census data. It is important to note the slight discrepancies between some of the income ranges. The census categories are listed above those categories used in our survey. Although the discrepancy is only $1 in some cases, this could still have an impact on the results because it is possible that people will have the tendency to report their income to the nearest ten-thousandth. For example, a respondent rounding their income to $20,000 would end up in a different income range in each of the surveys.

In a broad comparison of these two categories it appears that they are not entirely similar. For example, except for the $35,000 to $50,000 income range, each range reveals a discrepancy of greater than 10 percent. The largest discrepancy between the control group and the census for income is found in those who make more than $50,000 annually. Nearly 65 percent of the respondents from the control group earn greater than this amount, while the census revealed that in reality only about 30 percent of the households in the tracts from which our control group came earned more than $50,000 annually. It is perhaps by chance that our random sample

appears more wealthy or possibly this area has changes significantly in the time since the census was taken.

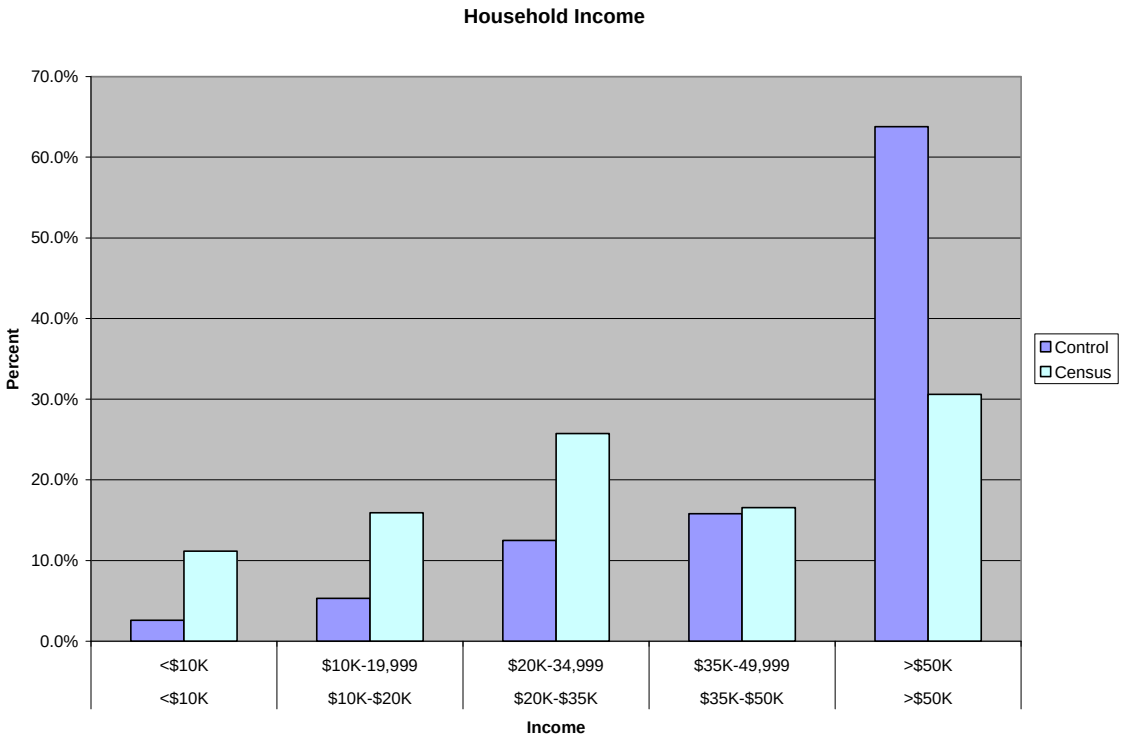

Figure 1.10: Household income for control group members

In comparing the result of only our two surveys, the discrepancies are found largely for those households who earn incomes greater than $35,000. For example, about 24 percent of the HOURCAR respondents had incomes in the $35K - $50K range while only 16 percent from the control group fell into that ranges. This is suggesting that there are indeed more middle income households in Twin Cities carsharing population than found in the control group.

Question 4: What motivates people in the Twin Cities to join a CSO?

The data collected from the open ended question, "what motivated you to join a carsharing program?" was placed into one of twelve categories based on the frequency of it being listed as a reason. They were selected after reviewing all the responses. The 12 distinct categories of motivating factors are presented in Table 1.11.

Table 1.11: Motivating factors

1. Environmental	7. To use own automobile less
2. Reduce number of autos owned	8. I/We don't want a car
3. Financial/Economical	9. I/We don't own a car
4. Support carsharing goals/concept	10. I/We don't want/have a second (or third) car
5. Needed extension of other less flexible modes (transit, bike, walking)	11. Employer membership or otherwise job related
6. Convenience (includes reliability)	12. Other

Because respondents had the ability to list multiple motivating factors we recorded up to four of their listed motivators (this was generally the largest number of reasons listed). Primary motivation was considered the first reason cited regardless of the structure of their response (i.e. full sentence vs. bullet points). When the motivations listed were not clear we did our best to interpret or extrapolate the intended and true meaning.

Figure 1.11 displays the 12 motivating factors for joining as extracted for the open ended question inquiring as such. Additionally, the figure displays the primary, secondary and overall total percentages of respondents who citied each of these motivating factors.

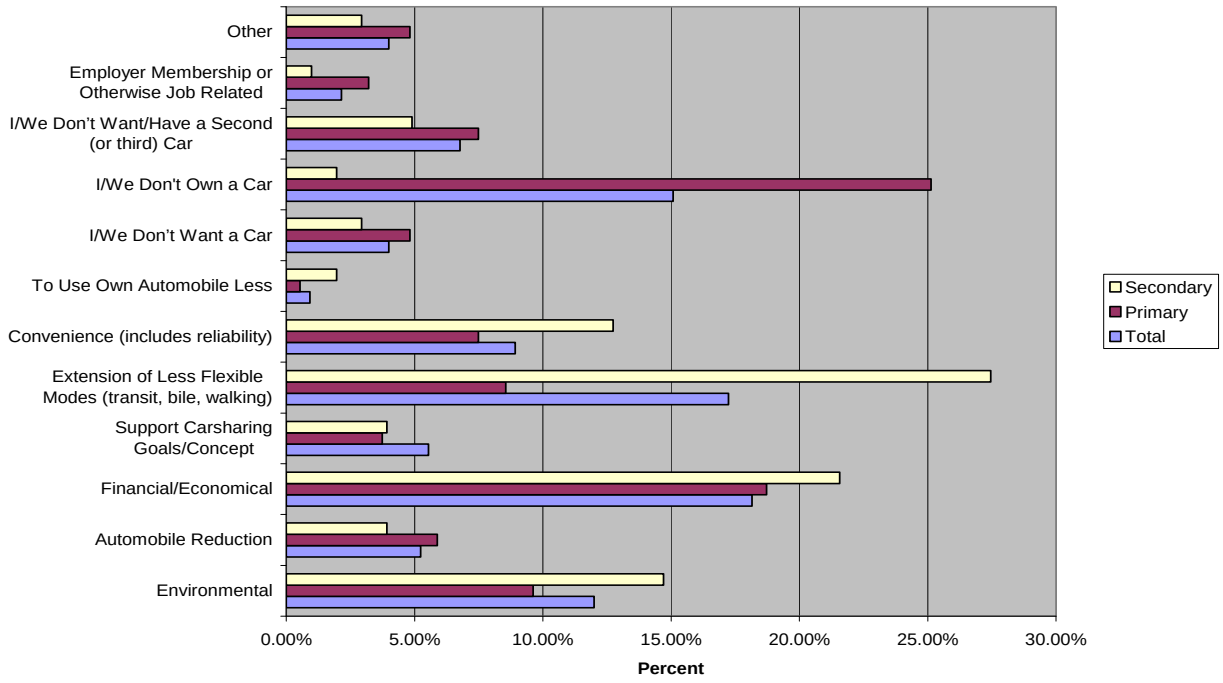

Figure 1.11: Motivating factors

Of all the member respondents, just over 25 percent mentioned that their primary motivation for joining was that they did not own a car. There were a variety of reasons respondents did not own cars. Some such examples include:

- "I sold my car, and wanted to be able to use a car from time to time when public transportation was not easy."
- "my car died,"
- "I don't own a car (and don't want to own a car). But it's still easier having a car to go to the grocery store, Target, pick up someone from the airport, etc."

It was quite common for the primary reason of not owning a car to be followed by another comment suggesting that the carsharing cars were used to fill a perceived gap that exists between transit use and car ownership. In fact, 40 percent of respondents whose primary motivation was lack of a car had a secondary motivation of "extension of other mode," or more simply put, just needing a car on occasion to complete specific tasks.

The second most commonly stated motivation for joining HOURCAR was financial. This is not surprising given the high fixed costs associated with car ownership. A few respondents who identified finances as their primary reason stated:

- "The ability to rent a nice apartment and have more disposable income by not owning a car"
- "I didn't want to pay car insurance every month for only using a car a handful of times"
- "I sold my old car and didn't want to spend money on a new one. I use my bike and public transit as my primary transportation and the car-sharing "fills the gap".

The third most commonly identified motivator was the environment. It was also the third most commonly listed secondary motivator. One respondent wrote:

- "Environmental and economic reasons. I am not a fan of car culture and am happy to support sustainable and cooperative options."

Given that there were no limitations to what survey recipients could write, many respondents listed multiple reasons. In fact, over 50 percent listed a secondary motivator, 16 percent listed a tertiary motivator and just over 3 percent went so far as to list a quaternary motivator.

Conclusions and Recommendations

Conclusions

1. Each HOURCAR removes 2.5 other vehicles Earlier, we noted auto ownership had declined among CSO members in nearly all cases. Lane even estimated a dramatic reduction of nearly 23 private vehicles for each carshare vehicle, based upon the assumption that some members chose not to purchase cars in addition to those that gave them up. However, as we noted in section V, we chose not to collect data on "cars not purchased," which would leaves us to alter Lane's

formula to: (cars discarded – cars added) / number of cars in the CSO's fleet. Applying this revised method to Lane's numbers yields an average of 10.7 cars removed.

In HOURCAR's case, the data show a net reduction of 18 vehicles among the 186 HOURCAR respondents, or roughly 1 car for every 10 members. Extrapolating 400 members as of the time of the survey yields 40 cars removed. Then, applying the final part of our equation and dividing 40 by 16 low-emissions, high-mileage cars in HOURCAR's fleet, equals 2.5 vehicles removed for each HOURCAR. Further, as shown in Table 1.5, above, most of those cars removed were lower-mileage, higher emissions vehicles as well.

Comparing this 2.5 vehicle number with the 10.7 in Philadelphia indicates this figure can vary greatly from city to city, which reduces the effectiveness of this argument for advocating widespread carsharing. Further, the overall number is practically negligible in terms of the total number of cars in the Twin Cities. However, even though time and budget constraints prevented analysis of whether the discarded car was most often the primary vehicle, or just a second or third car, it is not unreasonable to expect that, in the high density neighborhoods where HOURCAR currently has its hubs, this change could bring appreciable relief, and, to the individual HOURCAR member, the reduction in costs of owning, maintaining, and even parking their own car are easily noticed.

2. HOURCAR Members demonstrate "judicious automobility" Cervero's CityCarShare research indicated that new CSO's could show an increase in single-occupant trips given that many initial members are "green" types that may not have owned a car in the first place. On the other hand, he also noted that evidence of "judicious automobility" should be evident, as carsharing provides users with a reason to more carefully consider whether an SOV is truly the most efficient way for a person to take a particular trip. Finally, regardless of all this, his research showed that CityCarShare never was used for more than 10 percent of all trips.

While most other reports indicated that SOV trips should go down, given that HOURCAR was still relatively new at the time of this survey, and given the lower density land use patterns of the Twin Cities, the outcome for HOURCAR most closely resembles the CityCarShare experience. Table 1.9 shows HOURCAR members reported an increase in the share of trips made in their own vehicle, in addition to five percent of all trips being made in HOURCAR vehicles. Even though we did not have actual longitudinal data, this change is probably reliable, as it is counter to what one would expect "green" members to report.

Similarly, we can conclude that HOURCAR members are somewhat "greener" than their counterparts in the control group, given that their SOV share was half that of the controls. Consequently, this makes it difficult to conclude that joining HOURCAR caused their "judicious automobility," or adding HOURCAR to their travel options merely fit their existing patterns very well. Regardless, this group appears to work quite diligently to ensure they are choosing the most efficient mode for most trips.

3. HOURCAR's Greatest Membership Hurdle is Attitudinal Previous research on the Twin Cities market by Andrew and Douma, as well as results from reports on other CSO's created the expectation that HORUCAR members would be a fairly distinct, well-defined group. However,

a demographic comparison with the control group showed this to not be the case: other than travel behavior, HOURCAR respondents were not significantly different from their counterparts in the control group in terms of household size, income, age or housing type.

This discovery is likely good news for HOURCAR. While it is counter-intuitive, and suggests that HOURCAR members may be self-selected due to existing travel preferences (see conclusion ii above), the recent rapid increases in gasoline prices will likely increase judicious automobility for everyone. Consequently, with existing members demonstrating that HOURCAR membership can work for people who are otherwise like them, there are few barriers for people looking for alternatives to join as well.

4. Convenience and Finances are Motivators for Joining, although the Environment is also a Consideration This conclusion is closely related to conclusions 2 and 3, but merits separate discussion as it particularly highlights the trend that, while HOURCAR, similar to other CSO's, may have had "green" members make up a substantial portion of initial members, our data indicate that environmental considerations are not the key driver. Most members are weighing convenience and financial considerations when joining. With the increasing cost of gasoline is raising the variable cost of all travel, the more predictable costs of carsharing, combined with its nearly negligible capital costs, HOURCAR should become increasingly attractive to those who live near hubs.

Recommendations for Further Study

Once practical considerations of physical differences between San Francisco and the Twin Cities are taken into consideration, the consistency of the results of this research with Cervero's results is striking. Consequently, a **follow-up survey** in a couple years would be very interesting to determine if judicious automobility continues to increase among HOURCAR members as was noted for CityCarShare.

In the meantime, more research could be conducted on this data, especially regarding the emissions impact of HOURCAR. While outside of the scope of this research, data was collected that could provide information as to the **difference in emissions** between HOURCAR member's own cars and HOURCAR's, as well as HOURCAR vehicles versus the vehicles used by the members of the control group. A significant part of this would include comparing whether HOURCAR members are using the HOURCAR's as their primary or secondary vehicle. If the latter, it would be interesting to compare the emissions of the HOURCAR member's primary vehicles with those of the control group.

Recommendations for the Practice: Advantages for Diversifying?

The low percentage of trips for which HOURCARs are used raises the question of whether they are replacing the highest emissions trip made by members, i.e. are members keeping a higher emissions / lower mileage car as their primary vehicle to maintain greatest flexibility of use, and then using HOURCAR only for secondary trips? While this is advantageous in that it minimizes the marginal impact of secondary trips, especially when compared with the impact of a member owning and maintaining their own car that is likely lower mileage and higher emissions than

HOURCAR's Priuses, it does mean that a large majority of single occupancy vehicle trips are not being made as efficiently as possible.

Other CSO's have made a point of diversifying their fleet, including pickup trucks, minivans and other more specialized vehicles to meet the varied transportation needs of their members, and HOURCAR may find that providing this diversity to its members could lead to them purchasing a more efficient vehicle for their primary trips, as they know they would have a more specialized vehicle for particular secondary trips. The impact of secondary trips could increase, but it would still be less than the members owning their own specialized vehicle, and the use of a more efficient vehicle as their own primary car would have a positive impact on a greater number of trips.

Chapter 2:
Citizen Use of Advanced Traveler Information Systems (ATIS): How Using the System Affects Agency Trust and Confidence in the Transit System

Introduction

Online public transit web sites have become the tool of choice for many citizens to locate transit route information and to assist with trip planning. For many of these citizens, the electronic interface has become the only method of communication employed between themselves and the public service agency. This research seeks to understand the end user, citizen experience with transit web sites, including how citizen perceptions of the transit service and public agency are affected through web site use. Past research by the research team evaluated end-user satisfaction of public transit web sites in Los Angeles and Minneapolis utilizing an online survey instrument and focus group discussions (Abichandani and Horan, 2006). This first phase of research focused on understanding citizen satisfaction with online trip planners. In addition to the service satisfaction of online trip planners, findings revealed that transit planning web site use may also serve to increase feelings of confidence in the transit services and the transit agency. This phase of research aims to empirically investigate this citizen/user trust and confidence in a public service (i.e. the public transit system) and the public service agency (transit authority). As such, the purpose of this research is to investigate how citizen use of a public transit web site affects citizen's trust and confidence in transit services and the public agency responsible for providing the services (i.e., transit authority).

This report first presents a discussion on electronic public services, also referred to as e-government services and systems. The specific context of the study is then presented, which is online advanced traveler information systems (ATIS). The methodology is then presented followed by quantitative results and discussion. Findings from qualitative focus group discussions are then discussed followed by a conclusion.

Study Backdrop: Online Public Services and E-Government

Public services have largely been, and continue to be, redefined due to the implementation of electronic online government (e-Government) systems. For example, it is now commonplace for a transit service to provide a web site to citizens with route information and the ability to plan trips. In this way, a wide range of e-Government systems offer expedited services to citizens while saving unstinted amounts of monies and resources [1]. As Saad Bakry pointed out, e-Government has not only been able to successfully provide online services to citizens, but it has also benefited society by eliminating unnecessary overhead and contributing to the digital economy [2]. As the nature of interactions between citizens and public services has changed, so have citizen expectations. For example, West explains that a particularly appetizing characteristic of e-government is that it allows citizens to seek public services at their own convenience rather than just when the public service office is open [3]. While the promise of ubiquitous e-Government services is desirable, there are important government-to-citizen interactions that need to be taken into account in the design of such systems. As demonstrated by

one study, mere assurance of online delivery of a wide variety of information to disparate citizens should not be the sole aim of such systems [4].

Performance of e-Government in the wake of rising citizen expectations calls for confidence-inducing interactions between government-sponsored digital initiatives and citizens. Recent studies have focused on technical aspects of such interactions that work to motivate confidence [5-7]. For example, by utilizing Information and Communication Technology (ICT) applications public sector websites have proven to be successful and secure through implementation of various frameworks involving improved process management and security [8-10]. A well-established foundation in the technical landscape of e-government does not necessarily result in success of electronic government services. As Weber and Murray explain, there exist many deficiencies in delivering citizen-centric services through existing digital government initiatives [11]. Citizen perceptions of public institutions, initiating digital initiatives, are crucial elements in adoption of political efficacy.

Two elements in facilitating a definition and measurement of perception may be employed through examining citizen *"trust"* and *"satisfaction"*. Although the term *"trust"* may be implicated as vague and imprecise, it must be examined in order to understand citizen perception. In e-Government, *"trust"* has been demonstrated to characterize an exhaustive measure in examining cooperative relationships between citizens and government [4, 12–14]. Furthermore, based on previous research spanning across several domains, citizen "*satisfaction*" has been found to be an integral and evaluative aspect in determining performance expectations of an interactive system [15-17]. Other studies have argued that trust is strongly associated with satisfaction, which in turn, is linked with citizen's perception [4].

In terms of trust, citizens, first must have a baseline perception that the government agency is a trustworthy entity before they have perceived trust in an electronic service. With regard to satisfaction, our research confirms that this construct can be measured through citizen fulfillment with the e-government service they interface with. An interesting and important next step is to understand the relationship between citizen satisfaction with e-government services and the effect on how that experience relates to trust in the government entity that provides the e-Government service. Our review of the trust literature that informs this research can be found in Attachment D. The broad question that the research addresses is whether objective performance of an e-Government service (ATIS and online transit planning systems) effects citizen trust in a public agency and the physical services it provides (i.e., transit)?

This research considers aspects of performance and the effect it has on citizens in deciding whether a public institution that provides services (i.e., transit) should be trusted. By importing influences, described above, the research is exploring the association between objective performance of an e-Government service and the level of strategic trust it creates in the impression of citizens. This is discussed within the context of advanced traveler information systems (ATIS) discussed further in the next section.

Advanced Traveler Information Systems (ATIS)

Use of Intelligent Transportation Systems (ITS) can help ease the strain created by increasing demand for travel on highways and public transit systems in the United States through application of modern information technology and communications (Mitretek Systems, 2003). Advanced Traveler Information Systems (ATIS), are a part of the overall activity of creating an ITS infrastructure, and seek to inquire, analyze, communicate and present information to assist surface transportation travelers in moving from a starting location to their desired destination. It is expected that ATIS will provide assistance in a manner that best satisfies the travler's need for safety, efficiency and comfort. As an example of government-to-citizen services, ATIS provides (1) real-time network information, traffic or transit, and (2) traveler information, such as route guidance or destination information using advanced technologies such as Internet (Lappin, 2000; Zimmerman, 1999). According to the Intelligent Transportation Society of America (Intelligent Transportation System America), ATIS delivers data directly to travelers or citizens, empowering them to make better choices about alternate routes or modes of transportation. ATIS represents a part of ITS responsible for providing an assortment of traveler information services. Advanced Public Transportation Systems (APTS), a related set of services, focuses on providing information to travelers, assisting in transit management, and addressing the use of electronic payments (Federal Transit Administration). These services often involve delivering information through Internet-based systems. From a broader e-government perspective, ATIS/APTS (hereinafter referred to as ATIS) represents but one type of "web-enabled" services that are offered to a community of users resulting in better government-to-citizen relationships.

Characteristics of travelers and trips, in addition to other factors, determine customer demand for ATIS (Lappin, 2000). Studies and surveys have identified these characteristics to be diverse in nature (US Department of Transportation, ;Bureau of Transportation Statistics, 2003). While it is common to believe that work trips are the predominate purpose of travel, the situation is, in actual, more diverse (Hu and Reuscher, 2004). In a National Household Travel Survey (NHTS) of 2001 by the Bureau of Transportation Statistics (BTS), results indicate that a large portion of trips were taken for family and personal reasons such as shopping and running errands (45 %). Social and recreation trips, such as vacations and visiting friends, accounted for 27% of the trips. Despite the strong focus on work and commuting trips by researchers and urban planners, commute and related trips accounted for about 18% of all trips taken. Trips to school and church accounted for about 10% of all trips. Alternatives in the mode of transportation such as fixed-route and non-fixed-route services exist for various trips. Fixed-route travel includes services provided such as bus, rail, or other conveyances, either publicly or privately owned, on a regular and continuing basis (American Public Transportation Association). Non-fixed-route trips include demand response trip planning as well as alternative modes such as walking. By far the most common form of transit for all trips is the fixed route bus system, with significant use of fixed rail in selected metropolitan areas (American Public Transportation Association, 2004). Focusing in on transit usage, recent studies have identified different transit patterns across different socio-economic groups (Hu and Reuscher, 2004;Puccher and Renne, 2003). These socio-economic groups can be based on household income, race or ethnicity, gender, age and disability. Further, various purposes for making a trip identified can form an important part of building the overall context. These purposes range from utilizing transit for going to work to visiting a doctor to making a social or recreational trip.

ATIS delivery through e-government websites is just one of the various methods using which transit-related information can be disseminated. Widespread expectations towards ATIS delivery have been examined by various studies. Lappin has identified various user groups that use ATIS and their attitudes that could determine disparate expectations, thereof (Lappin, 2000). The results of the study indicated need for accuracy, timeliness, reliability, cost, personalization, convenience and safety. Further determinative features such as maps, route guidance, coverage and related findings were also identified. A much broader evaluation program is continuously being run by the US Department of Transportation (US Department of Transportation). The results of these programs are meant to be mainly utilized by administrators of ATIS initiatives. In these results, specific infrastructural expectations are noted. However, a citizen-centric evaluative perspective seems to be absent.

Inclusion of end-user needs in providing infrastructural facilities has been lately prescribed to be an important aspect. A 10-year ITS plan developed by U.S. Department of Transportation explicitly recognizes the importance of end-users (Intelligent Transportation System America, 2002). The plan recommends that ITS programs need to focus on providing improved choice of modes to diverse user groups – irrespective of their age or disability who use of transit for various purposes. The goal, as purported by the plan, is "universally available information that supports seamless, end-to-end travel choices for all users of the transportation system" (Intelligent Transportation System America, 2002). Further, Horan and Reany (Horan and Reany, 2002) recommend that planners, policy makers, engineers and service providers associated with ITS infrastructure should consider how well they can serve the needs of diverse users. A much more expanded specification and functional vision was provided by Horan (Horan, 2003), wherein, it was noted that ITS projects need to adopt a user-centric perspective and research on various aspects of the end-users of the system. Through providing an analogy of recent e-commerce initiatives, Horan (Horan, 2003) recommends "dedication to a customer focus, alternatively termed mass customization (e.g., Dell), personalization (e.g., Amazon), or, more generally, customer relationship management (CRM).

This research suggests that transportation services are quite diversified in both type of service offered and the range of citizens utilizing such services. The challenge is to devise a dynamic evaluation method that can evaluate online ATIS systems and provide deterministic recommendation that could ensure that the citizens utilizing the services are satisfied with the delivered information.

Research Setting

The research setting for this study is Metro Transit. Metro Transit is the principal transit system serving the greater Minneapolis, Minnesota area providing roughly 95 percent of the 73 million bus trips taken annually in the Twin Cities. Metro Transit operates the Hiawatha light-rail line, 118 bus routes — 63 are local-service routes, 46 are express routes, and 9 contract service routes, using a fleet of 821 buses.

Metro Transit has a very progressive customer service program. Its call center handles approximately 1.1 million calls per year. However, since the introduction of the trip planner, the web has become the major source of trip planning among riders. Some 4 million trips were planned online in 2007. According to Metro Transit representatives, usage continues to grow

setting new highs each month. The latest data from June, 2008 shows that over ½ million trips we planned using the trip planner that month.

In addition to these general factors that make Metro Transit an exemplary research setting, the study also came at a time when the agency was introducing several new trip planning features. This allowed the research to not only provide general findings on the site, but also specific findings relative to these new features.

Research Model

Below is the research model derived from the research literature on the various components of trust including: system trust, competence, benevolence, and usability (see Figure 2.1 below). Survey questions were designed, taken from research literature, which targets each of these components. Also included in the survey instrument were questions relating to the propensity of an individual to trust, that individuals experience relative to the system under evaluation, and the perceived reputation of the system under evaluation. Specific questions asked within the survey are provided below.

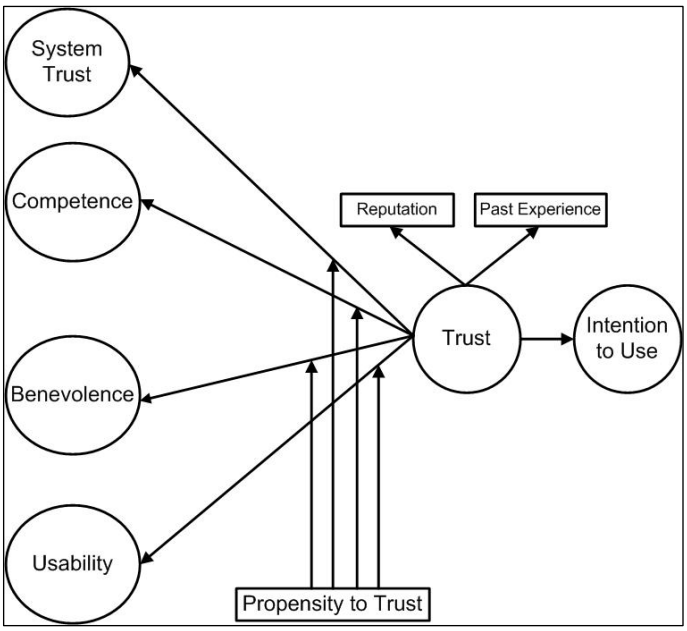

Figure 2.1: Trust model

In addition to questions directly related to the research model, the survey also inquired about use of several new features on the trip planner site, such as the mapping feature, a walking map feature, and personalized scheduling. These items were added in order to provide Metro Transit with specific feedback on Trip Planner features as well as a more general assessment of service usability, satisfaction, and trust.

Survey Instrument

Table 2.1: Survey instrument

CODE	QUESTIONS	SOURCES
System Trust [43-45]		
SYS1	I can verify that the Metro Transit provides facilities to ensure secured interaction between users and their website.	[43]
SYS2	Metro Transit website gives a sense of guarantee that the information provided reflect actual transit services provided through buses.	[46, 47]
SYS3	I believe if I provide personal information to Metro Transit, they will respect my privacy.	[48]
SYS4	While using online trip planner, I feel confident that the bus service shown will occur as portrayed.	
Competence [46, 49, 50]		
COMP1	I feel uncertain about whether Metro Transit is a capable and a competent online transit information service provider.	[51]
COMP2	I have full confidence in the ability of Metro Transit to provide different kinds of public transit information.	[52]
COMP3	Metro Transit is willing to customize its website based on our needs.	[53, 54]
COMP4	Metro Transit organization has knowledge and resources to serve us with online and real-time transit information.	[45]
COMP5	Metro Transit service towards efficient delivery of transit information is predictable.	[46, 55]
Benevolence [46]		
BEN1	Metro Transit agency keeps promises and commitments.	[49]
BEN2	I believe Metro Transit keeps my best interests in mind.	[49]
BEN3	I believe promises made by Metro Transit are likely to be reliable.	[56]
BEN4	I believe Metro Transit is trustworthy.	[49]
BEN5	Metro Transit organization is honest in dealing with the citizens of the city.	[45]
BEN6	In case of a dispute, Metro Transit will be fair in its decision.	[46, 48]
Usability [49, 57]		
USE1	I learned to use the website very quickly	[58]
USE2	I found helpful features on the website for accomplishing my task	[58]
USE3	I found the design of the website visually appealing	[58]

USE4	I found that various functions were well integrated	[58]
USE5	I found the website was easy to use	[58]
USE6	I found the information on the website to be useful	[58]
REP1	Metro Transit is well known and has good *reputation* among the users of online public transit information service.	[59]
PAST1	I am satisfied, in general, with my *past interactions* with Metro Transit website.	[48, 57]
Propensity to Trust [50, 61]		
PROP1	I believe it is best to avoid using new technologies for obtaining public information service.	[43]
Intention to Use		
INTENT1	It is very likely that I will use Metro Transit website, for trip planning, in the future.	[60]
INTENT2	I would suggest the online services of Metro Transit website to people who intend to obtain transit information.	[48, 62]
INTENT3	I believe using Metro Transit eases my task of trip planning for my transit.	[63]

Research Methodology

As mentioned above, an online survey was developed that was comprised of questions related to the above trust model, participant demographics, and experience using technologies. The survey was designed to inquire about the experiences of users utilizing the ATIS website (i.e., the online trip planner) and the effect of these experiences on the level of trust in the agency providing the website, in this case, Metro Transit. As discussed previously, the survey was conducted in Minneapolis / St. Paul (MN) through the Metro Transit website (http://www.Metro Transit.org).

The survey protocol was designed to collect reactions of respondents just after they had used the website for trip planning purposes. The link for the online survey was placed on Metro Transit.org from Feb 28th, 2008 to March 31st, 2008. The link was strategically placed on different pages on the website. The individuals who had planned a trip for their travel were presented with the survey. Additionally, the link was also placed next to and underneath specialized features offered by the website such as route maps and walking maps. The survey was implemented using a popular online survey designing tool (i.e., surveymonkey). In effect, the sample for the study was the actual users of the public transit who accessed and used Metro Transit's website. This process resulted in 552 participants of which 446 completed the survey in full resulting in an 81% completion rate.

Subsequent to the online survey, focus group discussions were arranged and held, with the help of Metro Transit, on their office premises. Two sessions were conducted – one with 11 participants and the other with 13. The participants were presented with open ended questions

relating to their perceptions of trust and online behavior. Additional information about the focus group methodology and results are described in Section IX of this report.

Sample Characteristics

This section provides an overview of the survey findings in relation to several participant characteristics including: 1) demographics comprising gender, age, ethnicity, level of education, occupation and household income, 2) public transportation usage, and 3) technology usage.

Demographics

Of the 446 respondents, 58% were female and 39% were male, illustrated in Appendix D - Table 1. Most of these respondents (approximately 76%) self reported belonging to the "White/Caucasian" ethnicity group, presented in Appendix D – Table 2. Nearly 50% of the sample is between 18 to 34 years of age and 35% belong to the age group 35-54 years of age (Table D-3 in Appendix D). Approximately 65% of the respondents possess "Bachelors", "Masters" or "Doctoral" degrees (Table D-4 in Appendix D). This is likely due to the presence of a large university in the city. As presented in Table D-5 in Appendix D, the majority of the respondents are employed either full-time or part-time. 55% of the respondents are full-time employees. Approximately 20% of the respondents are students, both working and non-working. There is a higher representation of middle-income group – 45% of the respondents have a household income of less than $50,000, as presented in Table D-6 of Appendix D. However, 17% of the sample did not disclose their household income.

Public Transportation Usage

Analysis of survey responses found that participants are regular users of the public transit system. 50% of the respondents utilize public transportation 5 or more times a week. Further, more than 70% of the respondents use the transit service at least twice a week; illustrated in Table E-1 in Appendix E. Merely 3.6% of the respondents did not use the transit service. Table E-2 in Appendix E illustrates that more than 70% of the respondents use the transit service for getting to work or school; but primarily for work commute.

Technology Usage

A large proportion of respondents are advanced users of computers with 80% using them for 10 or more years. In the case of Internet use, a little more than 80% have been using it between 6-15 years. These users however are regular users of the Internet with nearly 90% using it almost daily. These details are presented in Tables F-1, F-2 and F-3 in Appendix F. With such regular usage of the Internet and public transit, the expectation would be that these individuals plan trips on the Metro Transit website at a high frequency. This does not seem to be the case however. Merely 9.6% of the respondents indicate that they plan their trips 5 or more times in a week. A little more than 50% of the respondents plan their trips more than once a week. This discrepancy could also exist because the trips are for regular repeat commutes such as for work or school. Ordinarily, online planning for a trip occurs for a new or irregular route.

Respondents were asked in the survey about certain improved features that Metro Transit had recently introduced. These questions are presented in Section IV. The results are presented in the figure below.

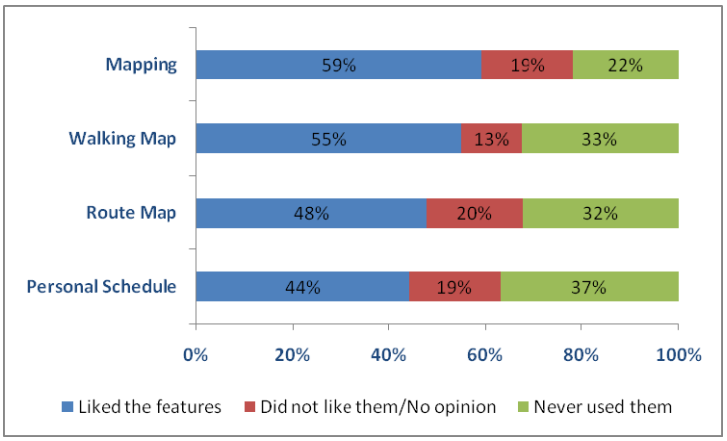

Figure 2.2: Responses to improved features

Most of the respondents have used the maps feature (78%) and have liked using these features (59%). In terms of the types of maps most appreciated, respondents indicated liking the "Walking Map" feature (55%) better than the "Route Map" (48%). 37% of the respondents have used another new feature called the "Personal Schedule". Of these, 44% liked the feature and nearly 20% indicated that they did not like this feature or had no opinion.

Inferential Statistical Analysis

This section details various inferences that can be drawn based on the data collected through the online survey. These inferences are classified under three distinct categories: scores for various constructs, correlations of these constructs with certain variables, and non-parametric tests.

Scores for the Constructs

Based on the trust research model described in Section IV, constructs were examined in isolation to understand citizen's expectations of a public transit agency based on determinants of trust building. As described in Figure 2.1, the factors that could explain the tendency for a citizen to trust online transit services is based on: 1) the degree to which citizens feel safe and secure when utilizing the website, including how safe they feel their personal information is, 2) the extent to which citizens associate the agency with honest and fair service delivery, 3) the ease and efficient usability aspects as provided by the website, 4) the impression citizens hold regarding the ability and competency of the transit agency, and 5) a citizens' intention to use the website in the future for transit planning based on their past and current experiences. The table below displays graphs of various constructs and the statistical means of those constructs. The details of the findings based on the sample of 446 collected through the online survey are found below in the Figure 2.3 below.

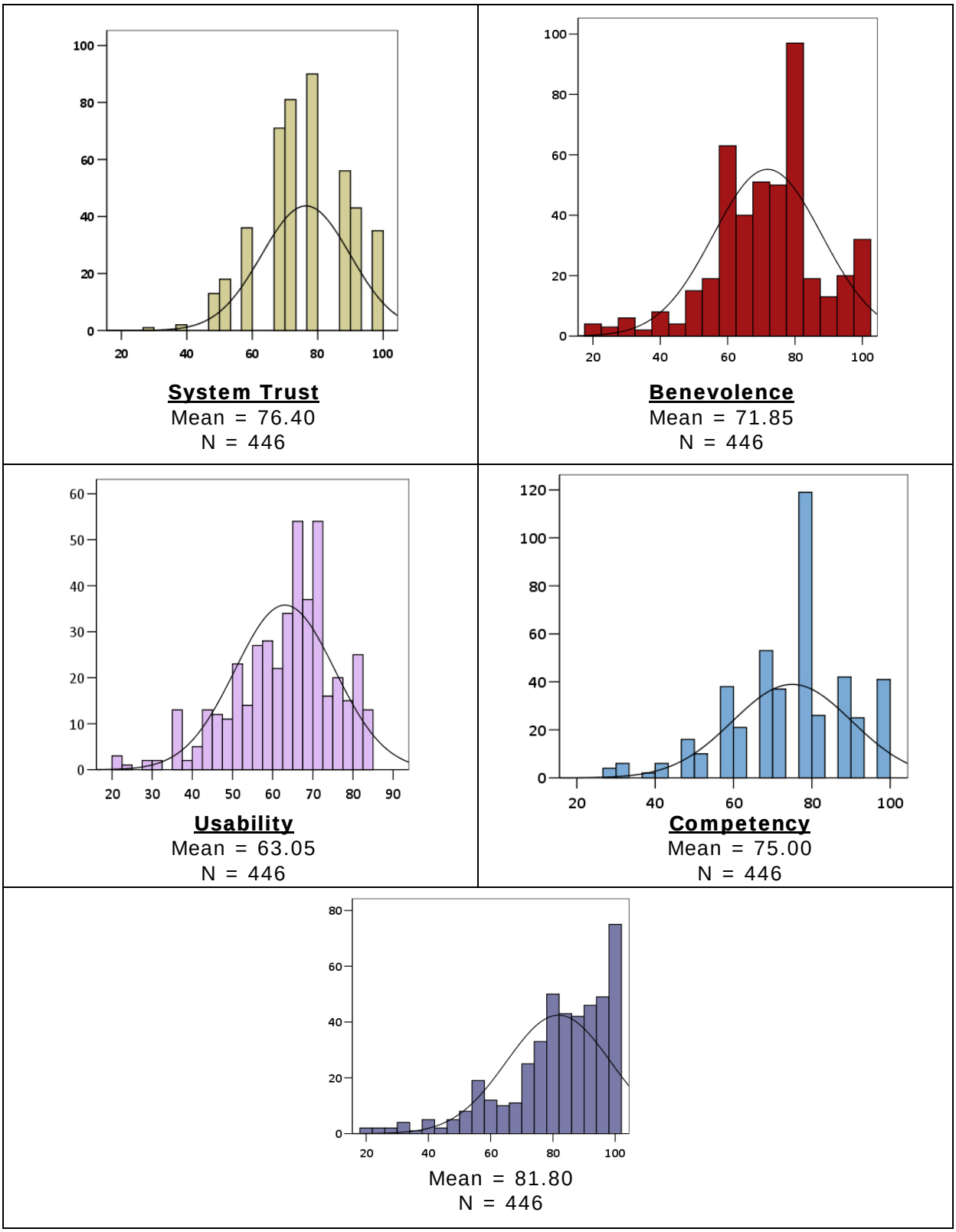

Figure 2.3: Trust factor scores

The vast majority of respondents indicated that they intended to utilize the website in the future ("intention to use"). The mean for this construct was obtained at 81.80 which indicate that users find information and facilities of getting transit related information through the website and would use the online transit agency's website in the future to get such information. The users of online transit website feel that the website is safe and secure to use ("system trust"). This is an encouraging indication as Metro Transit could introduce features related to customization or mass personalization without a high degree of customer fall off. Users would be willing to adopt these advanced offerings by providing their details, as they have a favorable opinion about security of the website. On a related construct of "competency", the users ranked the Metro Transit website fairly high (75.00). This is consistent with the ranking of "system trust" wherein the capabilities of Metro Transit in technological deliveries are rated favorably. These aspects indicate that users believe that the agency is capable of providing various advanced online features to enable advanced online trip planning activities. However, the users had more mixed perceptions of usability. They ranked this aspect lower than others (63.05). Similarly, users gave Metro Transit moderate rankings related to honest dealings and fair treatment. This aspect, however, is unrelated to the online offerings of the transit agency. "Benevolence" construct examines whether the agency keeps the best interests of the citizens in mind. Metro Transit was rated moderately here by participants. As will be discussed in the focus group findings below, such ratings might be due to certain external factors like behavior of drivers and facilities provided on the road or bus stops.

Correlation of Trust-related Factors

Of the five major constructs affecting trust, three constructs were found to correlate highly with certain measures that were utilized in the online survey. These three constructs include: "Benevolence", "Competency" and "Intention to Use". For this purpose, variables that explained the components of dependent constructs at more than 16% of variance were considered (i.e. correlation of more than 0.40).

The table below enumerates relationships between components of the "Benevolence" construct and specific aspects of the online survey. This construct examines whether the agency 1) fulfills its commitments, 2) keeps best interests of citizens in mind, 3) is trustworthy, and 4) is honest in its dealings. The correlations are presented in Table 2.2 below.

Table 2.2: Trust factors

Agency	Benevolence			
	Commitment	**Best Interests**	**Trustworthy**	**Honesty**
Provides satisfactory services	0.40	***0.41***	***0.41***	0.37
Provides safe and secured features	***0.43***	0.32	***0.45***	0.39
Delivers services competently	0.39	0.39	***0.43***	0.37
Gives an impression of being well-run	***0.51***	***0.50***	***0.49***	***0.47***
Has knowledge to deliver technological features	***0.51***	***0.45***	***0.41***	***0.42***
Users are confident in its ability	***0.60***	***0.57***	***0.56***	***0.54***
Delivers services efficiently	***0.50***	***0.50***	***0.54***	***0.47***
Has good reputation	***0.51***	***0.45***	***0.49***	***0.43***

"Competency" construct evaluates whether the agency 1) provides the ability to customize on its website, 2) delivers information competently, 3) gives an impression that the agency is well-run, 4) possesses knowledge to deliver online transit information, 5) instills confidence in the minds of the users, and 6) delivers its service efficiently. Table 2.3 below indicates the significant correlations of this construct with specific variables in the online survey.

Table 2.3 Competencies

Website	Competency					
	Customization	**Competent Delivery**	**Well-run Agency**	**Has Knowledge**	**Confidence**	**Efficient**
Is easy to use	0.40	***0.57***	***0.54***	0.34	0.39	***0.42***
Provides useful information	0.36	***0.55***	***0.48***	0.36	0.40	***0.43***
Supports learnability	0.33	***0.44***	0.38	0.28	0.34	0.33
Provides helpful features	***0.43***	***0.55***	***0.48***	0.33	0.40	***0.42***
Is consistently useful	***0.44***	***0.59***	***0.53***	0.38	***0.42***	***0.47***
Is appealing in its design	0.38	0.33	0.38	0.36	0.33	0.31
Is well integrated	0.40	***0.46***	***0.44***	0.37	0.36	***0.42***
Is worthy of recommending to peers/friends	0.38	***0.62***	***0.52***	0.38	***0.44***	***0.46***
Will be used in the future	0.32	***0.51***	***0.49***	0.31	0.37	0.36
Has satisfied transit needs in the past	***0.45***	***0.69***	***0.63***	***0.44***	***0.52***	***0.49***
Gives positive Impression	***0.42***	***0.66***	***0.56***	0.39	***0.44***	***0.49***
Reflects on reality	0.32	***0.51***	***0.43***	0.34	***0.46***	***0.42***
Has a good reputation	0.40	***0.49***	***0.51***	***0.45***	***0.53***	***0.51***

As shown in Table 2.4, the construct “Intention to use” measures whether a user 1) would plan their trips using the website (based on user experience related to website performance), 2) will use the website in the future and 3) has a positive impression about the website.

Table 2.4: Intention to use

Website	Intention to Use		
	Will Recommend	**Will Use Website in Future**	**Positive Impression**
Is easy to use	***0.62***	***0.50***	***0.68***
Provides useful information	***0.63***	***0.56***	***0.62***
Supports learnability	***0.53***	***0.44***	***0.55***
Provides helpful features	***0.63***	***0.59***	***0.68***
Is consistently useful	***0.61***	***0.49***	***0.65***
Is well-integrated	***0.55***	***0.44***	***0.56***

Non-Parametric Analysis

Subsequent to correlations in the trust-related constructs, non-parametric tests were conducted to detect differences in various variables based on demographics, technological maturity, and public transit usage. Table 2.5 below shows the significant differences that were found. Based on these differences, the following key insights were assimilated and are presented below:

1. Younger users (< 35 years of age) believe Metro Transit is honest in its dealings. Further, they think that their privacy is respected by the agency. They also indicate that they would use the website frequently and will use the online trip planner in the future. As expected, this group has also indicated that it is not best to avoid new technologies.
2. Highly literate individuals think that Metro Transit does not have knowledge and resources to provide advanced technologies to its users. Individuals in lower education levels think that it is best to avoid new technologies. However, they do realize the importance of facilities provided by the Metro Transit agency. Further, students are definitive about using Metro Transit facilities in the future.
3. Unemployed individuals think it is best to avoid new technologies. These individuals are mostly matured, elderly, and senior citizens.
4. People in the low income group have favorable opinions about Metro Transit and they avoid using new technologies.
5. Individuals with low computer usage have fewer propensities to trust new technologies. Advanced users of computers deem Metro Transit has good reputation
6. Advanced Internet users expect high levels of sophistication in terms of usability and advanced features. Further, respondents with high general use of the Internet tend to have a low-level of belief in the Metro Transit website. Respondents with high use of the Internet tend to have an unfavorable impression about the reputation of Metro Transit.
7. Respondents using transit for work did not find Metro Transit features to be well-integrated.
8. Transit users for Shopping/Medical trips indicated that they do have a positive impression about the Metro Transit website.

Table 2.5: Non-parametric variables

Questions		Age	Education	Employment	Student	Income	Computers	Internet	Transit Usage	Purpose of Transit	Website Freq.
USE1	Web site was easy to use.	0.793	0.780	0.645	0.311	**0.000**	0.694	0.092	0.066	0.653	0.166
USE2	Information on the website to be useful.	0.522	0.808	0.745	0.922	0.082	0.800	0.712	0.106	0.178	0.096
USE3	Learned to use the website very quickly.	0.162	0.675	0.123	0.467	**0.033**	0.202	0.863	0.104	0.301	0.266
USE4	Most people would learn to use this website.	0.140	0.221	0.982	0.554	**0.011**	0.800	0.092	**0.038**	0.496	0.070
USE5	Found helpful features on the website.	0.039	0.478	0.308	0.074	**0.013**	0.832	0.241	**0.018**	0.433	**0.034**
USE6	Consistently provided useful information.	0.305	0.244	0.730	0.155	**0.002**	0.859	0.125	0.120	0.743	0.200
USE7	Design of the website visually appealing.	0.695	0.782	0.500	0.683	0.580	0.752	0.107	0.595	0.640	0.776
USE8	Functions in this website were well integrated.	0.580	0.860	0.528	0.455	0.105	0.831	**0.045**	**0.021**	0.251	0.657
USE9	Access travel information when I wanted to.	0.966	0.499	0.876	0.892	0.003	0.876	0.675	0.748	0.985	0.943
BEN1	Metro Transit keeps its promises and commitments.	0.314	0.182	0.599	0.767	**0.016**	0.138	**0.049**	0.441	0.923	0.113
BEN2	Metro Transit keeps my best interests in mind.	0.464	0.200	0.134	0.870	0.198	0.181	0.422	0.153	0.505	0.339
BEN3	Metro Transit is trustworthy.	0.054	0.329	0.424	0.768	0.921	0.085	0.099	0.276	0.190	0.164
BEN4	Metro Transit is honest in its dealings with citizens.	**0.017**	0.202	0.418	0.267	0.163	0.984	**0.031**	0.221	0.663	0.263
COMP1	Metro Transit is willing to customize its website.	0.637	0.429	0.128	0.174	0.108	0.948	0.110	**0.039**	0.186	0.909
COMP2	Metro Transit is competent at providing information.	0.099	0.897	0.448	0.440	**0.004**	0.973	**0.014**	**0.025**	0.633	0.573
COMP3	Metro Transit is a well run agency.	0.101	0.337	0.768	0.194	**0.001**	0.652	**0.001**	0.103	0.189	0.516
COMP4	Metro Transit has the knowledge and resources.	0.810	**0.034**	0.601	0.318	**0.007**	0.464	**0.001**	0.995	0.498	0.645
COMP5	Full confidence in the ability of Metro Transit.	0.606	0.486	0.270	0.174	0.495	0.819	0.112	0.070	0.238	0.944
COMP6	Metro transit delivers transit information efficiently.	0.919	0.440	0.742	0.828	**0.032**	0.868	0.075	0.401	0.583	0.388
SYS1	Metro Transit provides a secure website.	0.248	0.428	0.571	0.187	0.868	0.186	0.163	0.326	0.600	**0.010**
SYS2	I have confidence that service will occur as portrayed.	0.150	0.755	0.658	0.222	0.581	0.878	0.558	0.580	0.950	0.853
SYS3	My privacy will be respected.	**0.024**	0.574	0.073	0.476	**0.026**	0.270	0.942	0.205	0.105	**0.008**
INTENT1	Would like to use this website frequently.	**0.001**	0.079	0.584	0.464	**0.016**	0.407	0.081	**0.000**	**0.005**	**0.000**
INTENT2	Would recommend the website to other people.	0.109	0.902	0.578	0.087	**0.005**	0.464	0.550	**0.009**	0.093	0.192
INTENT3	Will use the Metro Transit website for trip planning.	**0.001**	0.608	0.122	**0.011**	**0.002**	0.258	**0.048**	**0.000**	**0.001**	**0.000**
INTENT4	Trip planner has given me a positive impression.	0.271	0.703	0.748	0.151	**0.008**	0.967	0.134	**0.027**	0.419	0.393
INTENT5	I am satisfied with Metro Transit website.	0.451	0.670	0.638	0.254	**0.002**	0.597	**0.029**	**0.003**	0.117	0.297
PROP1	Best to avoid using new technologies.	**0.000**	**0.008**	**0.003**	0.078	**0.017**	**0.053**	**0.000**	0.925	0.094	0.524
REP1	Metro Transit has a good reputation.	0.150	**0.034**	0.880	**0.010**	0.087	**0.035**	**0.001**	**0.050**	0.199	0.108

Focus Group Discussions

The survey provided an interesting investigation into what perceptions individuals have about the online trip planner and the Minnesota Metro Transit services. The purpose of the focus group discussions was to gain more in-depth understanding about why individuals have the perceptions that they have. Focus group participants were individuals who answered the online survey. The online survey invited all respondents to participate in 1 of 2 focus group sessions at the Metro Transit building in Minneapolis, Minnesota. Of the 444 individuals that completed the survey, 155 volunteered to participate in focus group discussions. Each provided an email address for future contact. These individuals were subsequently sent an email inviting them to participate and each was offered a $30 gift card to Target™ stores for their participation. The first session included 11 participants while the second session included 13. The focus groups lasted approximately 90 minutes. Seven questions were asked along two overarching dimensions, 1) perceptions about the technical dimensions of the online service, and 2) the impacts that the technical service on perceptions of trust and confidence in the web site, the transit service, and the service provider (i.e., transit authority). These dimensions were in line with the following two study objectives:

i. To understand the citizen experience with public transit web sites including the current online planning features that they have used and what features they would like to see in the future.
ii. To understand how citizen use of a public transit web site affects citizen's trust and confidence in transit services and the public agency responsible for providing the services (i.e., transit authority).

The questions asked are as follows:

1. What do you like most about the Metro Transit "trip planner"?
2. What is your opinion of the new mapping and personal schedule features?
3. What improvements, if any, would you suggest for "trip planner"?
4. Are you confident that the trips you plan online will occur as scheduled?
5. Do you think that performance of the 'trip planner' reflects well on Metro Transit?
6. Do you think Metro Transit is a well run organization?
7. Do you think Metro Transit keeps your best interests in Mind?

The focus groups were digitally recorded and used together with written notes taken during the focus groups to derive and organize logical themes from participant responses. These themes are discussed below, organized by the two dimensions (i.e., technical benefits and challenges of the online trip planner; and perceptions about trust and confidence as they relate to the technical service) as discussed previously.

Technical Dimension Themes

Participants discussed the online trip planner features they use on a regular basis and their general satisfaction with those services. The consensus across the two focus group sessions was that the trip planner currently provides a high quality online service and that new features are both desired and expected in the future. One blind individual expressed his opinion about the online trip planner. He stated, "I pretty much use all the features. I

plan a trip. I use a screen reader cause I can't see the screen and it works quite well. I use the walking directions. I really like the new personal bus schedule so I can tweak and fine tune my trips." Another participant said, "I use the trip planner all the time. And I use it more for other people than for myself." There were many comments in support of the trip planner, how if functions, and the features that are offered to the public.

While participants discussed their satisfaction, they also noted several current functions that they felt should be improved in terms of the consistency of information, accuracy of information, and the display of information in the trip planner. One individual stated, "I know the system pretty well. I usually check the answers it [the trip planner] gives me because it doesn't always give me the best schedule. I check the system map to check on the answers it gives me because sometimes I know of a better route or bus stop than the system is telling me." Several others confirmed that they must use their own intuition and experience to compensate for the trip planner's inability to always provide optimal travel information.

Future improvements desired by participants included more real-time information and intelligence on mobile devices and onboard buses and trains, integrating real-time information (e.g., bus delays, detours) into the trip planner and its mapping features, and more personalization of the planning features and notifications. In regards to real-time information integration with the trip planner, one participant stated, "Alerts [bus detours, delays] should be integrated into the trip planner." Another participant provided more detail: "I would really like to see at some point on the website, integrated with the trip planner and scheduling, real-time accounts of where buses and trains are when you're planning your trip." Another individual described their desire to integrate the trip planner with other modes of transportation. She stated, "I have to go to a bike map to find the bike route. The more I can try to mix my bike and transit use the more I would like to see not only a walking map but where bike routes are. Cause there's no way I want to be on the big streets with the cars." These sentiments were stated and confirmed across both focus group sessions and among several participants.

The desire for real-time information was not only discussed as an important function of the current trip planner on a home computer, but also as an important future improvement to be used with mobile devices and on board buses. For example, one individual explained, "It would be really nice to be informed while I'm riding the bus. If my bus takes a detour from its normal route I wonder what's going on. I want to know what's going on when I'm on the bus." Another individual alluded to the need for a mapping system coupled with a voice activated system on board a bus to announce situational status. He stated, "The biggest problem as a blind person is its annoying to not have intersections 'called out' by the driver." Several others agreed, with one saying, "Devices that give voice prompts are good for me too."

Speaking through an interpreter, one blind, deaf, and crippled participant stated, "I use a device called a 'sidekick' [a wireless mobile computer for the deaf] but it doesn't work with the trip planner. I think the mapping feature on the site works good. But presently

the trip planner doesn't work on my sidekick. So that would be nice. My mobile needs are more important."

Several other participants discussed their desire for greater personalization and intelligence about their individual routes. For example, one participant said, "Take what you have and personalize it. Give us the memory of our location and past trips. Maybe a monthly email about route changes that relate to my route." Several others described their desire to receive text messages about their route if their bus is running late or early.

Several participants discussed their desire for greater system intelligence about the transit service. One participant drew a comparison to the airline industry. She stated, "It would be nice to know the reliability of certain routes [be]cause I know that certain routes run behind other routes. When you're buying a plane ticket now you can see how often that flight is on time." Another discussed how the trip planner only displays the closest bus or train station to an address, but that she would like to see other stations that are nearby as well for a greater number of choices. She stated, "I would like to put in my address and see what buses go by that address and how far away. And you know be able to show the bus routes even if it's a mile away."

While participants discussed the need for mobile applications, on board information, greater system intelligence, and the desire for greater personalization of information, all agreed that the trip planner had provided a strong basis to build upon and believed that Metro Transit would continue to build advanced functionality within an acceptable time frame. Taken together, the participants discussed their satisfaction with the current trip planner while presenting the challenges experienced and desired improvements. Desired improvements included a greater level of situational intelligence about transit services delivered in real-time and integrated with other related travel information; presented visually (and verbally) through mobile and on-board devices to support individual personalization.

Trust and Confidence Themes

The focus group discussions moved from discussing perceptions about the online trip planner into the perceptions about how using the trip planner translates into trust and confidence in the transit services provided and the agency providing the services. Prominent themes are discussed below. These themes were targeted and focused on a few key issues.

In general, participants discussed a high degree of trust and confidence in the Metro Transit services compared with other public transportation systems. For example, one participant stated, "[the service is]…much better than St. Louis or Manhattan." Another said, "I actually moved to Minneapolis because of the Transit system." Similarly, another stated, "Metro Transit is the best I have ridden. In general, its on time. Schedules are logical. I've ridden a lot of different bus services. Its really a well run organization." While participants described common challenges experienced in many transit systems, they also expressed Metro Transit's efforts to improve. One individual believed Metro

Transit had improved its reputation over several years. He stated, "I've used the transit system since 1964. They have slowly climbed out of the 'bad rap' hole when deficits were bad and the service seemed to be a least common denominator service."

Participants also discussed their feeling that the online trip planner has improved their perceptions about Metro Transit. One stated, "I think it [online trip planner] shows they're really trying when you're on the web site. They're trying to figure out a way to help you get to where you're going." Another stated, "The fact that they offer the web site makes me think that Metro Transit wants me to use their service, wants me to [pause] I think it reflects very well on Metro Transit." Participants believed that other factors, other than the web site, negatively impacted their confidence and trust in Metro Transit. One participant explained, "The system [trip planner] is easy to use and works well for me. I think that when the bus driver misses a turn or goes on a different route than he's supposed to, that impacts more of my confidence than the web site."

While participants across focus groups agreed that the web site and online trip planner demonstrated Metro Transit's genuine concern for the traveling public, most also expressed concerns about the actual, physical, transit service. As one participant described, "There's two different identities going on there. The site really shows that Metro Transit is trying. Well I think that the web site people are trying. Not the bus drivers." Several participants described personal experiences to relate their dissatisfaction with bus driver behavior and attitudes, bus and bust stop cleanliness, and discipline onboard buses. For example, one participant stated, "I think the bigger problem is the bus drivers…I'm surprised that the drivers don't seem to know the routes that they drive or even the names of the streets that they cross." Another expressed, "Some of them [bus drivers] can be very temperamental…some of them really just take off on you before you get to the bus." Another summarized, "I would concur with others that…bus drivers, bus cleanliness, bus driver decisions, customer service, friendliness are bigger issues."

In sum, participants agreed that while the web site served to improve their perceptions of trust and confidence in Metro Transit, bus driver behaviors, customer service, and bus and bus stop cleanliness caused negative perceptions of trust and confidence.
Participants described a trust gap - or a dual perception of trust in Metro transit. On the one hand, the web site provides a good public service and increases trust. On the other hand, the physical transit service can be frustrating and decrease confidence and trust.
Interestingly, some discussion took place that alluded to the potential for web based to help overcome the bus driver problems and consequently improve customer perceptions. For example, real time positioning of buses to allow customers to see if a driver is early or late. This would also allow for monitoring the performance of drivers, if done within the context of traffic and weather conditions. Mobile web based applications could also enable quick reporting of bus driver problems, bus stop cleanliness, and related issues. Finally, on-board visual and verbal systems that provide situational awareness (i.e., current location on a map, next bus stop, etc…) to customers could provide a level of customer service not provided by some drivers – acting as a proxy customer service agent. These suggestions and inferences were made and discussed while understanding that costs would prohibit timely implementation.

Conclusions

As stated at the outset, electronic systems are increasingly allowing online interaction between public agencies and the traveling public. Understanding the impacts of this exchange of information allows for a focused design and development effort and a method for constructing a concerted citizen centered online strategy. As such, this study has sought to understand how citizen perceptions of trust and confidence in an agency, and its services, are impacted by the use of an online trip planner. As the survey and focus group findings indicate, there are clear relationships in that demonstrate connections between online use and perceptions about the agency. Notably, there is a strong positive view of the trip planner and this is associated with trust in the agency to perform the service as well as generally positive responses to new features. Moreover, certain user groups strongly believe that Metro Transit is honest and trustworthy. These groups include those who are under 35 years of age, students, and advanced computer users. For example, many of these individuals feel that their privacy is respected by the agency and have indicated that they use the website frequently and will continue to use the online trip planner in the future. However, not all groups of individuals have such a positive impression. There are indications that show that highly literate individuals and extensive users of the Internet believe Metro Transit does not have knowledge and resources to provide advanced information services, and have unfavorable impressions about the reputation of Metro Transit, respectively. Unemployed, elderly, and low income individuals were also more hesitant, indicating a preference to avoid new technologies. Thus, it is worth considering if the needs of these groups should be better understood when thinking of future improvements. The focus group discussions provided valuable context demonstrating the hybrid nature of trust in a public organization that provides an online service. On the one hand, participants felt the web site functioned well and stood as a symbol of Metro Transit's good will towards citizens. On the other hand, the selected negative experiences described by participants, including bus driver behavior and attitudes, customer service functions, and bus and bus stop cleanliness, negatively impacted participant perceptions of trust and confidence in the organization. The potential for utilizing additional web based, mobile, and on-board technologies could help mitigate some of these service concerns. Taken together, this study provides support for the notion that public agencies can impact citizen perceptions by implementing quality, well designed, online e-government applications. For this study, an online transit trip planner, appreciated by citizens, provided a means for improving perceptions of trust and confidence, potentially mitigating against other frustrating aspects common among transit systems.

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Appendix A:

Carsharing Survey Respondents

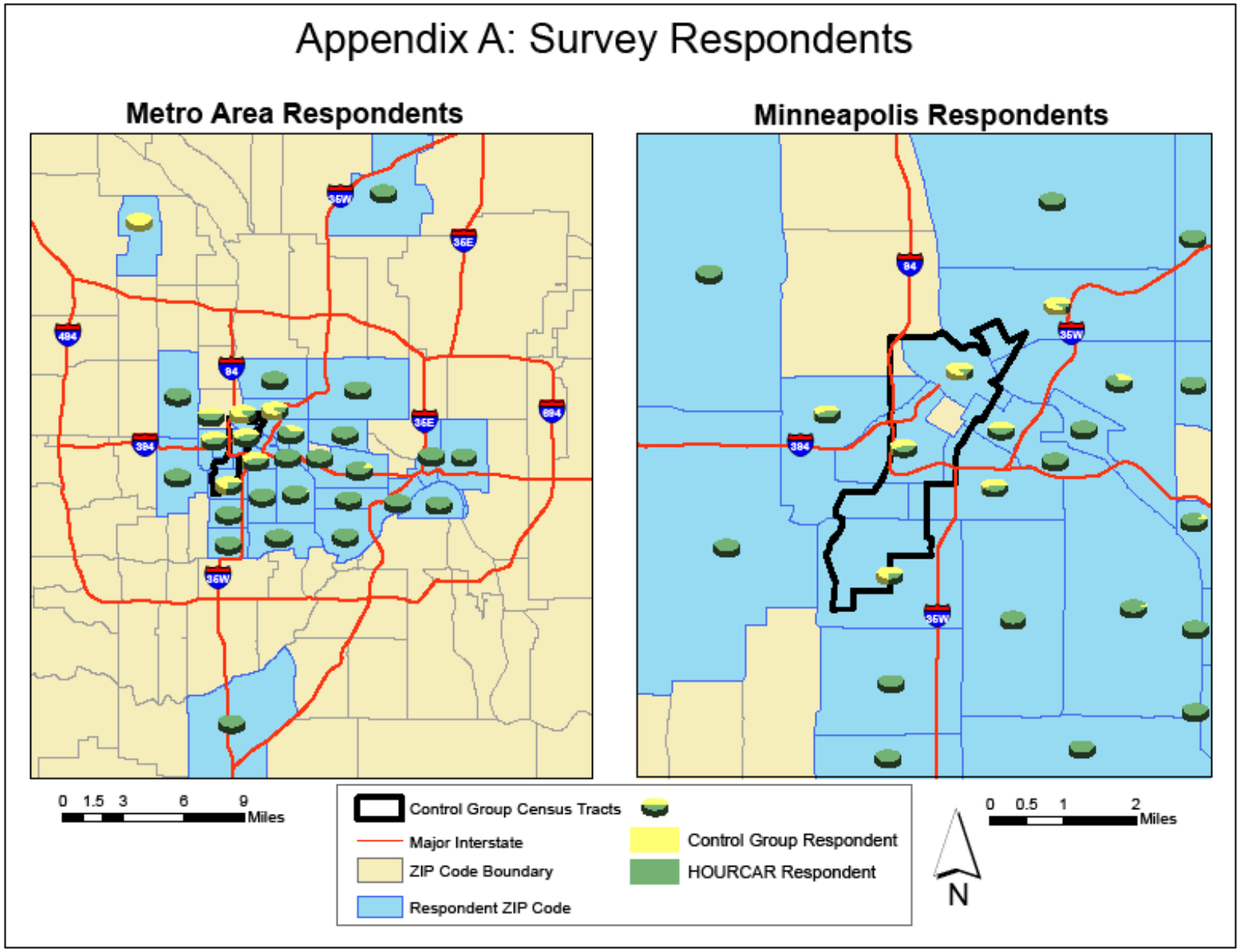

Figure A-1: Survey respondents

Appendix B:

Carsharing Travel Log

TRAVEL LOG

Step 1: To complete your travel log (page 2 below), record information about ALL trips you made **yesterday between 6:00 a.m. and 9:00 p.m**., including trips made by motorized vehicle, carshare vehicle (Zipcar or HOURCAR), foot or bicycle. **A trip is defined as one-way travel between two distinct and separate destinations. For example, going from home to the grocery store, then to work, and then home again counts as three trips. On the other hand, going from your office at work to the office of a colleague on another floor of the same building should NOT count as a trip.**

Step 2: Please return this completed travel log to the State and Local Policy Program via **e-mail** (gaugx001@umn.edu), **mail** (Attn: Frank Douma, 301 19th Ave. S., Minneapolis, MN 55455) or **fax** (Attn: Frank Douma, 612.626.9833) by October 8th, 2007. If you have any questions regarding the travel log or this survey call Frank Douma (Lead Researcher) at 612-626-9946 or Ryan Gaug (Research Assistant) at 612-626-9861.

Please record information about **ALL** trips you made yesterday. If yesterday was a Saturday or Sunday, please consider last Friday yesterday:

☐ Monday ☐ Tuesday ☐ Wednesday ☐ Thursday ☐ Friday October , 2007

Please re-enter your password here:

	Time of Departure (00:00 am/pm)	**Duration** (hours, minutes)	**Origin**	**Destination**	**Mode** (personal vehicle, carshare vehicle (Zipcar or HOURCAR), foot, bus, train, bike, etc.)
1	am				
2	am				
3	am				
4	am				
5	am				
6	am				
7	am				
8	am				
9	am				
10	am				
11	am				
12	am				
13	am				
14	am				
15	am				
16	am				
17	am				
18	am				
19	am				

Appendix C:

Hennepin County Census Tracts with HOURCAR Hubs

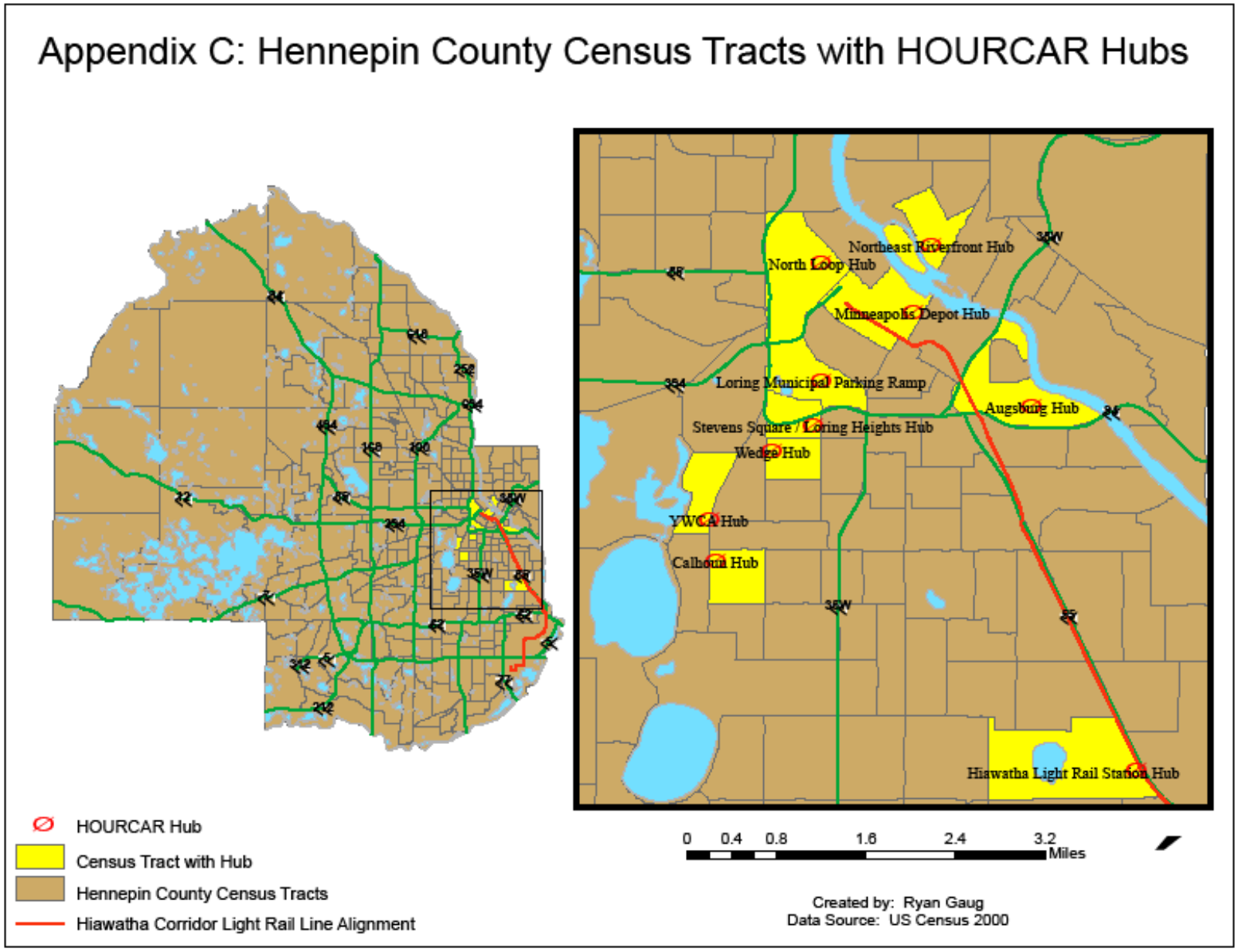

Figure C-1: Hennepin County census tracts with HOURCAR hubs

Appendix D:

Demographics from ATIS Survey

Table D-1: Gender

	N (Sample)	Percent
Female	258	57.9
Male	174	39.0
Did not disclose	14	3.1
Total	**446**	**100**

Table D-2: Age group

	N (Sample)	Percent
18-24 years	103	23.1
25-34 years	141	31.6
35-44 years	69	15.5
45-54 years	80	17.9
55-64 years	37	8.3
65 and above	6	1.3
Did not disclose	10	2.2
Total	**446**	**100**

Table D-3: Ethnicity

	N (Sample)	Percent
Black	22	4.9
Asian	16	3.6
Native American	4	0.9
Hispanic	6	1.3
White/Caucasian	340	76.2
Other	39	8.7
Did not disclose	17	3.8
Total	**446**	**100**

Table D-4: Education level

	N (Sample)	Percent
High School	71	15.9
Associate	54	12.1
Bachelors	182	40.8
Masters	82	18.4
Doctoral	22	4.9
Other	18	4.0
Did not disclose	17	3.8
Total	**446**	**100**

Table D-5: Occupation

	N (Sample)	Percent
Employed Full-Time	247	55.4
Employed Part-Time	35	7.8
Unemployed	27	6.1
Student (Working)	54	12.1
Student (Non-Working)	34	7.6
Homemaker	18	4.0
Retired	16	3.6
Did not disclose	15	3.4
Total	**446**	**100**

Table D-6: Household income

	N (Sample)	Percent
Less than 25,000	99	22.2
25,000 – 49,999	105	23.5
50,000 – 74,999	66	14.8
75,000 – 99,999	50	11.2
1,00,000 – 1,49,999	38	8.5
1,50,000 and above	12	2.7
Did not disclose	76	17.0
Total	**446**	**100**

Appendix E:

Public Transportation Usage

Table E-1: Frequency of using public transit

	N (Sample)	Percent
5 or more times a week	220	49.3
2-4 times a week	98	22.0
Less than once a week	29	6.5
1-3 times a month	32	7.2
Less than once a month	51	11.4
Don't use	16	3.6
Total	**446**	**100**

Table E-2: Purpose of using public transit

	N (Sample)	Percent
Work	233	52.2
School	72	16.1
Shopping	23	5.2
Medical	17	3.8
Recreation	32	7.2
Visit friends/family	6	1.3
Vacation	8	1.8
Other	12	2.7
Do not use	43	9.6
Total	**446**	**100**

Appendix F:

Technology Usage

Table F-1: Years of experience in using computer

No. of years	N (Sample)	Percent
1-5 years	15	3.4
6-10 years	81	18.2
11-15 years	113	25.3
16-20 years	136	30.5
20 and above	101	22.6
Total	446	100

Table F-2: Years of experience in using Internet

No. of years	N (Sample)	Percent
1-5 years	25	5.6
6-10 years	197	44.2
11-15 years	181	40.6
16-20 years	37	8.3
20 and above	6	1.3
Total	446	100

Table F-3: Frequency of using Internet

	N (Sample)	Percent
1-2 times a week	5	1.1
3-5 times a week	48	10.8
6-7 times a week	393	88.1
Total	446	100

Table F-4: Frequency of planning trips using Metro Transit Web site

Frequency of planning	N (Sample)	Percent
5 or more times a week	43	9.6
2-4 times a week	120	26.9
Once per week	71	15.9
1-3 times a month	121	27.1
Less than once a month	91	20.4
Total	446	100

Appendix G:

Trust Literature Review

Trusting an entity or an individual denotes belief in them in conducting certain action or set of actions in a particular context - a tripartite relationship [18]. The concept of trust has, often, been associated with behavioral nominations such as cooperation, confidence, commitment and belief. In fact, trust has been found to be a holding word for a variety of phenomena [19]. Described as “the chicken soup of the social sciences” [20], trust is considered to bind individuals or organizations in ensuring that the parties are willing to participate in a specific information, service or tangible deliverable exchange. Fostering of trust has been recommended wherein relationships between individuals bind institutions. Attempts at deriving better models of relationships involving trust and its variants have been explored in organizational settings [21, 22], for cooperative behavior and collective action [23, 24], for government policies and regulation [25-27] as well as social capital [28-30]. However, composition of and elements defining trust abound. It is important to differentiate these elements to form a holistic view of the dimensions underlying trust. Trust involves individuals evaluating personal interests due to certain goals to be attained in the future or benefits that were obtained in the past. Fundamental view in trust relationships assumes that rationality is embedded when truster and trusted perform their actions on being fully aware of the results of their actions [31, 32]. There are alternative views of trust that identify absence of mutual awareness – Cournot Theory [33]. In addition to this awareness, the truster and trusted would want to honor the expectations to maintain relationship in the future. As indicated by Hardin, trust embodies encapsulated interest [34].

In an “encapsulated-interest” view, trust is a tripartite behavior – a rational individual is expected to trust an institution or another person in a given context. “Bald” disposition of trust, like Abraham had on his god, by an individual toward others is denominated as open-ended trust [34]. An extension of this type is called generalized or social trust [32], wherein trust is imparted on a random individual or a social institution with no consideration to the context or any limitation to the degree. Generalized trust or moralistic trust is the belief that most people can be trusted, which, in turn is affected by moral orientations of the individuals [20, 37]. Trust within a group between individuals who share interests and respective views is termed as particularized trust [20, 36]. Trust toward other individuals based on the knowledge of their abilities is termed as strategic trust [15, 20, and 38] – which is the second element of the trust in this view. Finally, acting on trust involves taking a risk [34]. Trust toward public institutions, which is the focus of this study, includes these three elements. Reassurances about this composition can be found in the past research. Fenno [39] and Bianco [40] reflect on the need of constituents to focus on harnessing relationships with citizens in order to promote trustworthiness. Uslaner [20], while differentiating various trust, indicate the applicability of strategic trust in citizen interaction with institutions. Braithwaite extends this view and presents theoretical perspectives on trust norms [41]. These perspectives prescribe differing operationalization of trust dimensions for various types of public institutions – elaborated in Chapter 4.

In trusting government or public institutions, citizens tend to associate with performance-related aspects such as confidence, belief in the abilities as well as knowledge and transparency about the workings. Such alternative connotations have sometime been

found more important than the trust itself. Extending them leads to examination of service delivery provided by such institutions. As Hardin points out that trust in government requires examination of two arguments – account of trustworthiness and knowledge citizens have regarding government [34]. In the domain of e-Government, National Performance Review has clearly alluded to the promise of better service delivery at lower cost to the taxpayer [42]. Digital initiatives by government are being taken to alter the citizen's view of assuming government as a barrier to efficient transactional exchange of public service. The long-term hope is for a revolution not just in terms of service delivery but a fundamental shift in how citizens feel about government [12].