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Applications of Carsharing in Small Cities in the United States: A Framework for Implementation and Analysis

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APPLICATIONS OF CARSHARING IN SMALL CITIES IN THE UNITED STATES:

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ABSTRACT

Carsharing is an exciting and new alternative transportation mode that is gaining popularity throughout the United States and the world. It allows member of the program to have access to a car without owning one. Carsharing is becoming increasingly popular because it ties directly into the transit system by providing an alternative to car ownership for trips that cannot be made easily using mass transit.

In general, carsharing in the United States has been implemented in large cities in the United States such as San Francisco, New York, Chicago, and Washington DC, among others. Much of the current research regarding carsharing in the United States focuses on analyzing and supporting these large programs. Few attempts have been made to introduce carsharing in smaller cities; however, as carsharing continues to grow in popularity more and more small cities will be interested its implementation.

Small cities are defined in this thesis as cities with populations between 50,000 and 150,000. These cities present unique situations for carsharing due to their limited transit networks, lower population densities, and varied demographics. An analysis of US carsharing organizations, with a focus on small city programs, will be conducted in this thesis and will provide both the basis for an implementation framework and the steps for program analysis.

Various studies have been conducted on carsharing in the United States, but only a few have tried to quantify the relationship between characteristics of a city,

in terms of form and function, and the size and scope of a carsharing program. Census data will be analyzed in a regression analysis in attempt to determine relationships between the membership size of a carsharing program and the demographic, social, and economic characteristics of a city and the size of the carsharing program in terms of membership.

In addition to census data, an examination of Boulder CarShare, a small-city program, will provide an insight into the characteristics of a program in a small city regarding placement of vehicles, membership base, and operational strategies. Combining a member survey, an analysis of vehicle use and location, and a regression analysis will help to develop an implementation strategy for small city start-up carsharing organizations.

Small city local governments, grassroots efforts, and transit agencies can use these analyses and recommendations to help guide their own implementation efforts. The analyses and recommendations will present a series of steps that will enable start-up carsharing organizations to reach their full potential.

Chapter 1

METROPOLIS: A TRANSPORTATION NIGHTMARE

Congestion, traffic accidents, air pollution. These are all words commonly associated with transportation in metropolitan areas all across the United States. Most major metropolitan areas have a mass transit system, but despite increases in mass transit spending, there is a growing demand for single-occupant vehicle trips. Metropolitan areas are constantly trying to develop new and innovative ways to remove people from their cars and increase the use of alternative modes of transportation.

Mass transit systems are often thought of as the solution to traffic problems and air pollution in metropolitan areas. However, these systems can never be the entire solution to the transportation problems within a metropolitan area. Mass transit systems work best in metropolitan areas because there are a large number of people trying to get in the same general direction at the same times everyday. In addition the success of a mass transit system is based on its ability to provide certain benefits that can outweigh the perceived benefits of driving a car.

While mass transit is perceived as a solution to many transportation problems, it is not always the most appropriate or most convenient mode of transportation for every type of trip. Most mass transit is schedule-based and that schedule is typically centered on peak travel times in order to serve those who need to travel to and from work. Most mass transit systems are not convenient for trips made off peak, or to non-centralized locations. For example, a evening shopping trip can be

a difficult endeavor for people in many metropolitan areas that do not have access to a vehicle. Sometimes people that rely on mass transit need another mode of transportation for those more difficult trips.

Carsharing can offer a solution that will help to improve transportation while supplementing the transit system and allowing people to move around more freely.

1.1 Introduction to Carsharing

Carsharing offers a potential solution for congestion and offers users the freedom of a personal vehicle without the hassle of owning one. Carsharing allows individuals in a metropolitan area to access a fleet of vehicles that are strategically placed in locations throughout a city. Members access vehicles by reserving their use over the phone or online, and are charged a fee based on their use (Millard-Ball et al., 2005).

Carsharing provides individuals, who do not need a car all the time, with an opportunity to share with others in their area which distributes the expenses of owning a car over a larger group. Carsharing also provides businesses with an opportunity to supplement existing fleets, or to provide their employees with transportation for business travel (Shaheen, Cohen, & Roberts, 2005). Cities enact carsharing programs in order to reduce congestion and pollution and encourage mass transit use.

Private vehicle ownership is costly. Insurance, loan payments, gas, maintenance, and parking are all costs that an individual car owner must pay. Carsharing offers the opportunity to reduce individual and social costs of owning a private vehicle. A carsharing program typically covers all vehicle costs, and the users

pay a small fee that is based on their actual vehicle use. User costs are extremely low because the cost of the vehicle is redistributed over a larger member base.

Despite worsening traffic congestion, there is substantial opposition to transportation policies that involve financial or lifestyle sacrifices. Carsharing is similar to mass transit in that it offers benefits such as reduced congestion and improved air quality, but unlike mass transit, it does not require as many lifestyle sacrifices. Some of the benefits specific to carsharing include (Shaheen, Cohen, & Roberts, 2005):

- An average 44% reduction in vehicle miles traveled per person.
- Every carshare car on the road eliminates between 7 and 20 personal vehicles.
- Each member of a carshare program saves, on average, 100 gallons of gas per year.

In addition to the above benefits, carsharing forces a user to consider use of mass transit first and then consider carsharing as a secondary alternative. Carsharing is typically a pay-as-you-go program which causes the user to evaluate the need for paying for private transportation if public transportation is available for that trip. Carsharing is designed for short trips that occur only a few times a week, so it is necessary for the user to plan their trips more efficiently and try to combine all necessary trips into one larger trip so that multiple fees can be avoided.

1.2 Problem Statement

Recently, smaller metropolitan areas have started, or have looked in to starting, their own carshare programs. Small metropolitan areas experience unique challenges when trying to implement a carshare program because they do not have the same high density mixed-use developments, or comprehensive mass transit systems that make carshare programs in larger cities so successful. For the purposes of this study, a small metropolitan area is defined as having a population of 50,000 to 150,000, with a well-defined central business district with a sizeable employment base.

Because of the uniqueness of smaller metropolitan areas, the challenges that they present, and the difficulty in determining demand, many of the large growth-oriented organizations have been reluctant to start operations in these cities. This forces the cities to look internally to start carshare programs which can be a difficult and costly task.

Small metropolitan areas are not assisted by most of the current carshare research because it focuses on programs, problems, and technologies associated with carshare programs in the large metropolitan areas. In addition, most of the carshare research today is still very theoretical with little quantitative analysis, and has limited applicability to the unique situations that small cities present. More quantitative research is necessary in order to assist new organization formation in small metropolitan areas.

The problem with the current research in carsharing is that there is little information regarding small city applications in the United States, and their small city programs have little guidance in the implementation of a small scale carsharing program in terms of implementation framework, and program analysis.

1.3 Scope

This project will examine carshare programs in the United States only. Carshare programs in Canada and Europe will not be considered because of the differences in city form and function. (Cities in Canada and Europe are characterized by extensive public transit networks, and very low auto ownership rates). This study will consist of an in-depth literature review of carsharing in the United States, as well as a quantitative regression analysis of cities with carshare programs. This study will examine social, economic, and transportation characteristics of many of the cities with current carshare programs and relate them to the number of members.

1.4 Methodology

This research will consist of four parts: a literature review, a quantitative regression analysis, a carshare member survey and market analysis, and a case study. The literature review will examine research regarding carsharing in the United States with a focus on how it has been applied in smaller metropolitan areas. The literature review will also examine trends in carsharing, new markets, and characteristics of successful carsharing programs. The literature review will aid in the development of an implementation framework for mid-sized metropolitan areas.

The regression analysis is the cornerstone to this study. The regression analysis will attempt to identify important factors that affect how successful a carsharing organization will be. It will relate characteristics of a city and its people to how many members a carsharing organization might have. The census website along with the websites of existing carsharing organizations will provide the basis for the regression analysis.

The data on 30 cities and their programs will be collected for the regression analysis. The data will include large cities as well as smaller cities with carshare programs. The data will be randomly separated into a working group and a test group. The Statistical Analysis System (SAS) package will be used to complete the regression analysis. The working group will be used to create the regression formula, and the test group will be used to test the regression formula on existing data.

Boulder CarShare, a small carsharing organization in a small metropolitan area will be extensively examined in order to try to pull out unique characteristics of small city carsharing programs. A survey will be conducted on Boulder CarShare members in order to analyze the specific travel patterns of members belonging to a carshare program in a small metropolitan area. This data will provide the basis for comparison with similar studies in which larger carshare organizations were surveyed, as well as provide the basis for a market analysis for carsharing in small cities.

Finally, the case study will demonstrate the application of the framework that was developed by combining information from the literature review and from the regression analysis.

Chapter 2

CARSHARING YESTERDAY AND TODAY

The purpose of this chapter is to examine research conducted on carsharing programs, implementation strategies, trends in carsharing growth, and a history of carsharing around the world. This section will provide the basis for the analyses conducted in the following chapters as well as some of the basis for the recommendations that will be presented in the final chapters.

2.1 Carsharing Terminology

Carsharing is a unique program, first considered in the 1970's, that has many different applications and formats. It has developed in Europe, Asia, and North America in various forms, from the typical neighborhood model (often refereed to as neighborhood carsharing), to station car programs that provide connections between transit stations and employment centers, to complex-based carsharing (typically used in Universities) which provide transportation around a contained area.

In addition to the various methods of implementing carsharing, the programs can also have various business models. The most common business models for carsharing programs are for-profit, non-profit, and cooperative. Large carshare organization such as Zipcar and Flexcar are examples of for-profit models. While there are some for-profits in smaller cities, these companies typically run programs in large cities where the opportunity for a large membership exists. Non-profits tend to

be found in small to mid-sized metropolitan areas, although there are some, like Philly carshare, that are located in large cities.

While there are various methods for implementing carsharing, the core of all programs are similar. Every carshare organization is an organized group of participants that share one or more vehicles that are spread throughout an area and located close to homes, businesses, and transit stations (Millard-Ball et al, 2005). In addition users reserve vehicles ahead of time either over the phone, or online, and can access the vehicles at their scheduled times themselves.

To some, carsharing sounds a lot like a car rental program. In essence that is exactly what carsharing is. Members of a carshare program reserve the vehicles ahead of time, similar to a rental car agency, and pay a fee for the amount of time they use the vehicles and the mileage it is driven. However, unlike car rental companies which have centrally located vehicles, carsharing programs locate vehicles throughout a metropolitan area which increases the convenience of the program. In addition, carsharing vehicles are typically reserved for small amounts of time (a few hours or less).

Terminology may be the most critical piece of the definition of carsharing. When asked for a definition of the word "carsharing," many people are likely confuse it with carpooling. Carpooling is a method of sharing a private vehicle with other individuals for a particular trip (Millard Ball et al, 2005). Members share time within a vehicles, but do not share the vehicles itself. Carsharing is method of sharing vehicles that are owned by a separate organization. Members of a carsharing program share the vehicles, but do not share time within the vehicles.

There is also some international discrepancy in the terminology of carsharing between North America and Europe. In the United Kingdom and much of Europe, carsharing is referred to as Car Clubs, and carpooling is referred to as carsharing (Millard Ball et al, 2005). Other terms for carsharing include "car co-op", or "shared-use" vehicles. In addition, carpooling is also referred to as ride-sharing in some areas.

Most studies have been reluctant to give a definition for carsharing, instead providing a description of carsharing (Millard-Ball et al, 2005). However, for the purposes of this study carsharing will be defined as a program in which members share the use of one or more vehicles by reserving a vehicle ahead of time and paying a fee for its use.

2.2 History of Carsharing

The concept of carsharing was first considered in the 1970's when changing global pressures, the 1972 UN Conference on the Human Environment, and the oil crisis of 1973-74 pushed the transportation community to look to an innovative transit program (Shaheen, Cohen, & Roberts, 2005). The transportation community looked to a program that could offer an alternative to private vehicles ownership, but still offered the flexibility and convenience of a privately owned vehicle. Carsharing was first developed in Europe because of the density of transit access, high car costs, and low car ownership levels (Commonwealth of Australia, 2004).

2.2.1 Carsharing in Europe

The first attempt at carsharing, "Procotip," opened in Montpelier, France in 1971 (Millard-Ball et al, 2005). Witkar, Amsterdam followed with a program in

1973. Britain followed suit by launching "Green Cars" in the late 1970s, and Sweden launched a program in 1983 (Millard Ball et al, 2005). While there was interest in carsharing in the 1970's it wouldn't be until the late 1980s that the first commercially successful program would begin in Switzerland and Germany (Commonwealth of Australia, 2004).

In Switzerland, two grassroots organizations began providing carsharing services in 1987 and quickly achieved a growth rate of 50% per year, and in 1997 these two organizations merge to form "Mobility Car Sharing Switzerland" (Commonwealth of Australia, 2004). At the time they combined to form an organization with 11,000 members and a fleet of 600 vehicles. Today it is the biggest organization in the world with over 50,000 members and a fleet of 1750 vehicles, and serves more than 400 towns across Switzerland (Commonwealth of Australia, 2004).

Germany's first carsharing organization, StatAuto, was founded in 1988 in Berlin and Hamburg (Commonwealth of Australia, 2004). Similar to the organizations in Switzerland, StatAuto of Berlin and StatAuto of Hamburg merged to form StatAuto Car Sharing Aktiengesellschaft (Commonwealth of Australia, 2004). StatAuto Aktiengesellschaft was the first carsharing organization to be listed in the stock exchange.

Austria and the Netherlands followed Switzerland and Germany in the early 1990s, but on a much smaller scale (Commonwealth of Australia, 2004). Italy Belgium, Great Britain, Scandanavia, and Spain followed suit in the mid 1990s. European Car Sharing, founded in 1991, by a group of carsharing organizations such as Mobility Carshare of Switzerland, is a pan-European organization with goals to

standardize carsharing operations across the continent (Commonwealth of Australia, 2004).

The European Car Sharing organization is the first of its kind in the world, and offers a variety of services and funding for new start up carsharing organizations. Mobility of Switzerland, one of the founding members of the organization, provides most of the assistance to new carsharing organizations. Its headquarters handles the bookings for vehicles in over 80 cities across Europe (Commonwealth of Australia, 2004). European Car Sharing membership has grown at a rate of 50 to 60% annually, and today has 40 participant organizations with over 56,000 members in over 550 towns (Commonwealth of Australia, 2004).

2.2.2 Carsharing in North America

Carsharing was not seen in North America until 1983, when Purdue University researchers began the Mobility Enterprise program in West Lafayette, Indiana, and San Francisco started the Short-Term Auto Rental Service (STAR) (Millard-Ball et al, 2005). Both of these programs were early models of the carsharing programs existing today. The Mobility Enterprise program focused on encouraging members to use more fuel-efficient vehicles, choose other modes of transportation, and to reduce the need for purchasing additional vehicles (Millard-Ball et al, 2005). The STAR program only served the residents of a large apartment complex near San Francisco State University (Millard-Ball et al, 2005).

The STAR program closed in 1985, and Mobility Enterprise followed suit in 1986. It would not be until 1994 that carsharing would re-emerge in North America with the launch of CommunAuto (Shaheen, Cohen, & Roberts, 2005). Canada saw the first functional carsharing programs in North America. In 1997, the Cooperative Auto

Network and the Victoria Carshare Coop opened in Canada, along with the Dancing Rabbit Vehicle Cooperative in the United States (Shaheen, Cohen, & Roberts, 2005).

Since 1994 40 programs have been launched in North America, and currently only 28 are still in operation. Programs in the US quickly gained popularity, and by 2001 the US claimed 14 organizations with more than 5,000 members, while Canada claimed only ten programs with 3,800 members (Shaheen, Cohen, & Roberts, 2005).

2.2.3 Carsharing in Asia[1]

Japan and Singapore were the first two countries to embrace carsharing, and for good reason. Both Japan and Singapore have some of the most densely populated areas in the world, and these areas require a large amount of public transit options. The idea first emerged in Singapore in the mid-1990's when Mah Bow Tan, the former communications minister, recognized that communal cars were more efficient than privately owned vehicles. The idea of carsharing emerged in Japan in the late 1990's.

In May 1997, NTUC Income launched Singapore's first carsharing organization. NTUC, an insurance company that operates high-rise residential apartment complexes modeled their programs from European carsharing. $902,500 (US) was allocated to the launch of this new program in two complexes, Toh Yi Drive and Serangoon North. Since then three other programs have opened in Singapore; CitySpeed (2002), Honda DIRect ACCess (Diracc, 2002), and WhizzCar (2003).

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[1] Information in this section comes from Barth, Matthew, Susan Shaheen, Tuenjai Fukuda, and Atsushi Fukuda, *Carsharing and Station Cars in Asia: An Overview of Japan and Singapore*. 2006, pp 1-9.

Whizzcar, CitySpeed, and NTUC's program all focus on the neighborhood carsharing model, while Diracc focuses on carsharing services for businesses.

The first carsharing organization to emerge in Japan was Honda's Intelligent Community Vehicles Systems (IVCS) which was introduced as a new mode of individual transportation. Honda did not solely focused on typical carsharing models, but also introduced station cars. The goal of the IVCS was to adjust to the needs of the local areas in which their programs were located in a manner that would best benefit the environment and the society. IVCS launched its program with a major demonstration at the Motegi Twin Ring race facility in 1998. The demonstration showed off four applications of the carsharing concept; a electric vehicle (CityPal), a single-passenger utility vehicle (StepDeck), a low-speed electric vehicles (MonPal), and an electric bicycle (Racoon). The demonstration also showed off automated technologies for use at stations such as automatic vehicles platooning and automatic docking of electric vehicles.

In addition to Honda, Toyota launched a carsharing scheme with a demonstration in Toyoda City in the late 1990s. The Crayon System consisted of many small electric vehicles that were used for transportation around the area of its company facilities. The vehicles could be used by employees during the day, and there were options for people to use them to commute purposes. Similar to Honda, Toyota's program showed off new technology such as automated reservations, vehicle tracking, and on-board navigation.

The Japanese government started to back carsharing programs in 1999. Japan's Ministry of Construction helped to sponsor three programs. The first system, ITS Mobility System was launched as a commuter carsharing system which focused

on providing connections between transit stations and employment centers in Osaka. Members would commute from the transit stations to their work, and companies could utilize the vehicles during the day for business trips. The program was closed in 2002.

The second system, Tourist Electric Vehicles System was introduce in Kobe. This system focused on provided carsharing services to tourists using electric and natural gas powered vehicles. This program operated for one year before closing. The third system, Ebina Eco-Park & Ride launched in 2000 as one of Japan's first hybrid carsharing programs. Similar to the ITS Mobility System these vehicles served as station cars to connect homes and businesses to local train stations.

In addition to Japan's Ministry of Construction, Japan's Association of Electronic Technology for Automobile Traffic and Driving (JSK) helped to launch two other systems; Inagi EV-Car Sharing, and MM21. The Inagi EV-Car Sharing program served a total of 242 members using 50 electric vehicles from 1999-2002. This program focused on providing a second car for members and was modeled from similar carsharing programs in Europe and North America. The MM21 system, one of the few demonstration systems still in existence, focused on business use of vehicles in the Yokohama area, and allowed tourists and residents to access the vehicles on nights and weekends. The demonstration program had a total of 50 vehicle located at 12 different stations.

Many of Japan's initial demonstration programs have closed, due to the fact that they were not able to recover enough user fees to continue operations without subsidization. However, smaller scale carsharing programs continue to grow in Japan In April 2006, there were 18 programs with approximately 3,000 members in Japan.

Singapore's four major programs also continues to grow, and in March 2006, Singapore boasted 432 vehicle and 12,200 members.

2.3 Carsharing Models

There are three major models for the implementation of carsharing; neighborhood, station cars, and commuter-based carsharing. While neighborhood carsharing has offered the most potential, especially in North America, station cars and commuter-based carsharing models have been attempted, and are somewhat successful in certain areas of Europe and Asia. While this study will focus on the application of neighborhood carsharing in small metropolitan areas, it is important to note other possible implementation models. This section will briefly discuss each of the models.

2.3.1 Neighborhood Carsharing

A neighborhood carsharing program, like most programs in North America, is designed to alleviate congestion within the city by providing its residents alternatives to using private vehicles. In this scenario, carsharing vehicles are distributed throughout certain sections of the city, the target areas, and be accessible to residents and businesses in the area. The goal of a neighborhood program is to provide residents with another transportation option when mass transit is not an appropriate option. These types of programs are most suited for metropolitan cores which exhibit a high density of mix-used development, a good pedestrian environment, quality transit options, and parking problems (Millard-Ball et al, 2005).

Members of these programs typically reserve the vehicles ahead of time for a round trip using and online or phone reservation system. Members are typically

charged a monthly fee, hourly fee, and mileage fee for the use of the vehicle (Shaheen, Cohen, & Roberts, 2005). The vehicles are usually reserved for short periods of time, a few hours or less. Vehicles that are best suited for neighborhood carsharing are fuel efficient, and sometimes are hybrid or electric.

Neighborhood carsharing has typically gained momentum and membership from affluent city residents. The typical person who joins a carsharing program in North America is highly educated (35% have a Bachelors degree), be between 30 and 40 years of age, and have middle to high incomes (Millard-Ball et al, 2005). However, some research has hinted at the possibility of using carsharing in low income neighborhoods as a means of transporting residents to work and to run errands (Shaheen, Cohen, & Roberts, 2005).

The purpose of targeting low income neighborhoods is to help bridge the gap between those who own a vehicle and those that do not, which will, ideally bring more opportunities for employment in low income neighborhoods. While there has been a lot of speculation about the applications in low income neighborhoods, there is no reliable research on where this type of program has been implemented and what the specific results were.

Businesses in the core of metropolitan areas are often contacted as potential corporate members for carsharing program, and provide financial stability and a steady demand. Typical businesses applications are fleet replacement, where a company sells their business fleet and uses carsharing, and fleet supplementation, where companies reduce their fleet and supplement it with carsharing vehicles. Smaller businesses, who can not afford fleets can also benefit from carsharing. These

companies typically reimburse employees for travel which can be costly at times. Carsharing offers the benefit of a private fleet without all the costs.

2.3.2 Station Cars

On the other end of the spectrum of shared-use vehicle services, station car programs are primarily focused on facilitating transit access (Shaheen, 2004). The endpoints of the transit system are not convenient for many users. For example, it a commuter's final destination is beyond walking distance from the endpoint of the transit station, the commuter will likely choose to use a private vehicle instead of the mass transit option. Station cars would be located at major transit hubs where they could bridge the gaps between origins and transit stations and transit stations and final destinations. **Figure 2.1** shows a typical operational model.

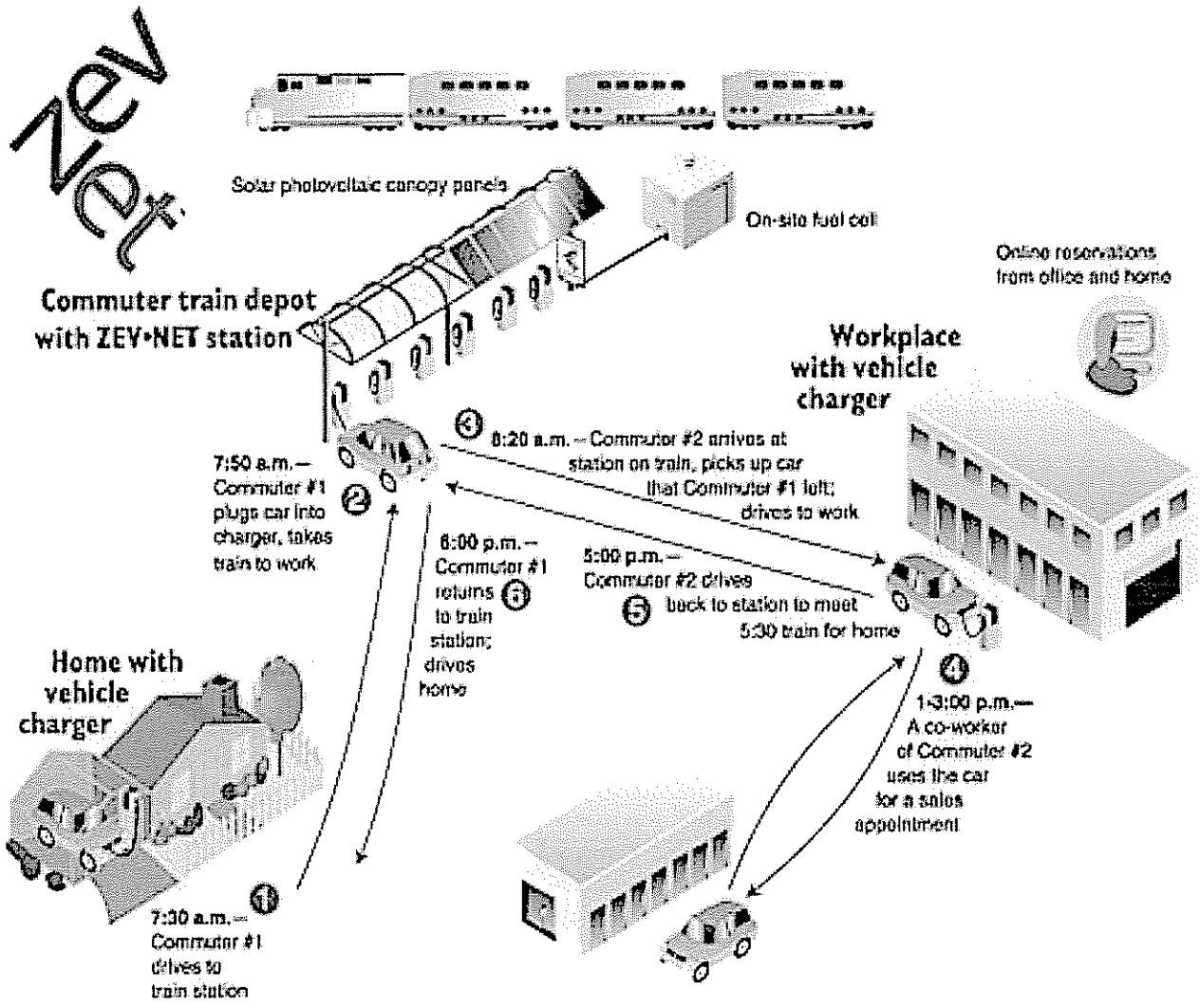

Figure 2.1 Example Station Car Operational Model (ZEV-NET 2005).

A typical station car program primarily focuses on the commuters and businesses at which the commuter are employed. A commuter will drive a station car to a transit station, or use a station car to access their place of employment. During the

day, the vehicles are used by business members to travel to business appointments. At the end of the day, the commuter then returns the vehicle to the transit station.

Station car programs have not faired well in North America. Since 1998, six station car programs were established, and only two are still in operation (Shaheen, Schwartz, & Wipyewski, 2003). Failures were caused in part by high insurance rates, reduced public funding, decreased customer demand, and funding non-renewal (Shaheen, Schwartz, & Wipyewski, 2003). In addition, station car programs can be very costly because they typically use electric vehicles which are high cost, unreliable, and require specialized maintenance personnel.

Station car services offer social and environmental benefits to the community. Use of existing transit systems and alternative transportation is strongly promoted. In the station car and hybrid models, the transit station is the foundation of the program. Use of the program in any form requires that the user be at a transit station to utilize the vehicles available. The promotion of transit use facilitates reduced auto ownership and reduced vehicle miles traveled. Various studies have been conducted on the benefits of station car programs and show a approximate VMT reduction of 18.5 miles per day, and an increase in new transit trips. (Shaheen, Schwartz, & Wipyewski, 2003).

2.3.3 Commuter-Based Carsharing

Much of the carsharing research today only considers two types of carsharing programs, neighborhood and station cars. This study would like to separate out a third type of carsharing, commuter-based. Commuter-based carsharing is a mix between neighborhood carsharing and station cars. It blends the concepts of a station car (centrally located vehicles used for commuting) and neighborhood carsharing

(vehicles located in neighborhoods and used for many different purposes, but rarely commuting) (Shaheen, 2004). Commuter-based carsharing vehicles can be used as the final link from a transit hub such as a rail station, and it could also be used as a method of carpooling at locations such as Park-N-Rides.

The commuter based model has three different types of users; home-based, work-based commuters, and work-based day users. The home-based user drives the vehicle from their home to the transit station in the morning, and back in the evening. They also have access to the vehicle on evenings and weekends. The work-based commuter picks up the vehicle at the transit station and drives it to work, and then returns it to the transit station at the end of the work day. The work-based day user has access to the vehicle during the business day to use for business trips. Typically each type of user has pre-determined window of time for vehicle use.

Many large metropolitan areas have shuttle services, funded by corporations, as a way to link transit to their offices. These shuttle services are used to attract and retain employees, as well as to promote transit use. However; transit feeder services typically cost 75-80 thousand dollars per vehicle per year to operate, and many smaller businesses may not be able to pay for such a service (Shaheen, 2004). In addition shuttle services can not assist those with unpredictable schedules, or those who prefer personal vehicles. Commuter-based carsharing offers the opportunity to fill the gap.

Commuter-based carsharing advocates transit use, carpooling, as well as walking and biking. This model has the potential to serve as a more efficient use of valuable parking spaces at office parks and garages as well (Shaheen, 2004). Even those who do not have direct access to the vehicles could benefit from the program.

For example, four or five employees, who work in the same building could walk, bike, or take a bus from their home to a rail station. They then would meet at the destination station and could travel in a carshare vehicles together. Commuter-based carsharing has the greatest potential for application in less densely populated areas.

Two commuter-based carsharing trials were conducted in the late 1990s and early 2000s in the San Francisco Bay Area. Their details are as follows:

2.3.3.1 CarLink Field Test I (Shaheen, 2004):

The CarLink I field test was launched on January 20, 1999, and ended on November 15, 1999. This ten month program had a total membership of 54 people who shared 12 natural gas powered Honda Civics. The participants were from the San Francisco, Oakland, and East Bay communities who all accessed the Dublin-Pleasanton Bay Area Rapid Transit (BART) station during their commute.

- Home-based users drove the vehicle between their home and the Dublin-Pleasanton BART station, and could also use the vehicle on nights and weekends for a fee of $200 a month.
- Work-based commuters took BART to the Dublin-Pleasanton station and drove the vehicle to and from work for a fee of $60 per month, which could be shared by carpooling.
- Work-based day users could use the vehicles for personal or business trips during the work day for a fee of $1.50 and hour and $0.10 per mile.

2.3.3.2 CarLink II Field Test (Shaheen & Rodier, 2005):

The CarLink II field test was conducted from July 1, 2001 to June 30, 2002. Over the 12 month study there were 107 members who shared 19 ultra-low emission 2001 Honda Civics. The study was conducted in Palo Alto and utilized Caltrain, a commuter rail service. In this study, there were 6 employer members who were located in the Stanford Research Park.

- Home-based users drove the vehicle between their home and the California Avenue Caltrain station, and could also use the vehicle on nights and weekends for a fee of $300 a month.
- Work-based commuters used the vehicles to drive between their work sites in the Stanford Research Park and the Caltrain station for a fee of $50 per month.
- Work-based day users consisted of the six member corporations themselves. They were charged a flat fee of $300 per month, and were provided with an option to cover their employee's monthly fee.

Other than the two studies above, commuter-based carsharing programs have not been attempted in the United States. Some of the reasons for this may be the large amount of membership support needed to sustain a program. CarLink I commuters increased their commute time by an average of 10 minutes, and CarLink II commuters increased their commute time by more than 30 minutes (Shaheen & Rodier, 2005). Increasing commute time, even while decreasing stress levels, may discourage some members from joining a similar program. In addition, while home-based users said they would continue if the program became permanent, work-based commuters said they would most likely return to their personal vehicle but would try to carpool more often (Shaheen & Rodier, 2005).

2.4 Overview of Carsharing Impacts

The true benefits of carsharing in the US are still unclear. There is substantial speculative research which examines the potential of carsharing, but little hard data has been collected. In addition, carsharing is a relatively new concept and has only been around for a short amount of time, and so the data that has been collected only covers a short amount of time. The long term impacts of carsharing are still unknown.

The empirical research that has been conducted is typically of low quality, and has been collected by carshare operators themselves, or other advocates of carsharing (Millard-Ball et al, 2005). The sample sizes for these studies are small, and the studies are typically conducted at the beginning of the program which skews the results to fit the profile and habits of early adopters (Millard-Ball et all, 2005). Many of the studies, especially those conducted by the operators, are not published in full, and only offer a "fact sheet" that typically sheds only good light on carsharing (Millard-Ball et al 2005).

While there seems to be rather poor or incomplete evidence of the true impacts of carsharing, all of the studies that do exist seem to agree on the same overall benefits (Millard-Ball et al, 2005):

- Reduction in vehicle travel
- Reduction in vehicle ownership
- Reduction in parking demand
- Cost savings and greater mobility for members

2.4.1 Effects on Vehicle Travel

Many proponents of carsharing suggest that it reduces vehicle travel by reducing the number and length of the trips (Millard-Ball et al, 2005). Carsharing is designed to compliment other transportation modes such as mass transit, walking and biking. After joining the carshare program, members do not rely on a personal vehicle to become their default mode of transportation. It is argued that members will weigh costs, travel time, convenience, and comfort of various travel modes before choosing the best fit (Millard-Ball et al, 2005).

Carsharing can also indirectly affect the vehicle travel by providing transportation during the work day. Many times, companies will reimburse their employees for travel, which means that if an employee has a meeting, they typically must drive to work in order to have access to a vehicle. Carsharing can provide access to a vehicle for those types of trips. In addition carsharing can provide a emergency route home if, for example, a child becomes ill, or a person has to work late. This may help to persuade some people to join carpools or use mass transit (Millard-Ball et al, 2005). Finally, carsharing also promotes compact development by lowering parking ratios (Millard-Ball et al, 2005). Holtzclaw et al. suggests that as residential density doubles, vehicle miles traveled per capita fall by approximately 20% (2002).

American and Canadian data revealed that one carsharing vehicle removes between 6 and 23 cars from the road resulting in a reduction in vehicle ownership and VMT (Shaheen, Cohen, & Roberts, 2005). This is impacted by the location of the carsharing program vehicles as well as their availability. A study conducted in Portland shows that vehicle miles traveled (VMT) for those who had owned a vehicle at the start of the program decreased 18%. However, the study also revealed that

members who had not previously owned a vehicle increased their vehicle use from 0.3 to 24.9 miles (Katzev, Brook & Nice, 2000).

In Arlington, Virginia members reported a VMT reduction of 45%, or 3,250 miles per year (Price & Hamilton, 2005). 35% of those surveyed reported that their vehicle use increased, while 54% said that their use of mass transit increased after joining the program (Price & Hamilton, 2005). North American studies suggest and average 44% reduction in VMT per user, while European users suggest a VKT reduction of 28 to 45% (Shaheen, Cohen, & Roberts, 2005).

In addition to the above benefits, carsharing compels a user to consider traveling by mass transit first, and utilizing carsharing as a secondary alternative. Since carsharing can be a pay-as-you-go program, it forces the user to evaluate the need for paying for private transportation if public transportation is available for that trip (Shaheen, Cohen, & Roberts, 2005). Carsharing is designed for short trips that occur only a few times a week, so it is necessary for the users to plan their trips more efficiently. In some cases, there is a flat fee for using carshare programs in addition to a fee per mile. This forces the user to try to combine all necessary trips into one larger trip so that multiple fees can be avoided.

Reduction in VMT corresponds to a reduction in greenhouse gas emissions. In Europe, Carshare members are estimated to reduce their annual carbon dioxide emissions by 40 to 50% (Shaheen, Cohen, & Roberts, 2005). As well as decreasing the number of vehicles on the road, carsharing programs often incorporate electric or hybrid vehicles into their fleets in order to further reduce emissions. Carsharing members also report a higher degree of environmental awareness after joining the program (Shaheen, Cohen, & Roberts, 2005).

2.4.2 Effects on Vehicle Ownership

A major transportation and social impact of carsharing is the reduction in vehicle ownership. Canadian studies and surveys suggest that 29% of carsharing members sold a vehicle after joining a program, while 25 to 61% delayed or had forgone the purchase of a vehicle (Shaheen, Cohen, & Roberts, 2005). US studies suggest that between 11 and 26% of members sold a vehicle after joining a program, and 12 to 68% delayed or had forgone the purchase of a vehicle(Shaheen, Cohen, & Roberts, 2005). A more recent examination of various carsharing studies by Millard-Ball et al. show an average 21% of members in the US give up a personal vehicle after joining the program, compared to an average 22% in Europe (2005). On average 34% of members said they avoided the purchase of a new car after joining the program (Millard-Ball et al, 2005).

Tables 2.1 and 2.2 show two studies in which data was gathered about changes in vehicle ownerships of members in a carshare program. In San Francisco, 26.6% of members sold a vehicle within the first two years of the carsharing program (Cervero & Tsai, 2003). In a study conducted by Millard-Ball et al., 49.6% of respondents reported selling their family's secondary vehicle (2005).

Table 2.1 Changes in Household Vehicle Ownership: San Francisco City Carshare (Cervero &Tsai, 2003)

Vehicle Ownership	% of Members	% of Non-Members
Reduced by 2 or more	2.5	0.0
Reduced by 1	26.6	8.0
Did not change	63.2	80.0
Increased by 1	7.4	12.0
Increased by 2 or more	0.4	9.0

Table 2.2 Changes in Household Vehicle Ownership: Carshare Member Survey (Millard-Ball et al., 2005)

Vehicle Ownership	Yes	No
Sold my car	11.3%	59.9%
Sold family's second car	49.6%	26.5%
Postponed buying a new car	70.5%	16.6%

Reducing vehicle ownership can have outside effects on the community such as an improved availability of parking, a reduced need to construct new parking, and reduced parking ratios for new developments (Millard-Ball et al., 2005). Parking availability will improve in older neighborhoods with carsharing that rely heavily on curb parking (Millard-Ball et al., 2005). A reduction in vehicle ownership within certain neighborhoods also can reduce the need for new parking areas or structures, saving developers or the cities time and money. In addition, if a developer incorporates carsharing into their design, they can reduce their need to construct parking (Millard-Ball et al., 2005). All of these improvements mean a reduced cost to developers, residents and city governments.

2.4.3 Effects on Transportation Costs

It is also important to note to what limit carsharing is beneficial compared to private vehicle ownership. This number can change from location to location given changes in gas prices or insurance rates. According to Millard-Ball et al. when comparing private vehicle ownership to carsharing in Chicago, the maximum mileage to which carsharing is cheaper is 5,000 miles per year (2005). In other studies the maximum mileage in which carsharing is cost-effective, in comparison to personal

vehicle ownership, lies between 10,000 to 16,093 kilometers (Shaheen, Cohen, & Roberts, 2005).

This threshold can vary given many different travel characteristics of a member, including (Millard-Ball et al., 2005, Shaheen, Cohen, & Roberts, 2005):

- Fee structures of the carshare operator
- The degree to which a member changes travel patterns. Are more trips traditionally made in a vehicle now made by walking, biking or mass transit?
- Whether or not a member household has a second vehicle, and for what types of trips that vehicle is used.
- The proportion of trips for which carsharing is utilized.
- Other unknown variables such as whether a person has paid off their vehicle loan, or whether they have to pay for parking, etc.

Many carshare companies make claims about the potential cost savings given the results of cost savings of their members. According to PhillyCarShare, 40% of their members reported that they have saved money using carsharing, while 16% claimed that they paid more for transportation using carsharing but were willing to pay more (Lane, 2005). The Flexcar website offers a cost calculator to compare vehicle ownership to carsharing (2007). Figure 2.2 shows an example calculation. According to the Flexcar website, a person that drives 500 miles a month with an average fuel rate of 25 miles per gallon, at a price of $2.15 per gallon, should expect to pay $599.08 per month for owning a car. This corresponds to being able to drive 80 hours per month in a carshare vehicle.

According to Zipcar, the average member saves $435 per month on carsharing (Zipcar, 2007). The website also offers estimates on carsharing savings given a location and a travel pattern (see Figure 2.3). According to the Zipcar website, if a person drives a lot in the DC metro area (several trips per week, and a weekend excursion), they could have a potential savings of $538 per month (Zipcar, 2007).

A study conducted by Millard-Ball et al., revealed that the average carsharing bill was $61.26 dollars per month, and the median was $40.50 (2005). The study also revealed a minimum expenditure of $1.00 per month and a maximum of $500 (2005). Some of the focus group members involved in this study reported savings of $100 or more, and one member reported an annual cost of $1,100 which is far less than the cost of owning a vehicle (2005).

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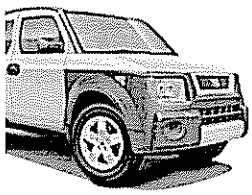


Cost of Owning

How many miles do you drive per month?	500
Estimate your average miles per gallon	25
Estimate your average cost per gallon	2.15
Estimate your monthly parking costs	0

submit

Your Operating Costs

Cost of Gas per Mile	0.09
Cost of Gas per Month	45.00
Average maintenance & repair costs per mile*	0.059
Maintenance & repair costs per month	29.50

Average Monthly Ownership Costs*

Full-coverage insurance	107.33
License, registration, taxes	32.42
Depreciation	323.25
Finance Charge (10% down; loan @ 6%/5 yrs.)	61.58
Average Monthly Ownership Costs	524.58
Your total monthly cost of car ownership	**599.08**

Cost of Using Flexcar

	Cost Per Month	Savings
5 hours per/month	45.00	554.08
10 hours per/month	85.00	514.08
25 hours per/month	200.00	399.08
50 hours per/month	375.00	224.08

For the same price as owning and driving your car, you can drive a Flexcar approximately 80 Hrs/Month or 3 Hrs/Day

Figure 2.2 Flexcar Cost Comparison (2007).

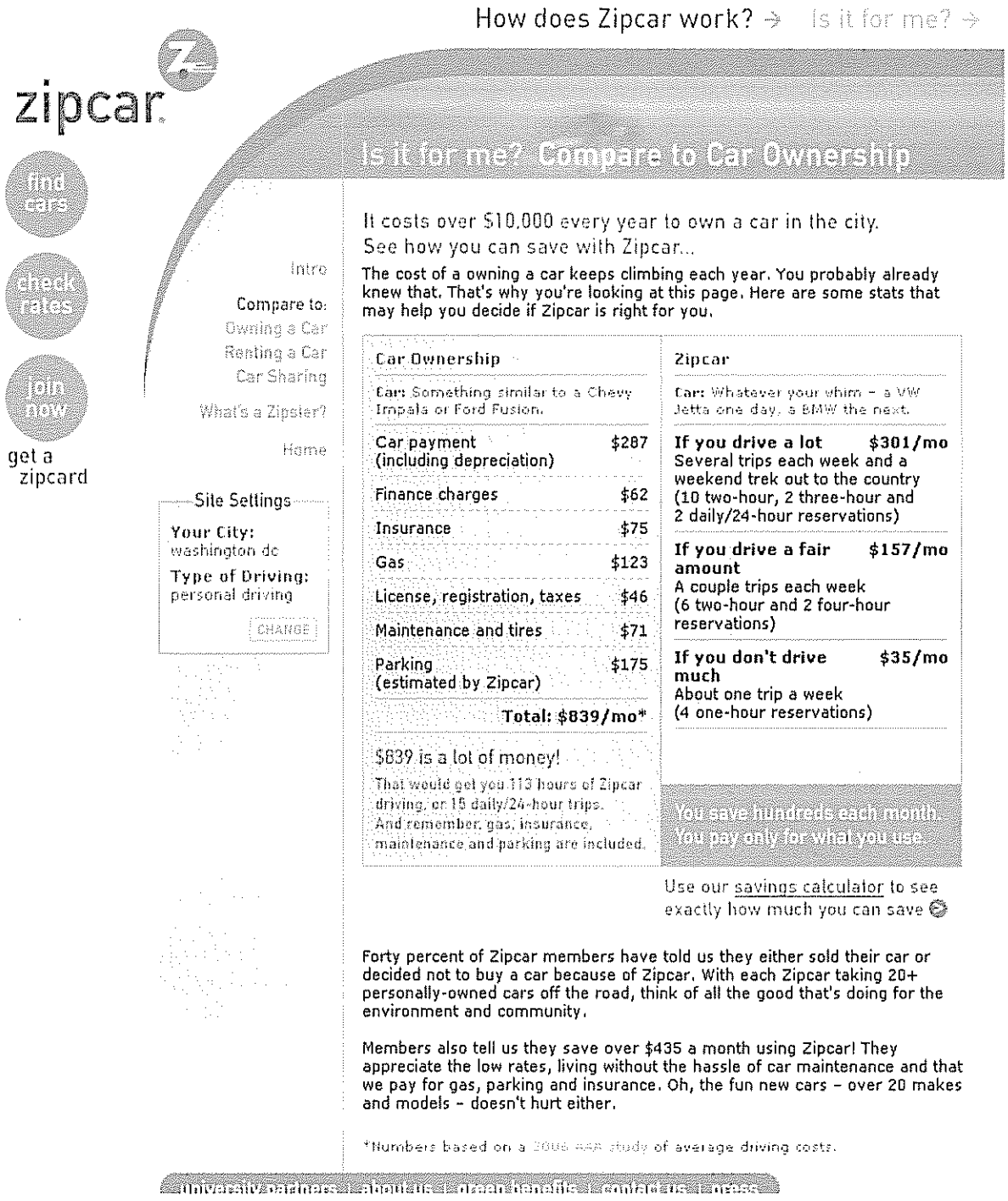


Figure 2.3 Potential Zipcar costs for a member in Washington, DC (2007)

2.4.4 Need for Standardized Research

As discussed earlier in section 2.4, there is a large amount of unreliable data that is being used to try to determine the true effects of carsharing. Due to the differences in study methodology and limited sample sizes, data is often inconsistent or difficult to analyze. There is a demand for a simple standardized methodology to collect and analyze data regarding the impacts of carsharing (Millard-Ball et al., 2005). Continuing research is needed in order to gather more information about the short-term and long-term impacts of carsharing (Shaheen, Cohen, & Roberts, 2005).

2.5 Overview Member Demographics

The demographics of carsharing members seem to be similar across all programs in the United States (Brook, 2004). The average carshare member is in their mid-30's with the majority having at least received a four year degree (Brook, 2004). Member incomes tend to be around the median for their area, and participation in wealthy areas was extremely low (Brook, 2004). To date, there has been little penetration into low-income neighborhoods, and these areas are considered to be untested markets. Gender, marital status, and home ownership seems to be evenly divided among members (Brook, 2004).

Susan Shaheen conducted a survey of CarLink study members in order to create an early adopter profile (2004). This information could potentially be used to create target populations for other cities interested in starting a carsharing program. Many of the characteristics in the profile are similar to the characteristics of early adopters of carsharing programs in Europe (Shaheen, 2004). In addition it seems to generally fit members in carsharing programs across the US, similar to those results

found in other studies. **Table 2.3** lists the some early adopter characteristics and the percentage of CarLink participants that fit into that category (Shaheen, 2004).

Table 2.3 Early Adopter Characteristics (Shaheen, 2004)

Characteristic	Percentage of CarLink Participants
Belongs to a 2-3 member household	50%
Male	60%
Female	40%
Married	70%
Between the ages of 24 and 40	56%
Not Older than 60	90%
Live in a city of at least 50,000	50%
Have a household income greater than $50,000 per year	60%
Not dissatisfied with their current transportation mode	80%
Believe that vehicle maintance is a hassle	60%
Believe that vehicles are enjoyable	20%
Believe that congestion is a serious problem	60%
Has concern for the environment	50%
Likes to experiment with new ways of doing things	80%

2.6 Carsharing Market and Trends

Since 2001, the growth in the US market has stabilized, with the formation of an additional 12 programs and the closure of 10 programs (Shaheen, Cohen, & Roberts, 2005). **Table 2.4** lists all the cities with operating carshare programs in the United States as of December 2006.

Table 2.4: US Carsharing Locations and Operators

Location	Operator
Ann Arbor, MI	Ann Arbor Community Car Coop, Zipcar
Aspen, CO	Roaring Fork Valley Vehicles
Arlington, VA	Flexcar, Zipcar
Austin,TX	Austin Carshare
Bellingham,WA	Community Carshare of Bellingham
Boston, MA	Zipcar
Boulder, CO	Boulder Carshare
Chicago, IL	I-GO, Zipcar
Chapel Hill, NC	Zipcar
Cleveland, OH	City Wheels
Detroit, MI	Motor City Carshare
Eugene, OR	Eugene BioCarShare
Hoboken, NJ	Zipcar
Irvine, CA	ZevNet
Los Angeles, CA	Flexcar
Madison, WI	Community Car
Minneapolis-St Paul	hOurCar, Zipcar
Montgomery County, MD	Flexcar, Zipcar
New York, NY	Zipcar
Oakland, CA	City Carshare, Flexcar, Zipcar
Philidelphia, PA	Philly Carshare
Portland, OR	Flexcar
Princeton, NJ	Zipcar
Prince Georges Cnty, MD	Flexcar, Zipcar
Rutledge, MO	Dancing Rabbit Vehicle Cooperative
San Diego, CA	Flexcar
San Francisco,CA	City Carshare, Flexcar, Zipcar
Santa Monica, CA	Flexcar
Santa Barbara, CA	Flexcar
Seattle, WA	Flexcar
Washington, DC	Zipcar, Flexcar

Figure 2.4 shows organization totals and closures from 1994 to 2005. Start-up activity also peaked in 2001, and has decreased ever since. This reflects some barriers such as start-up costs, competition with larger providers, and loss of first-to-market advantages in large urban areas (Shaheen, Cohen, & Roberts, 2005). It is likely that there will be increased competition between carsharing providers in the future.

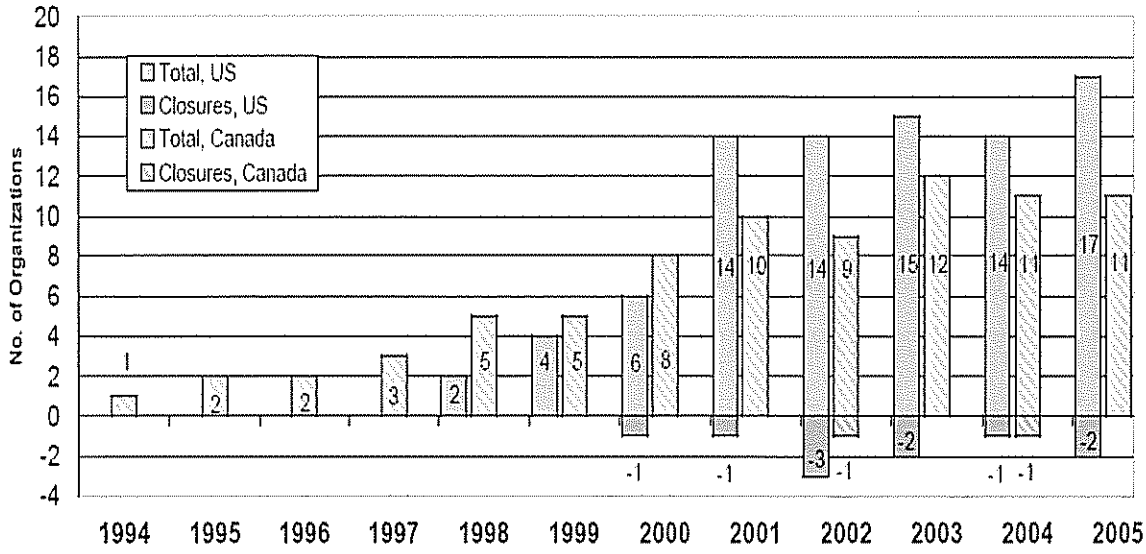


Figure 2.4 North American Organization Totals (Shaheen, Cohen, & Roberts, 2005)

Membership in the US rose by 46% in 2005, making it the first year that membership has not at least doubled (Shaheen, Cohen, & Roberts, 2005). **Figure 2.5** shows that growth rates in membership have also started to slow. As of 2005 there

were approximately 76,420 total carsharing members in the US, and 1192 total vehicles in the carsharing system (Shaheen, Cohen, & Roberts, 2005).

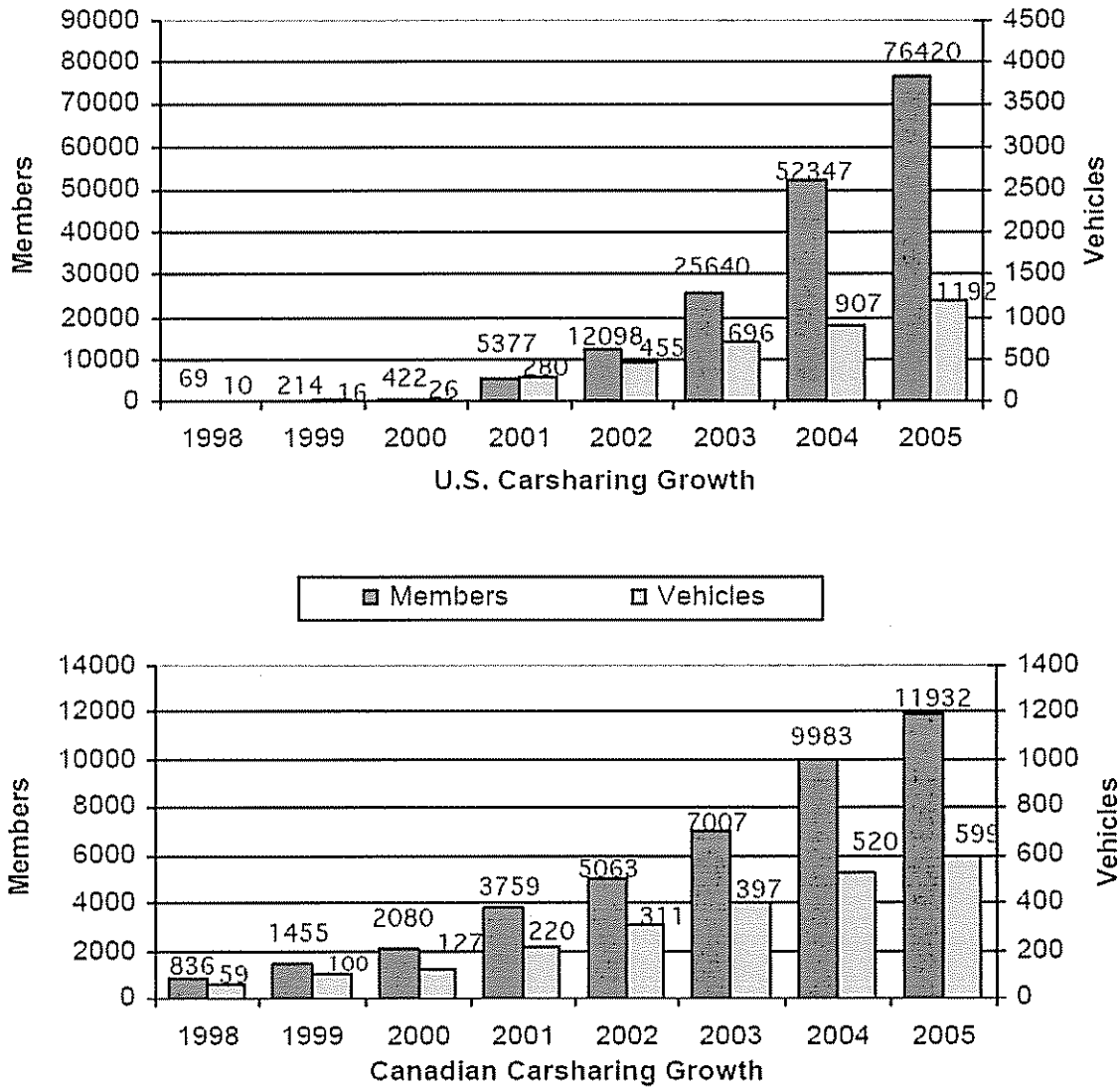


Figure 2.5 US and Canadian Carsharing Growth, 1998-2005 (Shaheen, Cohen, & Roberts, 2005).

Out of all the countries involved in carsharing, the US has the largest member-to-vehicle ratio (66:1). The average member-to-vehicle ratio in Canada is approximately 20:1 (Shaheen, Cohen, & Roberts, 2005). Higher US ratios can be explained in part by few membership requirements and low fees. Fourteen of seventeen US carsharing programs, including two of the largest, do not require deposits. Nine of seventeen programs only require a one-time fee (ranging from $100 to $350) (Shaheen, Cohen, & Roberts, 2005). Only 33% of programs require monthly fees (ranging from $10 to $20), and only three programs require annual fees (ranging from $35 to $100) (Shaheen, Cohen, & Roberts, 2005). In contrast, nine of eleven Canadian carsharing programs require deposits of $300 to $500 (Shaheen, Cohen, & Roberts, 2005). High deposits may require a greater commitment to join and use the program.

There are currently two carsharing business models in North America: for-profit and non-profit. While, in the US, only 29% of carsharing programs are for-profit, these programs represent 90% of the membership and 83% of the fleets deployed (Shaheen, Cohen, & Roberts, 2005). The non-profit carsharing operators represent a very small amount of users and fleets deployed in both the US and Canada. However, the top four growth-oriented programs in the US and Canada are split between for-profit and non-profit models.

2.7 Rate Structures

Profit, or at a minimum, cost recovery was the principle factor in selecting the current rate structure of 83% of North American carsharing programs (Shaheen, Cohen, & Roberts, 2005). In Canada, the mileage is emphasized as the primary cost basis, but in the US, carsharing service providers focus more on hourly or membership

fees. Many of the largest programs in the US provide a certain amount of free mileage per reservation or per hourly cost (Shaheen, Cohen, & Roberts, 2005). Programs in the US tend to charge high hourly rates bundled with free mileage, while Canadian programs tend to charge lower hourly rates with no free miles Shaheen, Cohen, & Roberts, 2005). Overall average user costs are much lower in Canada than the US. **Figure 2.6** shows the differences in rates over time.

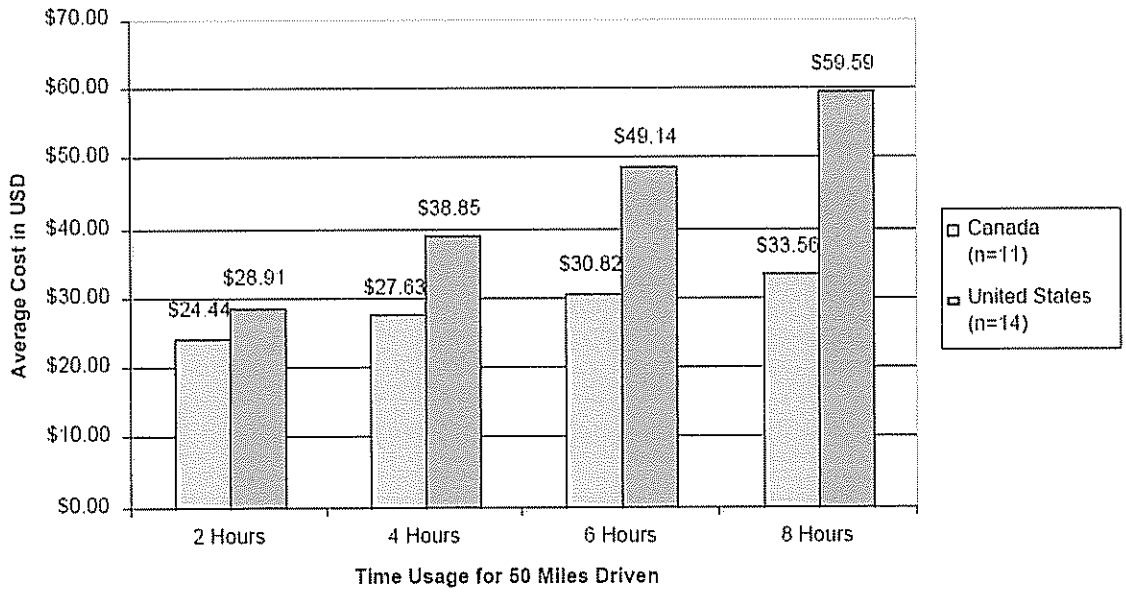


Figure 2.6 Changes in User Rates Over Time (Shaheen, Cohen, & Roberts, 2005).

Carsharing is typically priced on the basis of both hourly (or half-hourly) usage and distance traveled (Brook, 2004). Two considerations when determining a pricing plan are the balance between revenue from time and distance charges, and the allocation of administrative costs between regular and infrequent users. The majority

of carsharing services provide a free or reduced hourly fee for the overnight period, while still charging for the distance driven (Brook, 2004).

Carsharing organizations typically set a discounted daily rate as well, often in the form of a "maximum hours per day" charge (Brook, 2004). The administrative costs of maintaining members are typically defrayed by membership fees and security deposits. A new company must decide whether membership fees will be collected on an annual or monthly basis. Some companies also offer a pricing plan with lower usage rates when a higher membership fee is charged (Brook, 2004).

Beyond setting the basic pricing for the carsharing service, many other charges must also be established. Cancellation fees must be set for trip reservations that are terminated less than a specified time before the trip start (Brook, 2004). These fees are usually some portion up to the entire hourly fee for the time reserved. A related issue is whether to provide a credit on a member's account if a vehicle is returned early. Members may also incur penalties for the late return of the vehicle. These penalties are enforced to promote member responsibility (Brook, 2004).

2.8 Current Market Potential

As carsharing continues to grow in popularity, the opportunity for expanding programs to new markets is increasing. One of the markets expected to provide a large number of future members is individuals 21 and younger. Most carsharing programs' minimum age requirement is between 21 and 25; however, studies show that carsharing membership growth potential for individuals 21 and over in major metropolitan areas is estimated to be 6.9% (Shaheen, Cohen, & Roberts, 2005). Growth potential may be increased if programs allowed people as young as 18

to join, however, barriers such as high insurance costs may prevent many programs from reducing their minimum age (Shaheen, Cohen, & Roberts, 2005).

Neighborhood residential is the largest demographic market in the US and Canada, accounting for 81.7 and 96% of their membership, respectively (Shaheen, Cohen, & Roberts, 2005). The remaining markets in the US include business (12.3%), college (4.6%), low income households (1.3%), and commuters (0.1%) (Shaheen, Cohen, & Roberts, 2005). It is expected that neighborhood residential will still be the largest demographic in the near future, but will decrease as more businesses and colleges become involved in carsharing programs. It is anticipated that within five years, business and college members will make up 22 to 23% of all users (Shaheen, Cohen, & Roberts, 2005).

As more organizations become willing to lend support to new organizations in the US, more start-up organizations, many in smaller metropolitan areas are likely to develop. While these areas may not ever be able to obtain a high membership number as larger cities do, these locations can still provide a strong environment for carsharing.

Chapter 3

QUANTITATIVE MARKET ANALYSIS

Establishing a relationship between the size of a carsharing program and the characteristics of the city in which the program is located is a difficult process, yet a very important one. The size, operational structures, and the types of members vary greatly from city to city. The purpose of this chapter is to examine other attempts at quantitative analyses, and to present the methodology and results of the quantitative analysis developed for this study.

3.1 Quantitative Analysis to Date

To date, there has been little quantitative research attempting to relate certain characteristics of a city to the size or success of a carsharing program within that city. One reason for this is the difficulty of obtaining accurate information about certain carsharing organizations. Many of the larger organizations are unwilling to share specific information about their size and operations. Grossberg & Newenhouse were one of the first to try a quantitative analysis while conducting a feasibility study for the city of Madison, Wisconsin (2002).

The Madison, Wisconsin feasibility study published in 2002, utilized census tract data to attempt to identify suitable locations for carsharing vehicles in a city. The study examined possible factors that would create a suitable environment for carsharing through a literature review. The literature review revealed that high transit use, bicycling and walking, high household density, and low vehicle use, among other

characteristics, created a suitable carsharing environment (Grossberg & Newenhouse, 2002). Based on the literature review conducted for the feasibility study, the researchers were able to narrow down their variables and look for neighborhoods with (Grossberg & Newenhouse, 2002):

- A high percentage of the population using non-auto commute modes.
- A low average number of vehicles per household.
- A high household density per 0.2 acre
- A low percentage of the population between 16 and 24 years old.

The researchers narrowed the number of census tracts to 12 by first identifying those census tracts with high non-auto commute modes and with low auto ownership rates. Typically, the areas with high non-auto commute modes corresponded to the areas with low auto ownership rates. Three of the twelve remaining census tracts were then eliminated because they were located near a university, which had a high percentage of residents between the ages of 16 and 24. Community Car (the program in Madison) requires their member to have at least 5 years of driving experience before joining the program (Grossberg & Newenhouse, 2002).

The researchers were then able to rank the census tracts given the above variables. Table 3.1 shows these locations and their rankings. Residential density also played a role in the selection of the neighborhoods; all but two of the nine selected census tracts ranked within the top 21 census tracts for household density (Grossberg & Newenhouse, 2002). The two that did not fall within the top 21 were retained

because of a few high-density developments located in these areas (Grossberg & Newenhouse, 2002).

Table 3.1 Census Tracts Selected for the Carsharing Market Study (Grossberg & Newenhouse, 2002)

Neighborhood (Census Tract)	Non-Auto Commute Mode		Average Vehicles Per Household		Households per 0.2 acre		Age 16-24
	Percent	Rank	Average	Rank	Density	Rank	Percent
Old Market Place (17)	37%	2	.69	2	2.26	5	47%
Marquette (19)	28%	5	1.24	9	1.07	11	13%
Greenbush/ Vilas (12)	27%	6	1.44	18	1.15	10	43%
Dudgeon-Monroe (9)	27%	7	1.36	13	1.23	9	36%
Tenney-Lapham/ Old Market Place (18)	25%	8	1.31	12	1.68	7	28%
Eagle Heights (32)	24%	9	1.06	5	0.47	38	6%
Dudgeon-Monroe (10)	17%	10	1.47	20	0.46	39	19%
Sunset Village/ Hills/ Radio Park (8)	14%	11	1.41	16	0.76	19	10%
Bay Creek (13)	14%	12	1.20	7	0.72	21	10%

Another attempt at a similar analysis using GIS and census tract data was conducted for the study "Car-sharing: Where and How it Succeeds" (Millard-Ball et al., 2005). Census data was gathered on 13 US cities that had significant carsharing programs (Millard-Ball et al., 2005). The following cities were included: Aspen,

Boston, Chicago, Denver-Boulder, Los Angeles, Madison, New York, Philadelphia, Portland, Sand Diego, San Francisco, Seattle, and Washington DC.

Sixteen variables were examined for this study. These variables were analyzed first at a scale of ½ mile radius from every pod (carsharing vehicle, or collection of vehicles in one location), and then they were analyzed at a regional level. The variables included demographics such as income, household size and educational attainment, as well as travel characteristics such as vehicle ownership and commute share. In addition, Millard-Ball et al. included a residential density as well as factor for intersection density. The intersection density was included to act as a measure of the walk-ability of a neighborhood.

Millard-Ball et al. then compared these variables to a level of service rating. This rating was related to the number of carsharing vehicles within a ½ mile radius. When comparing the localized data with the regional data, significant differences were found. The localized data better reflected the carsharing environment. It was determined that one-person households were more common in the areas surrounding the pods, residents around the pods were more likely to take transit or walk to work, and residents around the pods owned fewer vehicles than the regional average (Millard-Ball et al., 2005).

The level of service correlated negatively with the percentage of people driving alone to work and the average number of vehicles per household (Millard-Ball et al., 2005). This indicates that areas with high car ownership and low transit use tend to have less carsharing service. The percentages of one-person households, rental households, households with 0 or 1 vehicle, as well as housing units per acre and intersection density all had strong positive correlations to level of service. The

percentage of households with children and the percentage of people that carpooled to work had negative correlations to level of service.

Millard-Ball et al. then combined the results from the quantitative analysis with the results of a member survey. One of the main conclusions of this report is that carsharing members are not necessarily representative of the neighborhoods that surround the pods. For example, 83% of members had a bachelor degree but only 55% of residents living close to a pod had a Bachelor's degree (Millard-Ball et al., 2005). Since carsharing member bases make up only a small portion of the total population of an area, it is to be expected that they do not fit within the average characteristics of a neighborhood.

> "It seems that car-sharing is appealing to a large number of highly educated, but not necessarily high-income, gentrifiers and young professionals. They are living in urban neighborhoods which are characterized by a high proportion of rental housing, single-person childless households, pedestrian friendliness, and a relatively high density" (Millard-Ball et al., 2005).

Millard-Ball et al. suggests that it may be easier to focus on neighborhood and transportation characteristics rather than focusing on the individual demographics of the carsharing members (2005). Concentrating on neighborhoods with low auto ownership, high use of alternative commute modes, and a low average household size may be the best way to find suitable carsharing environments.

Millard-Ball et al. also developed thresholds for where carsharing may succeed (Table 3.2). Two different sets of thresholds define the two different levels of service: low and high. A high level of service corresponds to approximately 10 or more carsharing vehicles within a half-mile radius (Millard-Ball et al., 2005).

Table 3.2 Thresholds for where Carsharing May Succeed (Millard-Ball et al., 2005)

Variable	Level of Service	
	Low	High
% of 1 person households	30%	40-50%
% drive alone to work	55%	35-40%
% walk to work	5%	15-20%
% households with no vehicle	10-15%	35-40%
% households with 0 or 1 vehicle	60%	70-80%
Housing units per acre	5	5

3.2 Methodology

The purpose of conducting this quantitative regression analysis was to attempt to develop an equation that can relate certain characteristics of a region with the carsharing membership within that region. This is not a measure of success, just a measure of size. Defining success is difficult because it may mean different things to different programs. Unlike the Millard Ball et al., and the Grossberg and Newenhouse studies, this analysis will examine carsharing only at a regional level. This regression analysis will help to outline what characteristics of a location affect a carsharing program's size the most and should be used strictly as a preliminary investigation tool for cities examining the feasibility of implementing a carsharing program.

Data was gathered for 27 US regions with carsharing programs as well as two locations considering the implementation carsharing in the near future (Wilmington, DE and Ithaca, NY). Cities with carsharing programs were identified using the www.carsharing.net website. Each location with carsharing was verified by visiting the website of the operator to ensure that the carsharing program in that location was still operational. Fourteen variables were analyzed (see Section 3.3).

These variables included demographic data, employment data, and transportation data relating to each city.

The data was entered into the Statistical Analysis System (SAS) in order to determine relationships between the variables and the number of members in the carsharing program. The following analyses were performed:

- Correlation analysis: To determine the correlation coefficients of the variables with respect to membership.
- R-Square Analysis: To determine what combination of variables produce the highest r-square value.
- Adjusted R-Square Analysis: To determine what combination of variables produce the highest adjusted r-square value.
- Mallow's Cp Selection Analysis: To choose the best subset of variables when a best subset regression analysis is being performed.

The above analyses were used to determine which variables to include in a regression analysis. Once the variables were identified, the data was randomly separated into a working group and a test group. The data from the working group was used to develop a regression formula, while the testing group was used to test the results of the regression analysis.

3.3 Data

As stated previously, data was collected on 27 US cities and counties with carsharing programs in operation as well as two cities that are in the final stages of implementing carsharing programs. Table 3.3 lists the cities that were examined in this analysis, the number of members in each program, and the program operators.

Table 3.3 Locations, Memberships and Operators Considered For Analysis

City	Approximate Number of Members	Operator(s)
Ann Arbor, MI	360.00	Ann Arbor Community Car Coop, Zipcar
Aspen, CO	57.00	Roaring Fork Valley Vehicles
Arlington, VA	3800.00	Flexcar, Zipcar
Austin,TX	60.00	Austin Carshare
Bellingham,WA	14.00	Community Carshare of Bellingham
Boston, MA	22520.00	Zipcar
Boulder, CO	65.00	Boulder Carshare
Chicago, IL	7520.00	I-GO, Zipcar
Chapel Hill, NC	160.00	Zipcar
Cleveland, OH	103.00	City Wheels
Eugene, OR	9.00	Eugene BioCarShare
Hoboken, NJ	520.00	Zipcar
Ithaca, NY*	165.00**	Ithaca Carshare
Los Angeles, CA	1360.00	Flexcar
Madison, WI	200.00	Community Car
Minneapolis	360.00	hOurCar, Zipcar
Montgomery County, MD	1800.00	Flexcar, Zipcar
New York, NY	26080.00	Zipcar
Oakland, CA	1520.00	City Carshare, Flexcar, Zipcar
Philadelphia, PA	1200.00	Philly Carshare
Portland, OR	5680.00	Flexcar
Princeton, NJ	80.00	Zipcar
Prince Georges County, MD	1760.00	Flexcar, Zipcar
San Diego, CA	1760.00	Flexcar
San Francisco,CA	16608.00	City Carshare, Flexcar, Zipcar
Santa Monica, CA	120.00	Flexcar
Santa Barbara, CA	80.00	Flexcar
Seattle, WA	7320.00	Flexcar
Washington, DC	19832.00	Zipcar, Flexcar
Wilmington, DE*	0	Philly Carshare
*** Cities in the final stages of implementation**		
**** Expected number of members given preliminary studies**		

Many of the smaller organizations had their membership numbers posted or were willing to share their information via email. The larger organizations such as Flexcar, Zipcar, and City Carshare were contacted via email and by phone for their membership numbers. These organizations were reluctant to provide the data, or did not have accurate numbers. The membership numbers for cities with these operators were calculated by multiplying the number of vehicles located in the city by the average vehicle to member ratio. The average US vehicle to member ratio is 1:20 (Shaheen, Cohen, & Roberts, 2005).

3.3.1 Variables

The literature review conducted for this study yielded twelve variables that may have a significant effect on carsharing program size. Census data was used to determine the values of the variables. These variables include information regarding demographics, employment, land use, and transportation habits.

X1) The population of the city or county. This value provides a baseline for the other variables during the analysis and is not expected to play a significant role in the regression analysis.

X2) Percentage of the population between 18 and 65 years of age. As discussed earlier, the median age of carshare members is in the mid-30s. Most programs do not allow members under the age of 18.

X3) Percentage of residents involved in professional occupations. For this study, a professional occupation is defined as "management, professional, and related occupations," and "sales and office occupations" (census definitions). This value will help to quantify employment characteristics of the location which is related to educational status and land use patterns.

X4) Per Capita Income. Various studies have indicated that members tend to have higher incomes (See CarLink studies).

X5) Average Household Size. Various studies have suggested that lower average household sizes create better carsharing environments (See, for example, Millard-Ball et al., 2005)

X6) Average Commute Time. Commute times provide information regarding transportation habits at a location.

X7) Percentage of people using mass transit. Numerous studies have concluded that carsharing works best in areas with high transit usage (See, for example, Millard-Ball et al., 2005).

X8) Percentage of people that walk to work. This relates to the walk-ability and land use of a location, which impacts the carsharing environment.

X9) Percentage of households with no vehicles. Many studies indicate that areas with low auto ownership provide for a better carsharing environment.

X10) Mass Transit Rating. This is an arbitrary value developed for this analysis which will help to identify the quality of a transit system within a city in terms of number of options and coverage. It relates the percentage of people that use mass transit for their work commute to the number of possible transit options in a particular location. The rating value is calculated as follows:

$$(NumberofTransitOptions * 0.25) + (\%PublicTransit * .75) = RatingValue$$

The final mass transit rating value is determined by scaling the rating value calculated in the equation above. The higher the final Mass Transit Rating value, the better the transit system.

RatingValue	Final Mass Transit Rating
0-5	1
5-10	2
10-15	3
15-20	4
>20	5

X11) Carsharing Operator. If a location has a carsharing program run by one of three largest operators, a value of 1 is assigned to this field. This is a value that will help determine how the size of a carsharing company is related to the size of the organization. If a city has more than one of the largest three carsharing organizations operating a program in its city, then it is assigned a higher value. For example, San Francisco has programs run by City Carshare, Flexcar, and ZipCar, so it receives a value of 3.

X12) Population Density. Many studies suggest that population density plays a role in the success of a carsharing organization. This variable (expressed in persons per mile) will help to determine the influence of population density on carsharing.

The data was compiled in an Excel spreadsheet for easy analysis. Appendix A lists the values of these variables for each location examined in this study.

3.4 Data Analysis and Selection of Variables

While all twelve variables may influence the size of a carsharing organization, it was necessary to determine which variables have the greatest effect in order to develop an effective equation that relates program size to characteristics of a city or region.

3.4.1 Correlation of Variables

The first step in the analysis process was to perform a correlation analysis of the variables. This was completed using SAS. Table 3.4 lists the variables and their Pearson correlation coefficients and probability values. Pearson correlation coefficients close to 1 or -1 indicate that there is a positive or negative correlation, respectively. In addition a correlated value should have a low probability value (0.001 or less) in order to be defined as significant.

According to the correlation analysis, the variables with the most correlation to carsharing program size are the mass transit rating (0.69709), the percentage of people using public transit as a commute mode (0.67934), and the percentage of households with no vehicles (0.70581). All of these variables have a probability value of less than 0.0001. These variables will be considered in the formation of the final equation.

Table 3.4 Correlation Coefficients

Variable	Correlation Coefficient	Prob Value
Population	0.69248	0.0548
% Population between age 18 and 65	-0.20631	0.2829
% of work force in professional occupations	0.02237	0.9083
Average household size	0.09627	0.6194
Per capita income	0.07673	0.6924
Average commute time	0.52573	0.0034
Mass Transit Rating	0.69709	<.0001
Population density	0.51620	0.0041
% using public transit	0.67934	<.0001
% walking to work	0.01894	0.9223
% of households with 0 vehicles	0.70581	<.0001
Carsharing company value	0.36794	0.0400

3.4.2 Model Selection

The next step in the analysis process was the R-Square analysis. This analysis examines various combinations of variables in order to determine which combination yields the highest R-Square value. Using the three variables found in the correlation coefficient analysis yielded an R-Square value of 0.6138. According to the analysis, an R-Square value of 0.9808 can be achieved using 11 of the 12 variables (excluding the percentage of people that walk to work). While the R-Square determines the degree of the fit of the line, such large variables and large errors can result in a relatively poor fit. Further analysis was deemed necessary in order to confidently select the variables.

An adjusted R-Square value analysis was performed next. Unlike the R-Square method, the Adjusted R-Square can decline in value if the contribution to the explained deviation by the additional variable is less than the impact on the degrees of freedom (CSUS, 2005). This means that the Adjusted R-Square will react to alternative equations for the same dependent. The equation with the smallest standard error of the estimate will most likely also have the highest Adjusted R-square (CSUS, 2005).

This analysis yielded a high R-Square value of 0.9474 with 8 variables. The variables highlighted were: the percentage of population between the ages of 18 and 65, the percentage of the workforce employed in professional occupations, the per capita income, the household size, the average commute time, the Mass Transit Rating (MTR), and the carsharing company value. It is interesting to note that only one of the variables outlined in the correlation analysis was used in the Adjusted R-Square value.

Next, a Mallow's Cp selection analysis was performed. Mallow's Cp statistic, introduced by Mallows in 1964, is used as an aid in choosing between

competing multiple regression models (Modelselection.org, 2005). With n observations and k explanatory variables, it defines an s^2 as the estimate of the experimental error variance (Modelselection.org, 2005). The lower the Cp value, the better the model.

In this analysis, a model with eight variables yielded the best Cp value (5.3678) and the highest R-Square value (0.9775). The variables selected by this model include the population, percentage of population between the ages of 18 and 65, the percentage of the workforce in a professional career, per capita income, household size, commute time, the MTR, and the carsharing company value. The Cp analysis yielded the same model as the adjusted R-Square analysis.

With two out of three model selection methods yielding the same results, it was necessary to utilize an additional model selection method to determine which model should be used. The final method used was the stepwise selection method. This method employs both forward and backward selection and evaluates more subsets than any of the other techniques, which usually leads to better results (modelselection.org, 2005). In this analysis a value of 0.25 was used to evaluate the significance of the variables for the stepwise model.

The stepwise analysis yielded a subset of eight variables. These variables included the MTR, the percentage of the workforce employed in professional occupations, the population, the average household size, the carsharing company value, the commute time, the percentage of the population between the ages of 18 and 65, and the average per capita income. Again, these are almost the same variables as those selected by both the Adjusted R-Square value and the Mallow's Cp selection method.

Table 3.5 shows the subset of variables that will be included in the regression analysis. While three out of four of the model selection methods selected the same subset of variables, the correlation coefficients of only three variables were deemed to be significant. As shown in Table 3.5, the eight variable model had a Cp value of 5.3678, one of the lowest values of all the possible combinations, and a anticipated R-Square value of 0.9775. The three variable model had a Cp of 2.5189, much lower that the eight variable model; however the R-Square was also much lower (0.6070). Because of this, a regression analysis will be performed on both subsets of variables, and a comparison will be made between the two.

Table 3.5 Final Model Selection

Model	Variables	Mallow's Cp Value	Anticipated R-square
Eight Variable	Population	5.3678	0.9775
	% between age 18 and 65		
	% employed in professional occupations		
	Per capita income		
	Average household size		
	Commute time		
	Mass Transit Rating (MTR)		
	Carsharing Company Value		
Three Variable	Mass transit rating	2.5189	0.6070
	% using public transit		
	% of households with 0 vehicles		

3.5 Developing a Linear Regression Equation

The final step in the quantitative regression analysis was to develop an equation that could be used as a preliminary research tool for cities looking to start a carsharing program. The goal of this section is not to develop a formula that will be an

exact predictor of program size, but instead to develop a formula that will provide a starting point for further investigation. The data was divided, at random, into two equal sets of data. One set was defined as a working group, which would provide the data used to formulate the linear regression equation. The other set of data was utilized as a test group, which would assess the accuracy of the equation developed with the data from the working group.

3.5.1 Eight Variable Model

A regression analysis was performed on the eight variable model first. Table 3.6 lists the data that was used to develop the equation (See Section 3.3.1 for the definitions of the variable abbreviations used in the table).

SAS was utilized to develop a regression equation through its "Proc Reg" tool. The results of the regression analysis are displayed in Table 3.7. The R-Square value of the equation was 0.9775 and the Adjusted R-Square value was 0.9474. The P-value of the model was 0.0002.

Table 3.6 Working Group Data with Eight Variables

City	X1 (#)	X2 (%)	X3 (%)	X4 (US$)	X5 (#)	X6 (min)	X10 (#)	X11 (#)
Arlington, VA	189453	61.90	77.19	37706	2.15	27.30	4.00	2.00
Austin, TX	672011	70.80	52.23	24163	2.34	22.20	2.00	0.00
Bellingham, WA	69057	73.40	41.03	22801	2.13	16.60	1.00	0.00
Cleveland, OH	414534	61.10	35.02	14825	2.33	25.80	2.00	0.00
Eugene, OR	142716	68.00	47.22	21685	2.25	16.90	1.00	0.00
Hoboken, NJ	38557	80.50	71.81	43195	1.92	34.70	5.00	1.00
Ithaca, NY*	29287	84.50	42.82	13408	2.13	14.30	2.00	0.00
Oakland, CA	399484	64.50	43.61	21936	2.60	31.10	3.00	3.00
Portland, OR	529121	67.30	49.44	22643	2.30	23.10	3.00	1.00
Princeton, NJ	14203	80.60	38.62	27292	2.20	20.30	1.00	1.00
Prince Georges County, MD	801515	61.90	26.41	23360	2.74	35.90	2.00	2.00
San Diego, CA	1223400	65.50	47.45	23609	2.61	23.20	1.00	1.00
San Francisco, CA	776733	71.80	56.68	34556	2.30	30.70	5.00	3.00
Santa Monica, CA	84084	71.00	65.88	42874	1.83	25.00	1.00	1.00
Seattle, WA	563374	72.40	57.43	30306	2.08	24.80	3.00	1.00

Table 3.7 Results for Linear Regression

Variable	Degrees of Freedom	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	1	68097.65	12006.8686	5.6716	0.0024
X1	1	0.00959	0.0017	5.6533	0.0024
X2	1	-256.145	76.6686	-3.3409	0.0205
X3	1	-396.365	72.7879	-5.4455	0.0028
X4	1	0.39174	0.1334	2.9373	0.0324
X5	1	-14485.824	4455.1226	-3.2515	0.0227
X6	1	-862.720	147.6656	-5.8424	0.0021
X10	1	3922.320	576.8603	6.7994	0.0010
X11	1	2685.592	595.0244	4.5134	0.0063

The next step in the analysis was to test the regression equation on the actual test group data using the parameter estimates. Table 3.8 shows the actual number of members compared to the computed number of members. As can be seen in the table, the eight variable analysis does not even come close to accurately predicting the number of members in a city. Many of the predictions are negative, and a large number of the positive predictions are very far off. However, when summing the total number of predicted members, the sum comes very close to predicting the total number of actual members. In addition, the average number of members is very similar. This model does not predict membership accurately enough to be considered for use.

Table 3.8 Eight Variable Regression Predictions

City	Number of Members (Actual)	Number of Members (Computed)	Difference
Ann Arbor, MI	360.00	-10334.21	-10694.21
Aspen, CO	57.00	-9486.91	-9543.91
Boston, MA	22520.00	3.54	-22516.46
Boulder, CO	65.00	-14875.70	-14940.70
Chicago, IL	7520.00	18610.88	11090.88
Chapel Hill, NC	160.00	-8487.05	-8647.05
Detroit, MI	6.00	-4597.95	-4603.95
Los Angeles, CA	1360.00	79823.64	78463.64
Madison, WI	200.00	-10430.87	-10630.87
Minneapolis, MN	360.00	-2719.09	-3079.09
Montgomery County, MD	1800.00	-14117.51	-15917.51
New York, NY	26080.00	63390.63	37310.63
Philadelphia, PA	1200.00	8440.31	7240.31
Santa Barbara, CA	80.00	-11008.35	-11088.35
Washington, DC	19832.00	2800.39	-17031.61
Total	81600.00	87011.76	5411.76
Average	5440.00	5800.78	360.78

3.5.2 Three Variable Regression Analysis

A regression analysis was also performed on the three variable model. Table 3.9 lists the data that was used to develop the equation (See Section 3.3.1 for the definitions of the variable abbreviations used in the table).

Table 3.9 Working Group Data with Three Variables

City	X8 (%)	X9 (%)	X10 (#)
Arlington, VA	23.30	8.50	4.00
Austin, TX	5.00	7.80	2.00
Bellingham, WA	3.60	10.20	1.00
Cleveland, OH	12.00	24.60	2.00
Eugene, OR	4.55	10.60	1.00
Hoboken, NJ	57.20	38.30	5.00
Ithaca, NY*	7.87	24.60	2.00
Oakland, CA	17.40	19.60	3.00
Portland, OR	12.30	14.00	3.00
Princeton, NJ	4.90	13.70	1.00
Prince Georges County, MD	11.90	10.50	2.00
San Diego, CA	4.18	9.50	1.00
San Francisco, CA	31.10	28.60	5.00
Santa Monica, CA	4.10	10.70	1.00
Seattle, WA	17.60	16.30	3.00

Again, SAS was utilized to develop a regression equation through its "Proc Reg" tool. The results of the regression analysis are displayed in Table 3.10. The R-Square value of the equation was 0.6137 and the Adjusted R-square was 0.5084. The P-value of the model was 0.0124.

Table 3.10 Results for Linear Regression

Variable	Degrees of Freedom	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	1	-5226.4634	2518.3224	-2.0754	0.0622
X8	1	4938.7873	1327.2313	3.7211	0.0034
X9	1	-351.7101	156.8642	-2.2421	0.0465
X10	1	66.4271	151.2362	0.4392	0.6690

The next step in the analysis was to test the regression equation on the actual test group data using the parameter estimates. Table 3.11 shows the actual number of members compared to the computed number of members. The three variable equation does a slightly better job of predicting membership within a city than the eight variable equations. However, the difference between predicted and actual number of members is still quite large. This model does not predict membership accurately enough to be considered for use either.

Table 3.11 Three Variable Regression Predictions

City	Number of Members (Actual)	Number of Members (Computed)	Difference
Ann Arbor, MI	360.00	2679.51	2319.51
Aspen, CO	57.00	-3614.16	-3671.16
Boston, MA	22520.00	10425.54	-12094.46
Boulder, CO	65.00	2309.83	2244.83
Chicago, IL	7520.00	12496.38	4976.38
Chapel Hill, NC	160.00	3119.14	2959.14
Detroit, MI	6.00	3591.14	3585.14
Los Angeles, CA	1360.00	1900.65	540.65
Madison, WI	200.00	2902.64	2702.64
Minneapolis, MN	360.00	5781.13	5421.13
Montgomery County, MD	1800.00	5656.55	3856.55
New York, NY	26080.00	4597.17	-21482.83
Philadelphia, PA	1200.00	12905.48	11705.48
Santa Barbara, CA	80.00	-1239.31	-1319.31
Washington, DC	19832.00	10241.86	-9590.14
Total	81600.00	73753.54	-7846.46
Average	5440.00	4916.90	-523.10

3.6 Members as a Percentage of Total Population

With the disappointing results from the above analysis, it was necessary to attempt an additional analysis to rate membership potential as a function of census data. Instead of relating census data to exact levels of membership, it was decided to try to link it to membership as a percentage of the total population. This figure is calculated by dividing the total number of members by the population. This allows membership to be analyzed as a function of city size. Table 3.12 shows the values for the working group cities and the test group cities.

Table 3.12 Members as a Percentage of Total Population

Working Group		Test Group	
City	**Members**	**City**	**Members**
Arlington, VA	2.01%	Ann Arbor, MI	0.31%
Austin, TX	0.01%	Aspen, CO	0.98%
Bellingham,WA	0.02%	Boston, MA	4.32%
Cleveland, OH	0.02%	Boulder, CO	0.08%
Eugene, OR	0.01%	Chicago, IL	0.28%
Hoboken, NJ	1.35%	Chapel Hill, NC	0.33%
Ithaca, NY*	0.56%	Los Angeles, CA	0.01%
Oakland, CA	0.38%	Madison, WI	0.10%
Portland, OR	1.07%	Minneapolis	0.09%
Princeton, NJ	0.56%	Montgomery County, MD	0.21%
Prince Georges County, MD	0.22%	New York, NY	0.33%
San Diego, CA	0.14%	Philadelphia, PA	0.08%
San Francisco, CA	2.14%	Santa Barbara, CA	0.09%
Santa Monica, CA	0.14%		

The same set of analyses was performed using this measure as in the above analysis. Table 3.13 shows the results of the correlation analysis. The variable

"population" was removed from this analysis because the measure of membership being used is a product of population.

Table 3.12 Correlation Coefficients

Variable	Correlation Coefficient	Prob Value
% Population between age 18 and 65	.1094	0.6978
% of work force in professional occupations	0.6260	0.0126
Average household size	0.5437	0.0362
Per capita income	-0.2641	0.3416
Average commute time	0.3828	0.1590
Mass Transit Rating	0.8581	<.0001
Population density	0.5162	0.0489
% using public transit	0.6850	0.0048
% walking to work	0.0723	0.7983
% of households with 0 vehicles	0.4065	0.1327
Carsharing company	0.5634	0.0287

The correlation between members as a percentage of total population is highest with the percentage of the workforce in professional occupations (0.6260), average household size (0.5437), the MTR (0.8581), the population density (0.5162), the percentage of commuter using public transit (0.6850), and the carsharing company value (0.5634).

An R-Square, Adjusted R-Square, Mallow's Cp, and a stepwise analysis were performed on this data, in the same method as conducted in the previous analysis. Table 3.14 shows the subset of variables chosen by each of the analyses. Common variables chosen by all the methods include X2, X3, X10, and X12. Common variables chosen by the subset selection methods include X2, X3, X4, X6, X8, X10, X12. Similar to the previous regression analysis, two regression analyses

were performed. First, a regression analysis was performed on the variables selected by the correlation coefficients (6 variables). Next, a regression analysis was performed on the common variables selected by the latter four subset selection methods (7 variables).

Table 3.14 Variable Selection by Analysis Method

Analysis	Subset of Variables Selected
Correlation Coefficient	X2, X3, X7, X10, X11, X12
R-Square	X2, X3, X4, X5, X6, X7, X8, X9, X10, X11, X12
Adjusted R-Square	X2, X3, X4, X6, X7, X8, X9, X10, X12
Mallow's Cp	X2, X4, X6, X8, X10, X12
Stepwise	X2, X3, X4, X6, X8, X10, X12

6.7 Final Regression Analysis

A final regression analysis was performed on both the 6 and 7 variable analyses. In addition, the variables outlined by Grossberg and Newenhouse (2002) were also used for a regression analysis. The results from the regression analysis can be seen in Table 3.15. The R-square value for the 6 variable regression analysis was 0.8717, the adjusted R-square was 0.7756, and the significance was 0.00327. The R-square for the 7 variable analysis was 0.9598, the adjusted R-square was 0.9196, and the significance was 0.00022. According to the statistics alone, the 7 variable analysis should better predict the percentage of the population that are members of carsharing.

Table 3.15 Results for Linear Regression

Model	Variable	Degrees of Freedom	Parameter Estimate	Standard Error	t Value	Pr > t
7 Variable	Intercept	1	0.03059	0.01824	1.67747	0.13735
	X2	1	-0.00047	0.00021	-2.25673	0.05861
	X3	1	-0.01964	0.01301	-1.50927	0.17497
	X4	1	0.000001	0.000001	3.65011	0.00818
	X6	1	-0.00068	0.00027	-2.54633	0.03831
	X8	1	0.00679	0.00089	7.64936	0.00012
	X10	1	0.000001	0.000001	-1.61106	0.15120
	X12	1	0.00027	0.00009	2.94078	0.02169
6 Variable	Intercept	1	-0.03037	0.01188	-2.55667	0.03382
	X2	1	0.00026	0.00015	1.67878	0.13171
	X3	1	0.02009	0.00951	2.11131	0.06773
	X7	1	0.00414	0.00206	2.01411	0.07878
	X10	1	0.000001	0.000001	-1.26176	0.24258
	X11	1	0.00007	0.00031	0.23579	0.81952
	X12	1	0.00142	0.00123	1.15538	0.28127
Grossberg and Newenhouse	Intercept	1	0.078654	0.039116	2.010803	0.072078
	X3	1	-0.000804	0.000362	-2.217949	0.050871
	X5	1	-0.011198	0.008599	-1.302169	0.222052
	X7+X8	1	0.000463	0.000171	2.705648	0.022098
	X12	1	-0.0000002	0.000000	-0.582120	0.573375

The application of the regression equations defined above to the test group data can be seen in Table 3.16. Neither of the equations do a very good job of predicting the percentage of the population that are members of a carsharing organization. The six variable equation seems to more accurately predict the cities with low percentages, but has a few negative values. The negative values are most likely a result of a city having a low percentage of professionals. The seven variable equation almost always over-estimates by an average of 2.06%. It comes close to accurately predicting the percentages for large cities like Boston, and Washington, DC which have large programs, but overestimates smaller programs by a large amount.

Table 3.16 Comparison of Results of Regression Equations

City	Actual Percentage	6 Variable	Difference	7 Variable	Difference
Ann Arbor, MI	0.31%	0.67%	0.36%	1.64%	1.32%
Aspen, CO	0.98%	0.56%	-0.42%	2.57%	1.58%
Boston, MA	4.32%	1.11%	-3.22%	4.73%	0.41%
Boulder, CO	0.08%	0.78%	0.70%	2.13%	2.05%
Chicago, IL	0.28%	0.78%	0.51%	4.02%	3.74%
Chapel Hill, NC	0.33%	0.79%	0.46%	1.59%	1.26%
Los Angeles, CA	0.01%	-0.80%	-0.82%	2.06%	2.04%
Madison, WI	0.10%	0.58%	0.48%	1.57%	1.47%
Minneapolis, MN	0.09%	0.63%	0.53%	2.47%	2.37%
Montgomery County, MD	0.21%	1.35%	1.14%	2.44%	2.24%
New York, NY	0.33%	-0.34%	-0.66%	4.81%	4.48%
Philadelphia, PA	0.08%	0.39%	0.32%	3.74%	3.66%
Santa Barbara, CA	0.09%	-0.17%	-0.26%	1.77%	1.68%
Washington, DC	3.85%	1.44%	-2.41%	4.33%	0.48%
Total	11.06%	7.76%	-3.30%	39.85%	28.79%
Average	0.74%	0.55%	-0.24%	2.85%	2.06%

The best results stemmed from the equation with variables outlined in the research by Grossberg and Newenhouse. Table 3.17 presents the results of this regression analysis. The Grossberg and Newenhouse variables include the percentage of population between the 18 and 65, the population density, average household size, and percentage of people commuting by mass transit or by walking. The equation developed by these variables has an R-square of 0.5811, an Adjusted R-Square of 0.4136, and a significance of 0.05037. While these are the lowest parameters of any of the other equation, it results in the lowest average difference between the actual and predicted amounts (-0.19%). The equation typically under-estimates most of the variables, but the error is relatively low compared to the other equations.

Table 3.17 Results of Regression using Grossberg and Newenhouse Variables

City	Actual Percentage	Grossberg Newenhouse Variable	Difference
Ann Arbor, MI	0.31%	-0.20%	-0.52%
Aspen, CO	0.98%	0.30%	-0.69%
Boston, MA	4.32%	1.42%	-2.91%
Boulder, CO	0.08%	0.02%	-0.06%
Chicago, IL	0.28%	0.80%	0.52%
Chapel Hill, NC	0.33%	0.02%	-0.31%
Los Angeles, CA	0.01%	-0.10%	-0.12%
Madison, WI	0.10%	0.21%	0.11%
Minneapolis, MN	0.09%	0.52%	0.43%
Montgomery County, MD	0.21%	0.46%	0.25%
New York, NY	0.33%	1.88%	1.56%
Philadelphia, PA	0.08%	1.37%	1.29%
Santa Barbara, CA	0.09%	0.09%	0.01%
Washington, DC	3.85%	1.62%	-2.23%
Total	11.06%	8.41%	-2.65%
Average	0.74%	0.60%	-0.19%

6.8 Discussion

The most important conclusion to be drawn from this regression analysis is that the size of a carsharing program, in terms of membership, does not always correspond to regional demographics, economical and transportation characteristics that have been outlined in other studies. This analysis reflects the conclusion drawn by Millard-Ball et al., that carsharing members do not necessarily reflect the characteristics of the region. The correlation analysis conducted in this section verified the importance of mass transit use, age, income, household size, and population density as a potential measure of membership. However, the relationship is not strong enough to conclude that membership depends on the levels of these variables.

While the Grossberg and Newenhouse equation had the lowest average error, it under-estimated many of the programs. It may be possible to use the seven variable equation to predict the potential percentage of a population that will be carsharing program members. This equation seems to reflect, more accurately, the percentage of the population in larger cities with more well-established programs. However, the equation seemed to over predict with smaller programs. This equation could possibly reflect the potential size of a carsharing program if conditions were perfect, and if the program was well established. Further research should be conducted to examine the potential use of such equations as carsharing becomes more of a mature form of transportation.

Chapter 4

MARKET CONDITIONS IN SMALL CITIES

Much of the research on carsharing today examines carsharing in large cities. Large cities offer extensive mass transit systems, high population densities, a variety of mixed use development, and a low average vehicle ownership rate. As a result, carsharing has been most successful in these locations; however, that does not mean that a carsharing program can not work in a smaller city environment. While smaller cities do not offer all the amenities of larger ones, programs currently in operating in smaller cities of Aspen, CO and Kitchener, ON share some of the characteristics of large cities such as access to a good transit system (Millard-Ball et al, 2005).

This chapter will study the market for carsharing in small cities by examining the carshare program in Boulder, Colorado. A market analysis was performed by surveying 40 active members as well as 7 members that have recently become inactive. This survey gathered information regarding demographics of the members as well as their transportation habits, vehicle ownership, and trip patterns. In addition, four months of trip logs were obtained for each vehicle. These logs list the amount of time the vehicle was in use as well as the mileage for that particular trip. These logs were used to examine typical travel patterns for users of the program.

4.1 Background on Boulder CarShare

The city of Boulder, Colorado has a population of 83,432, according to the 2000 census. In comparison, Wilmington, Delaware has a population of about 72,664. A series of e-mail and phone conversations with Karen Worminghaus, director of the Boulder program, were conducted over the week of January 29th, 2007.

Boulder CarShare is a non-profit organization that was founded in 1997 by a small group of volunteers with an interest in carsharing. The program started informally when a household of unrelated housemates realized that they didn't need a car for each person and could sell all but one car and share it. Boulder CarShare was incorporated as a non-profit organization in 1997 and in January 2001 it officially started its operations.

The carshare program began with one vehicle that was loaned to the program for two years. The program did not have a lot of advertising, and instead relied mostly on word-of-mouth and the logo on the vehicles to increase awareness of the program. Demand grew sharply within the first year of the program, once the vehicles were on the street. Today the program has expanded to six vehicles and 65 members.

Boulder boasts a good bus and bike system, which has helped increase the awareness of the carshare program as well. Most of the vehicles are located on major bus corridors in central areas of the city. Currently there are approximately 40 active members; the majority are between the ages of 30 and 50, with moderate incomes. The membership is slightly more female than male. The typical member cites the environment as the biggest driving force behind joining the program.

The program has not attempted to create partnerships with corporations or the city government. It still relies on volunteer labor and charges $1 per hour and 50

cents per mile, which only covers the cost of maintenance and insurance of the vehicles. Boulder CarShare uses a phone reservation system and utilizes lock boxes on the rear of the car for member access. The program relies on the members to make note of their trip distance and travel time on a log for billing. The program is hoping to acquire a web system soon.

The Boulder CarShare program continues to grow. According to Karen Worminghaus the program could easily support up to 50 vehicles if more funding became available. The program is looking to the Denver Regional Council of Governments and possible partnerships with the city or corporations to support further growth.

4.2 Member Survey

The purpose of conducting a member survey was to obtain information regarding the characteristics and habits of members of a carsharing organization in a small city. A mail survey of the 40 active members and 7 recently inactive members of Boulder CarShare was conducted in mid February. The survey consisted of a small 6-page booklet with a total of 36 questions (see Appendix B for survey questions).

The contact information of the Boulder CarShare members was provided through cooperation with Karen Worminghaus. She was very interested in the survey because Boulder CarShare has never surveyed its members, but would like to obtain more information about them. A draft of the survey was submitted to Boulder CarShare two weeks prior to the mailing of the survey. Boulder CarShare staff reviewed the questions and added questions that would help them gain more information about their members. Members received an e-mail from Boulder CarShare before the survey was mailed to inform the members about the survey as well as to

ensure that Boulder CarShare had permission to use their addresses. Only one person opted out of the survey. Members were offered a chance to win one of two $20 prizes that would be applied to future carshare bills.

The survey was distributed in mid February by US mail. Each members received a brown envelop containing the small 6-page booklet as well as a self addressed stamped envelope in which to return the survey.

4.3 Results

A total of 24 out of 40 active members responded, and a total of three out of seven inactive members responded. Inactive members were identified as persons who recently left the program (within the last 6 months). Three surveys were returned as non-deliverable; in two cases the members had moved, and in one case the address was labeled incorrectly. As a whole, 27 out of 44 surveys were received for a total response rate of 61.4%.

4.3.1 Demographics

The first eleven questions were designed to gather basic demographic data about the members, such as their age, sex, income, educational background, household size, and employment. The average age of the members was 38, the median was 35, and the mode was 31. Many other surveys have also found that US carsharing members tend to be in their 30's (Brook, 2004 & Lane, 2004). There were a wide variety of ages ranging from 21 to 64. One person chose not to disclose their age on the survey.

Almost two-thirds of the respondents (63%) were female. This is a much larger proportion of females than other surveys have suggested. In Norway, Germany,

Switzerland and Sweden, the typical carsharing member is a well educated male (Klintman, 1998). Brook identifies US carshare members as being evenly split between male and female (2004).

Almost all of the respondents (92.5%), both active and inactive, have obtained at least a college degree. 22% have completed some graduate school, while nearly 30% have received a graduate degree. Again these results are similar to those of other surveys of US carsharing members. Brook identifies most US carsharing members as having at least a college degree (2004). All three recently inactive members hold a graduate degree.

The majority of respondents (59%) rent their homes, while almost 37% own their own home. It must be noted that one person did not answer some of the demographic questions, and therefore some percentages may not add up to 100. In terms of household composition, 29% are married with at least one child, 22% are married with no children, 22% live alone, and 26% live with unrelated adults. The majority of households have at least two adults over the age of 16 (55.6%). Other studies have suggested that there is an even split between those who are married and those who are not, as well as between those who rent or own their own home (Brook, 2004). Approximately 77% of the respondents live with at least one other adult. None of the respondents reported living alone with a child.

In terms of employment, 44% are employed full time, 26% are employed part-time, another 22% are students, and 8% are self-employed and work from home. Incomes vary widely within the group of respondents. Over half (55.6%) of the respondents make less than $60,000 a year, and almost 30% make $30,000 or less.

These results are comparable to those of other US carsharing members. (See for example Brook, 2004 or Millard-Ball et al 2005).

4.3.2 Travel Characteristics

The majority of the respondents (55.6%) have been members of Boulder CarShare for one year or less. Interestingly, of the remaining 44% that have been members for longer than one year, 58% have been members for four years or more. There seems to be very few people in the one to four year membership range.

Just over half of the respondents (52%) reported owning one vehicle, while only one respondent reported owning two vehicles. Surprisingly, 44% of the respondents reported not owning a vehicle prior to joining the program. Of the 44% that lived in a no vehicle household, 83% listed not having access to a car as one of their motivations for joining the carshare program. Of the 27 respondents, 18.5% said that their vehicle was starting to feel like a burden, and 22% said that they were actively looking to decrease their car ownership.

All 27 respondents lived within the city of Boulder, and 24 of those worked within the city. The majority of respondents who worked in the city of Boulder (70.4%) resided three miles or less from their place of work (this includes the two people that work from home). In terms of the commute to work:

- 26% walk to work
- 37% bike to work
- 22% take the bus to work
- 4% use the carshare service

- 7% drive alone
- 4% do not have to commute at all

One of the factors most commonly cited for the success of carsharing is its partnership with mass transit. About 90% of the Boulder CarShare members reported having at least two bus routes within walking distance of home. Specifically, 37% reported two, 22% reported three, 4% reported four, and 26% had at least five or more bus routes within walking distance from their homes. Table 4.1 shows the estimated number of trips per month taken using various modes (total of all respondents).

Table 4.1 Total Estimate Trip Distributions for One Month

Trip Mode	Number of Trips per Month	Percent Share
Walk	135	30.5%
Bicycle	135	30.5%
Bus	107	24.2%
Carpool	15	3.4%
Motorcycle/Scooter	0	0.0%
Carshare	30	6.8%
Drive Alone	18	4.1%
Other	3	0.7%
Total	443	

4.3.3 Motivations and Use

A total of 24 of the 27 respondents identified themselves as active members. Of the 24 active members, 25% use the carsharing service less than once a month, 37.5% use the carsharing service one to three times per month on average, 20.8% use the carsharing service about once a week, and 16.7% use the carsharing

service several times a week. These results are very interesting in the fact that the majority of the vehicles' use is coming from only a small percentage of the active members. A large portion (62.5%) of the active respondents use the carsharing vehicles three times a month or less, which is a very low vehicle utilization rate for such a large portion of the membership base.

Boulder CarShare was a grassroots organization that started with no funding and little advertising. Basically, the program expanded by word of mouth. According to the survey:

- 23% learned about the program through a friend
- 15% learned about the program by seeing the logo on one of the vehicles
- 33% learned about the program via the website
- 11% learned about the program through a newspaper article
- 11% learned about it during a tabling event
- 7% reported themselves as being one of the founders

The respondents reported making an average 3.67 trips per month using Boulder CarShare. The Millard-Ball et al study found a similar number of 3.34 trips per month, with a median of two trips per month (2005). The respondents of the Boulder CarShare survey also reported a median of two trips per month.

In addition to determining the average number of carsharing trips per month per member, the survey asked respondents to list how many times a month they

use the carsharing vehicles to conduct certain types of trips. Table 4.2 lists the types of trips and the total number of trips taken in an average month for all members.

Table 4.2 Distribution of Trip Type over One Month

Type of Trip	Number of Trips per Month	Percent Share
Commute to Work	7	4.93%
Work-Related Activities	17	11.97%
Social	25	17.61%
School	14	9.86%
Personal Business	19	13.38%
Grocery Shopping	28	19.72%
Other Shopping	17	11.97%
Recreation	12	8.45%
Dining	3	2.11%
Other	0	0.00%
Total	142	

The largest number of trips (28) were grocery shopping trips. Work related activities, social events, personal business, and other shopping were the other trips that had a share over 10% of the total average monthly use. Dining, commuting to work, and recreation had the lowest number of trips per month.

When asked about characteristics or benefits of a carsharing program that mattered most to them, survey respondents listed affordability, convenience, environmental benefits, and the general carsharing philosophy as highly important. Other factors such as fewer hassles, personal freedom, and increased productivity were listed as moderate to very important. When asked to select the benefit that had the most importance (four people did not respond):

- 26% listed affordability
- 13% listed convenience
- 9% listed fewer hassles
- 17% listed personal freedom
- 26% listed environmental friendliness
- 9% listed the carsharing philosophy

Respondents were also asked to check any other motivation behind joining the carshare program (respondents could select more than one).

- 12 respondents said that they joined because it helped them save money on transportation
- 18 listed environmental friendliness as one of the reasons why they joined.
- 20 said that they needed access to a car.
- An additional 20 said that they like the carsharing philosophy.
- 7 said that they couldn't afford to own a car of their own.
- 14 said that they wanted to eliminate the hassles of owning a car.

Respondents were also asked what they felt the least attractive features of carsharing were. Table 4.3 lists the response rate for each of the negative characteristics. Just over one quarter of the respondents said that they are concerned that a carsharing vehicle will not be available when they need one. Almost 19% said that the vehicles are located too far away from their home or office. Only about 7% of

respondents said they frequently experience times when a car is not available when they need it.

Table 4.3 Most Disliked Features of Boulder Carshare

Negative Attribute	Percent of Responses
The reservation process is not convenient	7.41%
It is too expensive	11.11%
The vehicles are located too far away from your home or office	18.52%
I have frequently experienced that cars are not available when needed	7.41%
I am concerned that cars will not be available when I need them	25.93%
None	11.11%
Other	18.52%

Almost 19% of the respondents listed something else as a negative attribute. One respondent commented that the vehicles are old and unattractive, and that could be holding Boulder CarShare back from increased membership. Another respondent, who recently left the program, also noted that most of the cars are manual and that is a problem for people who can't drive a manual car. In addition, a respondent noted that a few of the cars are in disrepair and are often at the shop. Another respondent disliked having to return the vehicles to their original locations.

4.2.4 Behavioral Changes

In addition to asking respondents about their transportation habits, a series of questions were designed to identify changes in travel after members joined the carsharing program. Since joining Boulder CarShare:

- 7% acquired a car
- 14.8% got rid of a car
- 33% decided not to purchase a car (or a second car)
- 7% strongly considered getting rid of one car
- 37% did none of the above

General travel habits did not change among most of the members. Respondents were asked how often they traveled more than 5 miles from their home per week (excluding work trips) before joining, and then after joining. The majority (60%) of respondents said that they typically travel more than 5 miles away from their home one to three times per week. Of that 60%, 87.5% did not decrease the number of times per week that they traveled more than 5 miles away from their home, after joining the program. 85% of all respondents experienced no change in their transportation habits.

Next, participants were asked how their use of modes has changed after joining the carshare program. Before joining the program:

- 4% never used mass transit
- 22% used mass transit a few times per month
- 48% used mass transit a few times per week
- 26% used mass transit almost everyday

Table 4.4 shows responses to question 27, which asked if the use of certain modes increased, stayed the same, or decreased after joining the program.

In general, the majority of people's transportation habits stayed the same. About a quarter of the respondents said that they walk, bike, and take public transit more. Approximately 1/3 of the respondents said that they drive more since joining the program, another third said they drive about the same, and another third said they drive less.

Table 4.4 Changes in Mode Use After Joining Boulder CarShare

Mode	More	The Same	Less
Walk	29.63%	70.37%	0.00%
Bike	25.93%	59.26%	14.81%
Take Public Transit	25.93%	51.85%	22.22%
Take a Taxi	0.00%	70.37%	29.63%
Borrow a Friend's Car	3.70%	59.26%	37.04%
Drive	33.33%	33.33%	33.33%
Consolidate my Trips	48.15%	44.44%	3.70%
Forgo Trips	40.74%	40.74%	18.52%

In terms of trips, almost 50% of the respondents say they now consolidate their trips more, and 40% say that they sometimes forgo unnecessary trips. The largest decrease (37%) occurred in the use of a friend's car. Taxi use stayed the same; however, the majority of those who had an unchanged use of taxis noted that they never, or rarely, use taxis.

When asked what they would do if carsharing was discontinued 13 respondents said that they would walk or bike more, while nine said that they would use transit more often. (Note: Respondents were allowed to select more than one mode.) Interestingly, nine said that they would borrow a friend's car more, and

another nine said they would rent a car. Only five respondents said that they would consider buying a car.

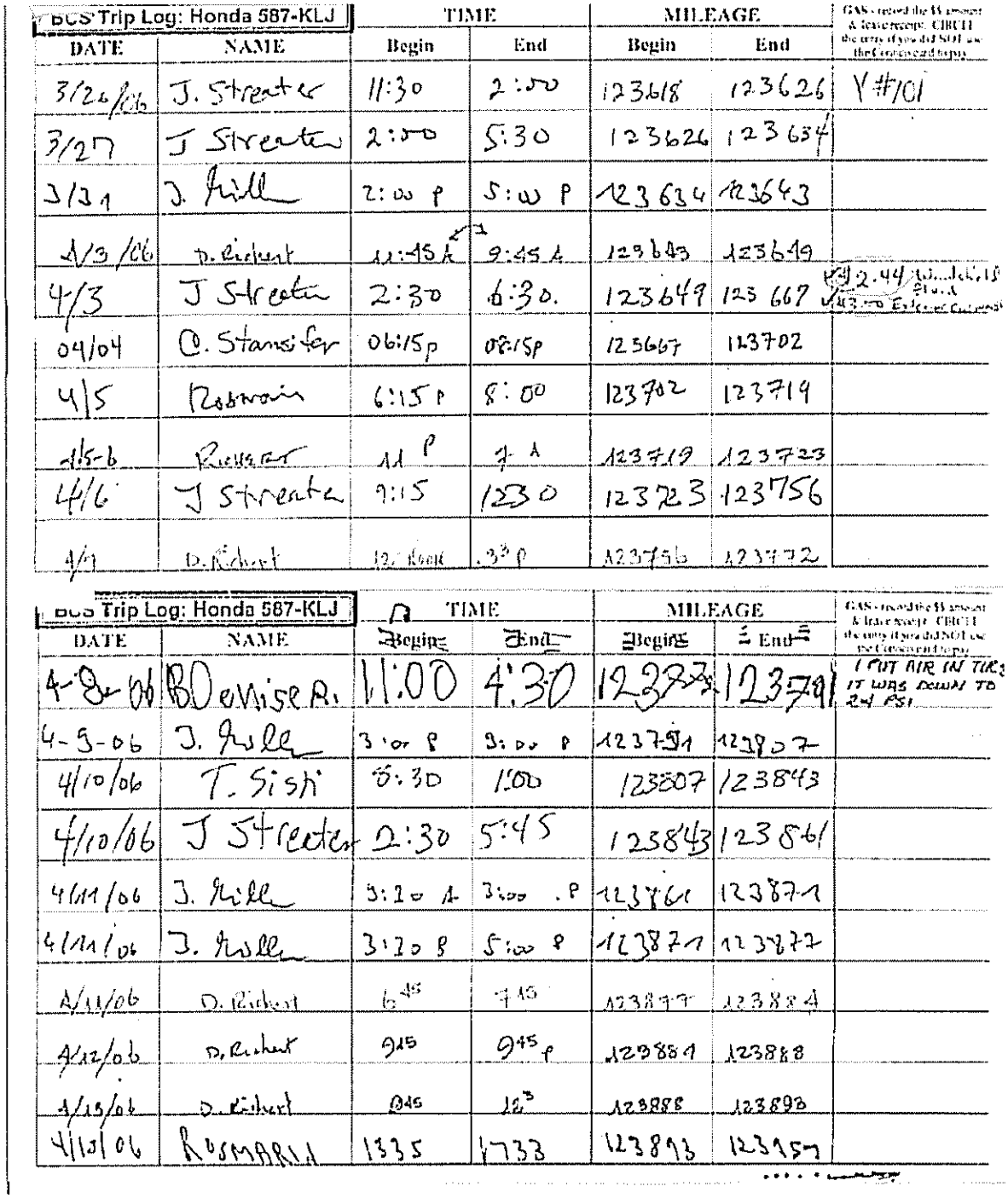
Finally, respondents were asked how the availability and location of the carsharing service would affect their decision on where to move, if they were to move. The location of a carsharing vehicle would be very important to 22% of the respondents, and slightly important to 56% of the respondents when determining where to look for a new house or apartment.

4.4 Trip Log Analysis

In addition to providing contact information for the carsharing program members, Karen Worminghaus also supplied four months of trip logs from each carsharing vehicle over the past year. Boulder CarShare uses trip logs located in the vehicles to monitor use. Members are expected to record their starting and ending time, as well as their starting and ending mileage for billing purposes. While this method offers an opportunity for members to record their usage incorrectly, there were no reported difficulties thus far with this system (in terms of accuracy and completeness). Figure 4.1 shows an example trip log.

4.4.1 Methodology

The four months that were chosen for the trip logs were April, May, November, and December of 2006. These months were chosen in order to determine if there is a seasonal impact on carsharing program use between warmer months (April and May), and colder months (November and December). Trip logs for all six vehicles were sent via e-mail. Two of the most recently acquired vehicles did not have trip log data for the months of April and May.



BCS Trip Log: Honda 587-KLJ

DATE	NAME	TIME Begin	TIME End	MILEAGE Begin	MILEAGE End	GAS - record the $ amount & letter receipt CIRCLE the ones if you did NOT use the Corporate card to pay
3/26/06	J. Streater	11:30	2:00	123618	123626	Y #101
3/27	J Streater	2:00	5:30	123626	123634	
3/31	J. Rolle	2:00 P	5:00 P	123634	123643	
4/3/06	D. Richert	11:45 A	2:45 A	123643	123649	
4/3	J Streater	2:30	6:30.	123649	123 667	2.44
04/04	C. Stansifer	06:15p	08:15p	123667	123702	
4/5	Robinson	6:15 P	8:00	123702	123719	
4/5-6	Rueger	11 P	7 A	123719	123723	
4/6	J Streater	9:15	1230	123723	123756	
4/9	D. Richert	12 Noon	3:30 P	123756	123772	

BCS Trip Log: Honda 587-KLJ

DATE	NAME	TIME Begin	TIME End	MILEAGE Begin	MILEAGE End	GAS - record the $ amount & letter receipt CIRCLE the ones if you did NOT use the Corporate card to pay
4-8-06	BOeNISER.	11:00	4:30	123783	123791	I PUT AIR IN TIRE IT WAS DOWN TO 24 PSI
4-9-06	J. Rolle	3:00 P	9:00 P	123791	123807	
4/10/06	T. Sisti	8:30	1:00	123807	123843	
4/10/06	J Streater	2:30	5:45	123843	123861	
4/11/06	J. Rolle	3:10 A	3:00 P	123861	123871	
4/11/06	J. Rolle	3:10 P	5:00 P	123871	123872	
4/11/06	D. Richert	6:45	7:45	123877	123884	
4/12/06	D. Richert	9:15	9:45 P	123881	123888	
4/13/06	D. Richert	9:45	12:3	123888	123893	
4/10/06	ROSMARIA	1335	1733	123893	123957	

Figure 4.1 Example of a Boulder CarShare Trip Log

The purpose of examining these trip logs is to analyze the travel habits of carsharing program members in a smaller city. This is not intended to represent the travel characteristics of all programs in small cities. It is solely an examination of the travel patterns of one program that may help to form the implementation framework presented later in this paper. The trip logs do not provide a list of the origin and destination of each trip; rather they list only the date, user name, beginning and ending times, and the beginning and ending mileage.

Each vehicle's trip log data was recorded in a Microsoft Excel spreadsheet (see Table 4.5 for the description of each vehicle and its location). The date, beginning and ending time, and beginning and ending mileage were transferred from the trip logs to the spreadsheet. The total time and total mileage for each trip were calculated. Total time was rounded up to the nearest quarter hour. In addition, a factor, "miles per hour," was computed in order to examine the utilization of the vehicle during a particular trip. This factor represents how many miles a user has traveled per hour that the vehicle was being used (according to the trip log). Averages were calculated for each month for all the factors (total time, total mileage, and miles per hour).

Table 4.5 Vehicle Numbers, Types, and Locations

Vehicle Number	Type	Location
101	Honda Accord (White)	South Boulder
102	Ford Taurus (White)	Downtown Boulder
103	Saturn Sedan (Dark Blue)	North Boulder
104	Honda Accord (White)	Central Boulder
105	Ford Pickup (Green)	North Boulder
106	Honda Insight (Silver)	North-East Boulder

4.1.2 Results

The usage patterns varied from vehicle to vehicle. The Honda sedan, located in South Boulder, experienced the most use, while the Ford truck in North Boulder saw the least amount of use (on a monthly basis). Table 4.6 lists the monthly totals and averages for each vehicle.

Table 4.6 Monthly Total and Average Usage by Vehicle

Month	Measure		Vehicle					
			101	102	103	104	105	106
April	Time (hr)	Total	129.25	88.50	167.75	16.50	N/A	N/A
		Avg.	3.69	8.05	7.29	2.36		
	Mileage (mi)	Total	617	339	753	71		
		Avg.	18	31	33	10		
	Mileage/Hour	Avg.	4.77	3.83	4.49	4.30		
	# of Trips	Total	35	11	22	7		
May	Time (hr)	Total	194.50	96.50	134.50	91.00		
		Avg.	4.86	5.68	6.40	8.27		
	Mileage (mi)	Total	1009	357	553	201		
		Avg.	25	21	25	18		
	Mileage/Hour	Avg.	5.19	3.70	3.92	2.21		
	# of Trips	Total	39	17	21	11		
November	Time (hr)	Total	30.50	80.50	160.75	137.50	13.50	43.50
		Avg.	6.10	9.47	13.98	14.47	5.40	21.75
	Mileage (mi)	Total	146	356	612	505	89	90
		Avg.	16	22	28	28	22	30
	Mileage/Hour	Avg.	2.66	2.35	1.99	1.94	4.12	1.38
	# of Trips	Total	8	15	21	17	4	3
December	Time (hr)	Total	96.33	60.00	144.00	142.75	39.00	27.50
		Avg.	10.70	3.75	5.54	6.80	13.00	3.06
	Mileage (mi)	Total	332	282	578	381	96	99
		Avg.	33	18	22	18	32	10
	Mileage/Hour	Avg.	3.10	4.70	4.01	2.67	2.46	3.24
	# of Trips	Total	9	15	25	20	3	10

In general, there seems to be more activity during April and May compared to November and December. Vehicle 103, located in North Boulder, experienced consistent use throughout the four months in terms of mileage and total number of trips. Vehicle 104 experienced very low usage during April and May. This was mainly due to the fact that prior to November 2006, the vehicle was small, old, and unreliable. It was replaced with a Honda Accord in better condition in November and the number of trips increased. Vehicles 105 and 106 had the lowest total number of trips for the months of November and December.

Excluding vehicles 105 and 106, the vehicles were used most during the month of May. They were driven an average of 22.25 miles per trip, and were in use for a total of 516.5 hours. The average amount of time per trip was 6.30 hours. This number is not necessarily the total time the car was being driver; rather it is the total time it took the vehicle to be returned to its origin. Closer examination of the trip log data shows that the vehicles were used steadily throughout the month, with each vehicle being used at least once every other day.

During the winter months, November and December, the total usage for all vehicles was lower than in April and May. The vehicles were used more in December than in November. In December, the vehicles were used for a total of 82 trips. The average mileage per trip was 22.17, and the average time per trip was 7.14 hours. While there were fewer total trips made in December when compared to May, the average miles per trip were essentially the same. Upon closer examination it appears that the vehicle usage increased towards the end of December.

Table 4.7 lists the overall vehicle mileage statistics for the entire four months that were examined. Each of the vehicles has a relatively unique break down

of trip lengths. Vehicle 101 has the most standard distribution of trip lengths. Vehicle 102 experienced peaks at 5-10 miles and greater than 30 miles. Vehicle 103 had the highest percentage of trips greater than 30 miles; 33.33% of all trips made in this vehicle (over the four months) were longer than 30 miles. This may reflect trips to Denver or other important locations in the region. Almost all trips made over 30 miles were made during the day between the hours of 8 AM and 8 PM.

The majority of trips (52.63%) in vehicle 104 ranged from 5 to 15 miles. The majority of trips (57.15%) made in vehicle 105 were 15 miles or less. There were no trips made in vehicle 105 that were between 15 and 20 miles long, and 42.86% were 20 miles or greater. Unlike most of the other vehicles, 61.54% of the trips made in vehicle 106 were 10 miles or less.

Table 4.7 Distribution of Trip Mileage over 4 Months

Vehicle #	Percentage of Trips					
	<5 miles	5-10 miles	10-15 miles	15-20 miles	20-30 miles	>30 miles
101	13.68%	22.11%	13.68%	21.05%	16.67%	12.81%
102	8.33%	38.33%	15.00%	5.00%	13.33%	20.00%
103	0.00%	22.58%	12.90%	18.28%	12.90%	33.33%
104	7.02%	24.56%	28.07%	14.04%	10.53%	15.79%
105	14.29%	14.29%	28.57%	0.00%	14.29%	28.57%
106	38.46%	23.08%	0.00%	23.08%	7.69%	7.69%

Table 4.8 lists the trip time statistics in terms of percentage of trips that fall within a certain reservation time interval. Most of the vehicles experienced the same type of patterns regarding total trip time. This is the total time that the vehicle was reserved for, and does not necessarily correspond to the amount of time the vehicle was in use (i.e. the user was driving the vehicle). In general, the majority of

the vehicles had similar distribution of time intervals. The majority of vehicle use (40-60%) occurred for five hours or less. Vehicle 105 had a high percentage of trips (28.57%) lasting between 9 and 11 hours; however, there were only 7 total trips made in this vehicle, so it is difficult to deduce a trend for the use of this particular vehicle.

Table 4.8 Distribution of Trip Time over 4 Months

Vehicle	Time Intervals (hr)								
	<1	1-3	3-5	5-7	7-9	9-11	11-15	15-20	>20
101	13.68%	26.32%	26.32%	9.47%	9.47%	3.16%	4.21%	1.05%	5.26%
102	1.67%	36.67%	28.33%	10.00%	8.33%	8.33%	3.33%	0.00%	3.33%
103	4.30%	23.66%	16.13%	12.90%	6.45%	11.83%	18.28%	4.30%	2.15%
104	7.02%	21.05%	22.81%	10.53%	8.77%	8.77%	14.04%	5.26%	1.75%
105	0.00%	42.86%	14.29%	0.00%	0.00%	28.57%	0.00%	0.00%	14.29%
106	15.38%	38.46%	0.00%	7.69%	23.08%	0.00%	0.00%	0.00%	15.38%

Interestingly, all the vehicles had a higher percentage of trips over twenty hours than expected. Vehicles 105 and 106 experienced the greatest percentage of trips lasting longer than 20 hours. The majority of the trips lasting longer than 20 hours had a relatively low mileage per hour (typically less than 3 miles per hour). The length of the trip in terms of reservation time does not correspond to the actual distance the vehicle was driven.

Typically, vehicles in carsharing programs in larger cities are reserved for smaller intervals of time and driven shorter distances. Before this examination of trip logs, it was hypothesized that the Boulder CarShare vehicles would be in use for small amounts of time, and driven for small distances because the city is relatively compact and contained. However, this analysis has shown that there are more trips greater than 20 miles in length and more trips longer than 11 hours than was previously

hypothesized. These types of trips may reflect business and pleasure trips to Denver, which lies about 30 miles to the south. In addition, the cheap prices ($1 per hour and $0.50 per mile) make Boulder CarShare more affordable than a rental car for trips even as long as 15 to 20 hours (depending on mileage).

4.5 Mapping Vehicle and Member Locations Using GIS

In addition to examining trip logs and conducting a survey, an examination of vehicle locations with respect to the location of the members and the land use was conducted using GIS. The addresses provided by Boulder CarShare were utilized to map the residences of the members. In order to keep member information confidential, the locations of the members were mapped by the block (i.e. if an address was 410 14th Street a point was placed on the 400 block of 14th Street rather than on the actual address), and no names were used in the attribute file. The addresses of the vehicles were found online.

4.5.1 Applications of GIS for Carsharing

GIS has been used in various studies (see, for example, Millard-Ball et al, 2005) as a tool for locating sites most suitable for carsharing. GIS can also be used as a tool to help identify new areas for locating vehicles after a program has been implemented. GIS has the ability to map changes in land use, member locations, distances from members to vehicles, and other demographic data that can aid decision-makers in deciding where to expand service, where to adjust service in order to provide better access for members, or where to target advertising to recruit new members.

4.5.2 Applying GIS to Boulder CarShare

Mapping the locations of the members, vehicles, and land use will help to examine the patterns of use and membership of the program in Boulder. Figure 4.? shows the locations of the members and vehicles as well as multiple buffers showing the distance away from the vehicles. About one-third of all the members live within half a mile of a vehicle. Thirteen members live within a 1-mile radius, seven live within 1.5 miles, three live within 2 miles, and one lives approximately 5 miles from the nearest vehicle.

The placement of the vehicles throughout the city provides for good coverage of the entire city. In general, most of the city is within a one mile radius of the nearest vehicle. While most of the vehicles have at least two to four members living within half a mile of a vehicle, Vehicle 106 (located in North-East Boulder) seems to be under utilized as it only has one member living within a half mile radius, and no other members living within a mile radius.

The placement of the vehicles also seems to cover most of the areas within the city with the highest density of development. Figure 4.? shows the locations of the vehicles and members as well as the land use. Two of the vehicles (104 and 102) are located in Downtown Boulder, with one right in the center of the business district. Vehicles 106 and 101 (North-East and South) are located in areas of moderate to heavy residential development. Vehicles 103 and 105, located in North Boulder, lie in an area of light to moderate residential development. (See Appendix C for maps of land use around each vehicle).

Vehicles 101, 102, 103, 104, and 105, are placed along Broadway, which is one of the major thoroughfares throughout the city, and the majority of the members seem to cluster along this route. This route has a very convenient bus route, providing

easy access to Downtown Boulder and the University of Colorado. Much of the highest density development is also located around this route, which makes it an ideal selection for the placement of the vehicles. The high density of development is most likely the reason the majority of the vehicles are already located along this route.

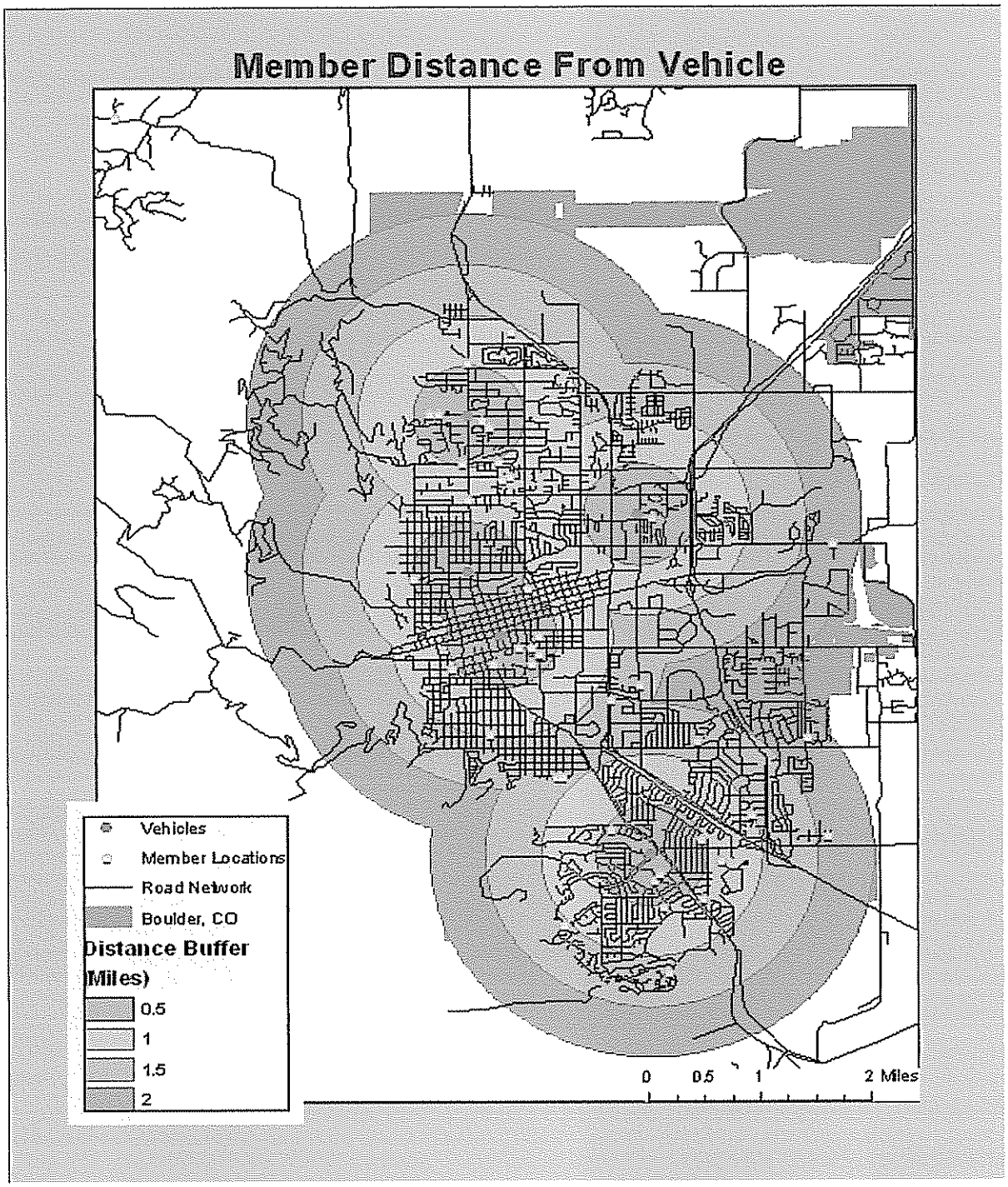


Figure 4.2 Distribution of Member and Vehicles

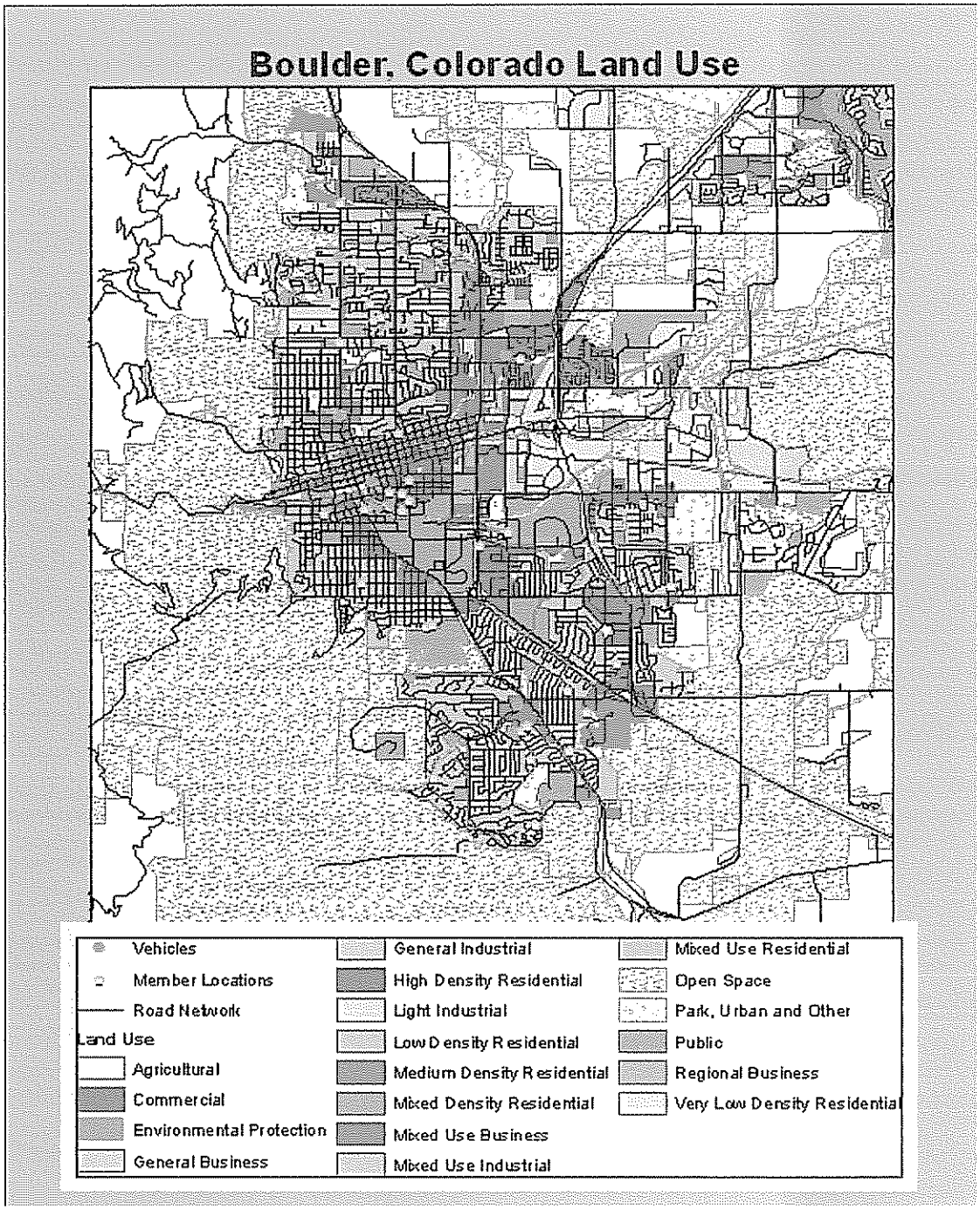


Figure 4.3 Land Use in Boulder, Colorado

4.5.3 Possible Recommendations for Boulder CarShare

GIS is an excellent tool that can provide information that is not only valuable for the start-up of a program, but for the entire life of the program. Visualizing data is often the easiest way to analyze it and make recommendations. This short section will offer two example recommendations for Boulder CarShare based on an examination the locations of members, placement of vehicles, and land use. This is a recommendation solely based on the GIS analysis and is meant to be an example of how GIS can be applied. Local dynamics should be considered before implementing any recommendations. In addition, census tract data may be valuable to GIS analysis in areas where demographics may play a larger role in membership.

Recommendation 1

When examining Figure 4.3, it is clear that there is a gap in coverage between vehicles 101 and 102. There are approximately 6 members that live on the 1.5 mile ring. Some studies indicate that half a mile to a mile is about the maximum distance away a member should be from a vehicle (i.e. within easy walking distance). The fact that these members chose to join even while living about 1.5 miles away from the nearest vehicle suggests that distance alone should not be the only factor to consider for placing a new vehicle. In addition this may dispute the fact that demographics of the area that surrounds a vehicle may not have much effect on membership.

Land use data can also be a valuable piece of information when selecting the location of a new vehicle. The land use (Figure 4.3) shows that there is a mixture of low, moderate, and high density residential development as well as a large university campus. Because the campus is located next to Broadway and close to

Downtown, it has excellent access to mass transit. In addition, there is a dense street network which implies a good level of walk-ability for the area.

Just to the left of the college campus, there are quite a few blocks of medium to high density residential development. Since this area is so close to the campus, it is populated by a large number of University students. Though Boulder CarShare has not yet entered the college market, this area may be best suited for expanding the carsharing service because of the low auto-ownership rate of college students.

The first recommendation would be to place a vehicle around Euclid or Aurora Avenues near Broadway Street. This will provide easier access to the members that are located in this area, and also generate new, younger members. The market potential of this area is high given the type of residents, low auto ownership rates, access to transit, and proximity to Downtown. If that location is successful, the area around Pennsylvania and College Avenues should be explored for future expansion.

Recommendation 2

Vehicle 106 appears to be underutilized based on the GIS analysis. Figure 4.2 shows that there is only one member living within a half mile radius of the vehicle, and the next nearest member is more than one mile away, and lies closer to vehicles 103, 104, and 105. The land use data shows that vehicle 106 is located within a high density residential area with lots of commercial and business activities. This would imply that the area is well-suited for carsharing.

Based on the land use data as well as some census data, there should be more members in this area. It is possible that the vehicle is being used by people that work in this area and live elsewhere. The trip log data shows that Vehicle 106 is being

used, by a variety of people and for a variety of trips. This implies that other people residing outside the radius of this vehicle are using it. Given the density of development, it is recommended that advertising be increased in this area. Public meetings, flyers, demonstrations, or other advertisements may help generate more awareness and interest in carsharing in this area, which may increase membership.

4.6 Discussion

When comparing the results of the rest of the survey with surveys conducted in other studies (such as Millard-Ball et al, 2005 or Lane, 2004) the results of the average member do not differ as much. The age ranges, income ranges, vehicle ownership rates, program use, and motivations for joining the program, among other characteristics seem to be about the same across the board with only small variations here and there.

According to Millard-Ball et al., programs in smaller cities and towns are characterized by a high degree of personal involvement by their members (2005). Members of these programs are personally invested in the success of the program, and usually do more to support them than members in larger cities. According to some studies, a strong local champion is one important factor in the success of carsharing in small cities, towns, or rural environments (Millard-Ball et al., 2005).

The results of the trip logs, GIS analysis, and survey also support these conclusions but suggest a modification in the theory. The length of membership of the survey respondents varied widely. There is a large percentage that have been members for one year or less, and then another spike in percentage of people that have been members for four or more years, which tend to be members that were involved from

the beginning. The Boulder CarShare program was a grass roots effort that started with just one vehicle and a few "champions" of the cause.

It seems that Boulder CarShare is seeing a shift in its members from people that had a high degree of involvement in the program to those who are involved less. These are the people that have been members of the program for less than one year. Their surveys differ slightly. Table 4.9 displays the difference in some key survey responses:

Table 4.9 Differences in Some Key Responses between New and Old Members

Characteristics	Members <1 year	Members 4 or more years
Age	Slightly Younger (20-40)	Slightly Older (35-60)
Income	Lower (<50k)	Higher (>50k)
Household Status	Live alone or with unrelated adult	Married (with or without children)
Home Ownership	Rent	Own
Car Ownership	1 or less	1 or more
Distance from a Boulder CarShare Vehicle	Within a few blocks	½ mile or more
Reason for Joining	Affordability, need access to a car, environmental friendliness	Environmental friendliness, carsharing philosophy, help to save money on transportation bills

Startup carsharing organizations in small cities need to have two sets of implementation plans. The first set should be designed to attract those initial users, which have very different characteristics than the users who adopt the program later. Many studies have identified early adopters as having unique motivations (see for example Millard-Ball et al, 2005). Once the program is established, and a shift in

membership is observed, it may be necessary to utilize a second strategy in order to attract and keep members who adopt the program later.

In the case of Boulder CarShare, issues like old, unattractive vehicles may discourage some potential members from joining. While funding may be difficult to acquire at the beginning of the program, funding is need throughout the life of the program in order to acquire more attractive cars, and to be able to expand to new areas.

It would seem that champions of carsharing are needed at the beginning in a grass roots effort, especially in a small city. However, once the program is established there will be a shift to a more typical user. The degree of this shift, and the time it takes for the membership base to shift, may be dependent on city size and program size, but more research is needed to analyze this shift.

The results of the GIS analysis and the trip log analysis show the dynamic characteristics of a carsharing program in a small city. Distance from a member to a carsharing vehicle does not seem to have a drastic effect on program use. While some noted that the carsharing vehicles were too far away from their residence or place of work in the survey, their use of the program per month did not vary much from those who lived closer. It seems that the use of the vehicles has more to do with the members' needs rather than difficulty in accessing a vehicle.

Almost all studies point to mixed-use high density areas as best suited for carsharing. While these areas may be best, they may not be the only areas that can implement carsharing. Looking at the land use map, it can be seen that many members live in low to moderate density residential areas, and three of the vehicles are located in these areas. Placement of vehicles in small cities should not be based solely on land

use or population, but on the demand for the service and an attempt to provide service to a wide city area.

Chapter 5

CASE STUDY: WILMINGTON, DELAWARE

This chapter will present a summary of a feasibility study developed by Delaware Center for Transportation at the University of Delaware for the City of Wilmington, Delaware. The document "Carsharing in Wilmington: Feasibility Study and Preliminary Recommendations" (Catherine et al, 2007) was submitted to the Transportation Management Association (TMA) of Delaware at the end of January, 2007. Carsharing in Wilmington is still being evaluated by TMA as well as Philly Carshare, therefore this feasibility study is only meant to be an example of a low-cost, short-deadline feasibility study and may not reflect the actual future implementation of the carsharing program.

5.1 Project Background

Wilmington Delaware is located along the Delaware River, approximately 30 miles Southwest of Philadelphia. It lies along Interstate 95, which the major North-South corridor on the East Coast of the United States. Wilmington also lies about half way between New York City and Washington D.C, which means that in addition to commuter traffic, the highway system handles a lot of traffic that is passing through on I-95.

Wilmington has a population of almost 80,000 people with a large suburban population. Wilmington is an "office park" city. It has a centralized downtown with lots of office buildings, but with few residential buildings, and on

nights and weekends the downtown area is relatively deserted. The majority of the people that work in the downtown area live outside the city. However, in recent years, Wilmington has experienced a boom in residential construction as young professionals seek living arrangements close to their offices.

The majority of the transportation problems in Wilmington arise from commuters during peak periods. During peak times traffic inside the city is heavy, with large backups on I-95 and routes connecting I-95 to the downtown area. The transit system, consisting of buses, is improving, but is still not adequate to support the large number of commuters. Wilmington also has a SEPTA commuter rail station, however the station is located out of walking distance of the downtown core, and requires commuters take a bus or taxi to complete the last leg. If Wilmington is going to keep up with the growing development and demand for a more efficient transportation system, new methods, programs, and policies must be established. Carsharing could be the city's solution to augmenting its mass transit system, especially for the areas of future residential development in the city.

The Transit Management Association (TMA) of Delaware, a non profit group that manages a program to increase transit usage, approached the Delaware Center for Transportation at the University of Delaware to investigate the feasibility of carsharing in downtown Wilmington in May of 2006. They requested a feasibility study to be conducted to evaluate public interest in carsharing as well as where, when, and if carsharing should be implemented. The study had to be completed by the end on July (2 months). After the preliminary document was submitted, TMA requested a more extensive examination of the downtown area be performed. This portion of the study was conducted in January of 2007.

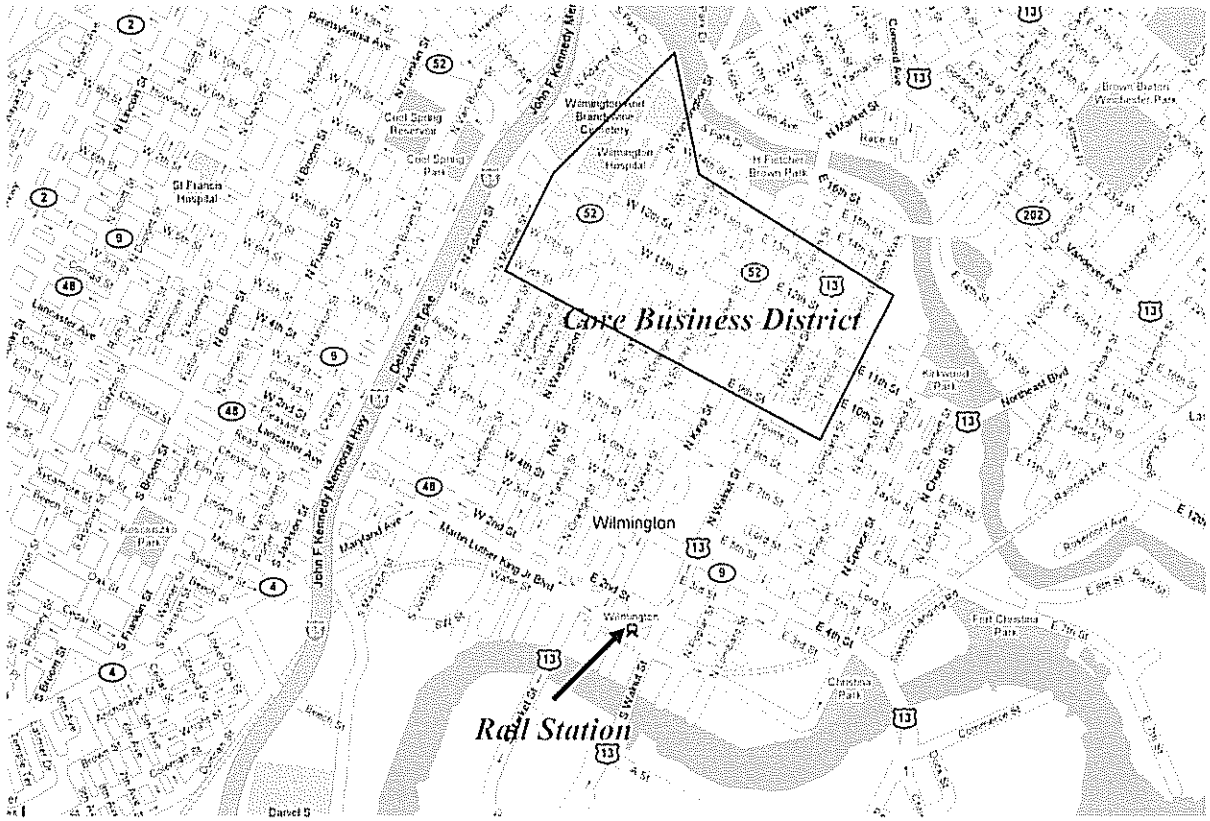


Figure 5.1 Downtown Wilmington

5.2 Methodology

This feasibility study and recommendations were developed by accomplishing four tasks. The first task was to conduct a literature review regarding the history of carsharing as well as market growth and potential, and carsharing programs in other cities. The main purpose of this task was to evaluate how carsharing has been conducted in other cities, where growth potential lies, and who should be targeted.

The second task was to identify areas within the city that would be most suited for implementing carsharing. The Wilmington Renaissance Corporation, a

development group, was contacted to identify areas with new high-density middle to upper class housing within the downtown area that were built, in the construction phase, or in the planning phase. Census data was also used to outline areas with high transit use, higher than average incomes, and higher than average densities.

Since transit plays a large role in carsharing programs, the DART bus system was examined to see where coverage is the best and frequencies are relatively low. Combining the recommendations from the Wilmington, Renaissance Corporation, the census data, and the transit survey, an focus area was outlined (Figure 5.2). The focus includes areas of high density middle to upper class residential structures as well as the downtown core and the area surrounding the Wilmington rail station. Figure 5.2 shows the outline of the "Wilmington Carshare Corridor" as well as the locations of some high rise apartment and condo developments.

Task three consisted of a public interest survey. During the first phase of the study, conducted in June and July of 2006, a web survey was distributed to employees in downtown Wilmington via an email from TMA to the employers. The purpose of the survey was to examine public knowledge and determine the level of interest in carsharing. The response rate was extremely low, less than 0.5%. Of those who responded most were not interested in joining a program.

A second survey was conducted in January of 2007 targeting the residents of the residential developments identified in Figure 5.2. Approximately 600 surveys were distributed door to door. The surveys contained 7 basic questions that evaluated public knowledge and level of interest in carsharing. The survey also offered a chance to win $50 dollar gift certificate to a local mall. Out of the 600 surveys distributed, only 15 were returned. Out of the 15, only one person said they were interested in

carsharing. After a discussion with a survey expert at the University of Delaware, it was determined that there was no low cost effective survey method to obtain the information that was needed.

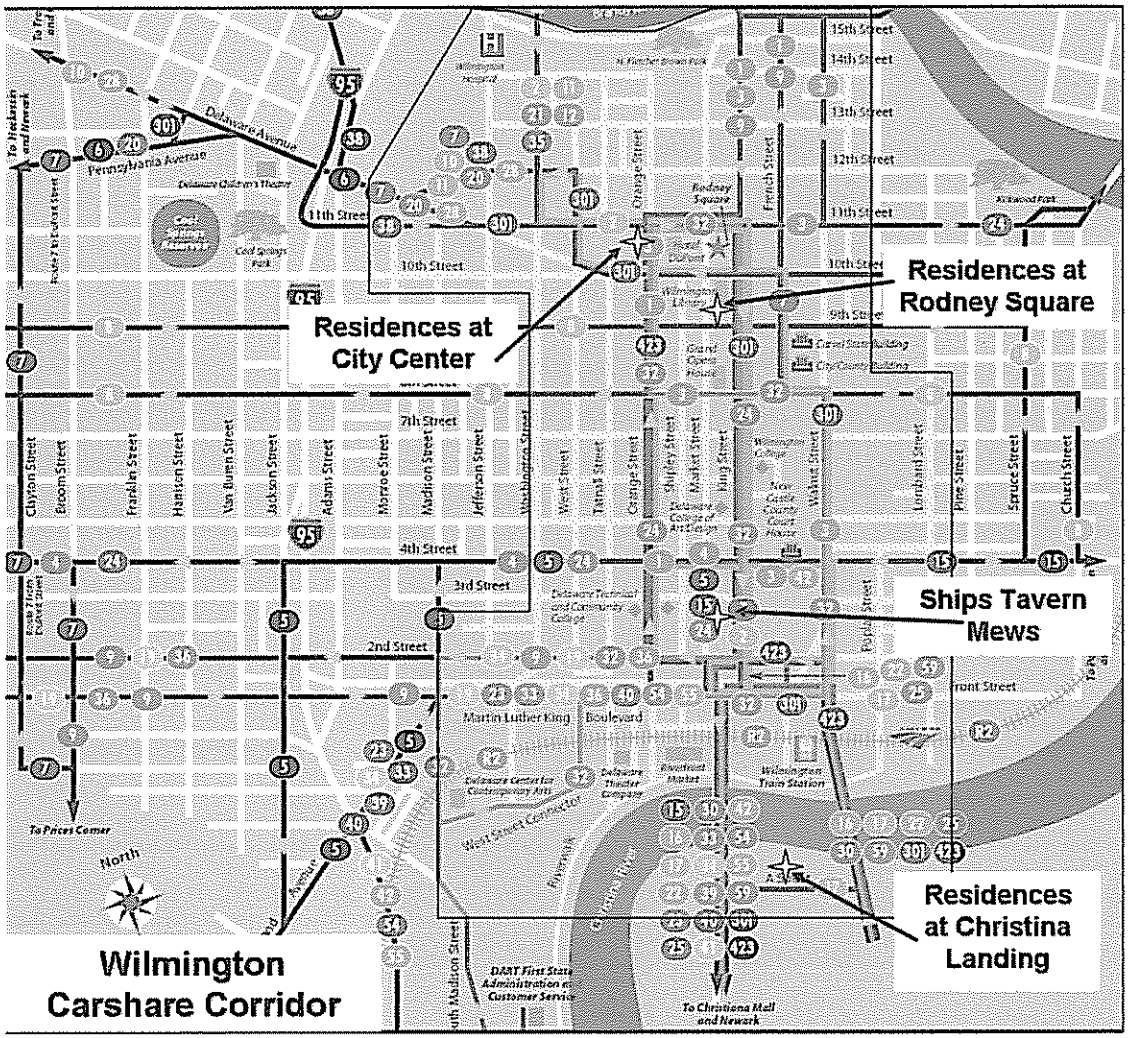


Figure 5.2: Wilmington Carshare Corridor Study Area

The final task was to make a recommendation for the gradual implementation of carsharing in Wilmington, if indeed it could be implemented. This section would include the implementation strategy, a methodology for monitoring the program, and policy recommendations. Philly Carshare was also contacted to be included in the recommendations because TMA indicated that Philly Carshare was interested in administering the program.

5.3 Recommendations

Based on the results of a literature review, an examination of current US carsharing programs in mid-sized cities, and a public interest survey, a city-based carsharing program is the best option for the implementation of carsharing in the City of Wilmington. This type of program focuses on the residents and businesses in downtown Wilmington.

Given the vague results from the survey and the lack of extended research on carsharing in smaller cities in the United States, the best strategy for implementing carsharing in Wilmington is to conduct a pilot program to assess potential demand and operation strategies. The survey did not yield enough information regarding potential demand and should not be used to discourage or support carsharing in Wilmington.

In order to minimize this risk, the managers of carsharing in Wilmington should start the program small by running a 12-month pilot program. Pilot programs have been used in similar assessments such as the Carlink I and II studies. These programs allow carsharing administrators to evaluate the demand, how well their original strategies work, and how to modify those strategies to increase membership.

5.3.1 Pilot Program

The pilot program should be started with no more than three carsharing vehicles, which will be supplied by Philly Carshare. The vehicles should be located around Rodney Square (See Figure 5.3). This location is most suitable for carsharing because it contains a large transit hub with access to multiple bus routes, and a mix of middle to high income residential apartment buildings and office buildings with shopping and dining.

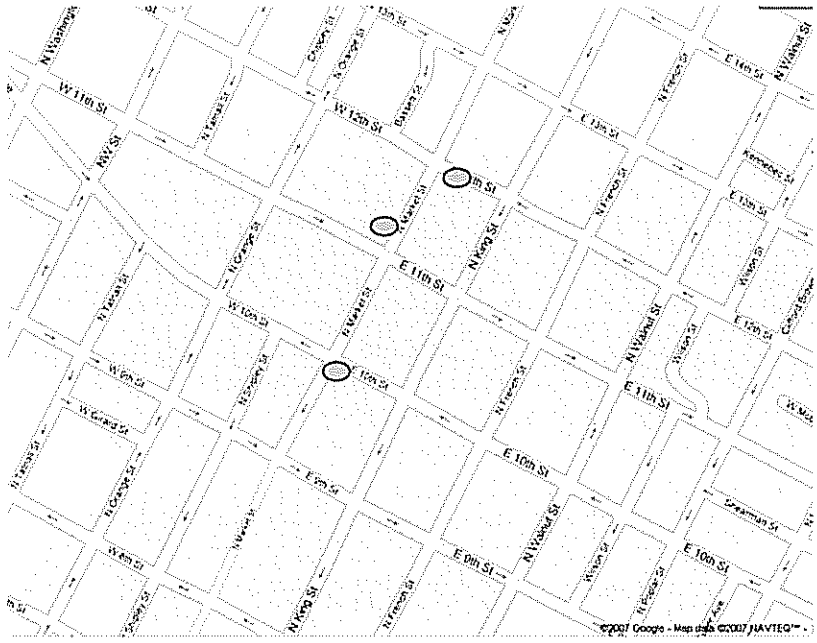


Figure 5.3 Vehicle Locations

Target members for the pilot program should be between the age of 21 and 50. They should live or work within 5 blocks of Rodney Square. Apartment buildings like the Residences at Rodney square are excellent target areas due to their

proximity to Rodney Square and their abundance of young professionals with moderate incomes. For the purposes of the pilot program target members should have moderate incomes ($40,000 or more per year). Low income members can be accepted, but proliferation of carsharing into low income neighborhoods should be a future goal. Target members must be willing to participate in multiple surveys and interviews that will address the performance of the pilot program.

5.3.2 Policy Recommendations

Prior to the beginning of the pilot program, the City of Wilmington Parking Authority and Colonial Parking must be contacted in order to discuss locations for on street parking. The pilot program vehicles should be located on-street near the Rodney Square transit hub in order to increase visibility which will increase awareness of the program. The location will also make it convenient for both residential and business users to access.

TMA and the City of Wilmington should offer their full support in the effort to bring carsharing to Wilmington. Philly Carshare requires that TMA and the city help to support the implementation of the pilot program with financial assistance. This financial assistance should be determined prior to beginning the pilot program, and should include assistance that would help to reduce user costs.

5.3.3 Generating Public Awareness

Nine months before the pilot program begins, TMA and Philly Carshare should work together to develop an advertising campaign that consists of radio, newspaper, and possibly TV advertisements. Public interest meetings should be scheduled for residents within the Rodney Square area. TMA should also advertise the

carsharing program at other community meetings and festivals to increase the awareness of the general city population.

Advertising should continue throughout the duration of the pilot program. If possible, the three pilot program vehicles should be of different models such as one Honda Element, one Toyota Prius Hybrid, and one Toyota Sienna in order to show the dynamism of the carsharing program. According to Boulder Carshare and Philly Carshare, the most valuable piece of advertising has been having the cars on the street and word-of-mouth. Providing an attractive variety of cars for the pilot program should increase interest in the program.

5.3.4 Recommended User Fees

Since Philly Carshare has offered to help support the pilot program, a fee scheme similar to that of the Philadelphia program should be used for the Wilmington pilot program. Currently, Philly Carshare utilizes two resident user fee schemes; however one scheme for all users should be selected in order to simplify the pilot program analysis process. In addition, fees should be slightly lower for the pilot program. Lower fees will be very attractive for new users, and also provide them with a form of compensation for participating in the multiple surveys and interviews that will be conducted for program evaluation. Table 6.1 shows a breakdown of recommended user fees.

Table 5.1 Recommended User Fees

User	Monthly Fee	Hourly Fee	Mileage Fee
Residential	$5	$3.00/hr	$0.10 per mile up to 200 miles, $0.20 after 200 miles
Business	$10	$2.00/hr	$0.10 per mile up to 200 miles, $0.20 after 200 miles
City Government	$5	$2.00/hr	$0.10 per mile up to 200 miles, $0.20 after 200 miles

5.3.5 Internal Operation and Insurance

The pilot program should have a dedicated staff of at least one person to maintain the program, update the reservation systems when needed, conduct the surveys and interviews for the program analysis, and to conduct meetings with the community and businesses. The staff member should be from TMA, if possible, because of their contacts within the community, and their ability to quickly address maintenance issues.

Maintenance issues must be addressed quickly and locally in order to reduce vehicle downtime. Philly Carshare and TMA need to work together to establish a contract with a local repair and body shop, preferably within five miles of the Rodney Square area. Depending on the level of use of the vehicles, weekly or bi-weekly vehicle cleaning should be considered. Contracts with carwashes could be established to handle this task, and in some cases carwash companies will travel to the vehicle.

Insurance should not be a problem for the pilot program because Philly Carshare will be loaning the vehicles and they will be covered under their insurance. Currently, Philly Carshare uses an online reservation system and a phone reservation

system, as well as GPS vehicle tracking. This method should be used in the pilot program as well in order to give members an accurate view of how an established program would operation.

5.4 Evaluating the Pilot Program

The most important function of the pilot program is to collect data on how the system is performing and to address what the future demand might be. The program should be evaluated based on five major measures of effectiveness (MOEs); transit ridership, user costs/savings, changes in user vehicle miles traveled (VMT), changes in membership demographics, and revenue generated. These evaluation methods should also be used throughout the life of the actual carsharing program, if one is established after the pilot program.

Member surveys will likely be the most important method for gathering information on the opinions of the users. A series of seven surveys should be developed and distributed throughout the life of the pilot program at pre-determined membership milestones. All members should receive a survey prior to starting the program in order to determine their transportation habits before using carsharing. This, combined with future surveys will help evaluate changes in VMT and travel time.

Surveys should be distributed to members after one, two, three, six, nine, and twelve months. In addition an exit survey should be given to those members who leave the pilot program early. These surveys will form the basis for a trend analysis of the program's performance as well as allow program administrators to examine the changing needs of its members. All the surveys should ask similar questions regarding:

- transit ridership

- travel patterns
- trip durations and destinations
- opinion of carsharing
- changes in user needs
- willingness to continue membership given changing variables (such as fees)

Increasing transit ridership is a cornerstone of any carsharing program. Although Wilmington is not expected to experience the same benefits as larger cities such as San Francisco and New York have, it is expected to see an increase in transit ridership as a result. People that join the program to use the vehicles during the work day are excellent candidates for increasing transit ridership because they can access transit to get to work, and use carsharing for work trips. Transit numbers should be monitored throughout the duration of the program. It will be possible to determine increases in transit due to carsharing by combining transit data with survey data.

A small cross section of the membership should be selected for personal interviews. These interviews will help to obtain more in-depth feedback from the users which may help to sculpt a future program.

Each vehicle should be equipped with a GPS tracking device. This device is typically used for billing purposes but it may also be used to gather information on the types of trips being made with carsharing. The GPS analysis should be conducted on a monthly basis and consist of an origin-destination analysis. This type of analysis will help administrators to determine where people are traveling using carsharing, to analyze user costs given the typical cost of car ownership, and to determine VMT trends over the life of the program. Preferably, an average of 10-20% VMT reduction

should be observed; any less and the program should not continue until the system is re-evaluated.

Changes in revenue and membership should be relatively easy to evaluate. Ideally, the pilot program should experience an increase in membership throughout the 12-month period. Depending on the success of the program it may be necessary to increase the number of vehicles on the street before the pilot program concludes. More vehicles should be added when all of the below criteria are met:

1. A vehicle to member ratio of at least 1:20. (With three cars, there should be at least 60 members.)
2. A vehicle utilization rate of at least 17%. The vehicles should be in use for about 4 hours per day on a typical weekday.
3. A member retention of at least 85% per month. This will be assessed through interviews with members and surveys.

5.5 Possible Roadblocks

City-based carsharing in Wilmington would face three major roadblocks; transit, separation between business and residential areas, and public opinion. These potential roadblocks may not entirely stop a carsharing program from being successful, but addressing these roadblocks ahead of time may create a more suitable environment for carsharing.

Carsharing operates best when it is used to complement a comprehensive transit system which Wilmington is missing. An examination of bus routes and schedules show that while Wilmington may have the best transit coverage of any other location in Delaware, accessing certain locations outside the city can be a challenge, especially on weekends. In addition very few bus stops in the city have bus shelters or

time boards. If carsharing is expanded to other locations such as Christina Landing more amenities should be provided.

While Christina Landing has access to bus stops, none have shelters or travel boards, and all of them are located in precarious locations that are hard to access and would not be attractive or safe locations to wait for the bus. Many of the other potential locations face the same issues. Increasing the number of shelters, improving access to bus stops, and adding travel information boards will make public transit more attractive to new riders.

Carsharing works best in areas of mixed-use development. While Wilmington is making changes in this area, there is still a well defined separation between the office areas and the residential areas. Downtown Wilmington is relatively deserted at night as most of the employees that work there live in the suburbs. This lack of residents in the downtown area may cause the carshare vehicles to be underutilized in these locations during the evening hours. In addition most of the major shopping for the area is located in the suburbs. Increasing shopping opportunities as well as increasing the number of apartments and condos in the downtown area will create a better environment for carsharing.

Finally, public knowledge may slow down the growth of the program during its initial implementation. Many people confuse carsharing with carpooling, and therefore dismiss the idea. The public must be fully aware of the definition of carsharing as well as its applications in order for the program to reach its fullest potential. Advertising early and often may help to eliminate this potential roadblock.

5.6 Future Policy Recommendations

If a carsharing program is to realize its full potential as a transportation option, it will need the help of partner organizations. These partner organizations, in many cases, refer to cities, counties, and regional agencies working together with the carsharing program. The most beneficial thing that these cities, counties, and regional agencies can do to aid the creation and expansion of carsharing programs in their jurisdictions is to create supportive policies.

Many local governments use policy to encourage the growth of carsharing in different ways. Parking provisions are one of the most common forms of support since local government controls both on-street and some off-street parking facilities. For parking provisions in areas not controlled by government, zoning changes and policies are made that give developers added bonuses if they incorporate carsharing parking into their designs. In some cases, it was mandated that any parking garage in the city limits must make a certain number of spaces available to the local carsharing program.

Tax credits have been distributed to businesses that carry out energy-saving activities such as carsharing. Not only would this encourage businesses to utilize a carsharing program, but carsharing programs could directly benefit from these tax credits by using ultra-low-emissions vehicles or zero-emissions vehicles.

Local governments may even give benefits to companies and businesses that enter in a partnership with a carsharing program. These private businesses can provide marketing, administration, parking, and financial support. Supportive policies within the private sector have proven beneficial as well. Some companies have given their employees benefits for utilizing local carsharing programs so that the company can use the vehicles in place of purchasing company cars.

Additional policy measures include insurance funding support and innovative research funding. The above policy measures address the very large issue of carsharing insurance. Not only would insurance funding keep the carsharing company afloat, but research funding would go toward developing a carsharing risk class in the insurance sector which would reduce insurance costs across the country. At that point, with a risk class established, the carsharing program would not require insurance funding to the degree that it does currently.

Local governments may also offer incentives for automakers that place low-emissions vehicles into carsharing fleets. If automakers receive incentives, they would be able to sell these vehicles to the carsharing programs at a reduced rate. This would lower the costs of the program and improve its chances of growth in the future.

All of the above policy recommendations could be implemented in Wilmington. Not only would the potential for carsharing success improve, but the carsharing program would bring its environmental, social, land-use, and transportation benefits to the city.

Chapter 6

SUMMARY OF KEY ISSUES FOR THE START-UP OF A CARSHARING PROGRAM

This chapter presents a summary of issues related to the implementation of a new carsharing program by tying the literature review, regression analysis, survey, trip log analysis, and GIS analysis together. The following summary may not present issues applicable to every situation, and organizations that are considering implementing carsharing in a small city should evaluate local issues in addition to referencing this framework when trying to examine the feasibility of implementation. This chapter will provide the base for the recommended framework for implementation that will be presented in the next chapter.

The first objective of this summary is to outline the market potential for carsharing in small cities. This will utilize the regression analysis (focusing on the highly correlated variables), the survey, and the trip log analysis to develop a series of demographic and spatial checkpoints for implementation. This will include populations and locations to target for the best chance of having a sustainable carsharing program, as well as how to define the spatial characteristics of a particular city that may best support a carsharing program.

The second objective is to discuss barriers to the implementation of a carsharing program and how to overcome them. The importance of partners and their roles in the carsharing implementation process, financial barriers, and regulatory barriers will be examined. In addition, the second objective will also take a look at the

public, and the barriers that arise when trying to create interest and understanding of the program.

6.1 Defining Program Success

In TCRP Report 108, Millard-Ball et al. writes about where and how carsharing succeeds. But, what is the definition of success for a carsharing program? Success may mean different things to different organizations or different cities. Is success defined as a level of service threshold, or the number of members, or the amount of profit being made?

Each individual carsharing organization should define their goals early in order to determine what success means for them. Success is also a changing concept. As one threshold for success is passed, the bar can be raised and a new definition of success is adopted. Carsharing organizations in small cities should, however, be realistic when defining these thresholds for success.

6.2 Summary of Market Conditions in Small Cities

The first step in evaluating the feasibility of a carsharing program in any city is to define if there is an adequate environment for carsharing. This section will help to outline what start-up organizations should be looking for in terms of member base as well as locations for implementation. This section will utilize the regression analysis, surveys, trip log analysis, and GIS analysis to help determine the who and where of a carsharing program.

6.2.1 Finding a Target Population

Determining the correct target audience for a new carsharing program may be one of the most important steps in ensuring the sustainability of the program

(see Table 6.1). As defined by many studies, and Chapter 4 of this report, there is a difference between the early adopters of a program and those who may join once the program is established. Susan Shaheen developed and early adopter profile during the CarLink studies (2004). Some of the criteria include people who:

- Belonging to 2-3 member households
- Male (60%), Female (40%)
- Married
- Between the ages of 24 and 40
- Not older than 60
- Living in a city of at least 50,000
- Having a household income of over $50,000 per year
- Not being dissatisfied with their current transportation mode
- Having concern for the environment

The examination of the Boulder CarShare survey yielded slightly different results. Seven of the 27 respondents for the survey were members for over four years. For the purposes of this study, these members were considered to be early adopters. (15 of the 27 respondents were members for one year or less, and are referred to as later adopters). The results of this early adopter subgroup of respondents can be examined separately because all of the them gave very similar results to many of the survey questions. The early adopter profile from the Boulder CarShare survey show members:

- Between the ages of 30 and 50 (average age: 44)
- Male (43%), Female (57%)
- Who own their own home
- Live in one or two person households
- Owned only one car prior to joining the program
- Who live less than four miles away from work
- Who utilize mass transit, walk, and bike to work more often than driving
- Who list environmental friendliness and affordability as primary reasons for joining
- Who have an average household income greater than $50,000

In general, the results are similar to the early adopter profile developed by Shaheen except for the gender distribution, ages, and household size. The gender distribution of Boulder CarShare was noted by Karen Worminghaus to be slightly skewed to females, and the majority of the survey respondents were also female. Gender should not be a factor when considering who to target for a carsharing program. Even though there are some key differences between the seven early adopters and the remaining members, especially in terms of age, household size, and income, the members that have been involved for one year or less still share many of the same transportation habits as well as education.

Almost all of the Boulder CarShare respondents (92.5%) have received at least a college degree. This factor has been outlined in various studies as being a common factor among all members across all carsharing organizations. Highly

educated members tend to have a better understanding of the program and a willingness to try new transportation modes.

In addition to their education, members, regardless of membership time, seem to have similar characteristics when it comes to transportation habits. Almost 45% of the respondents reported never owning a car, and for this reason 83% of those members said that needing access to a car was a major motivation for joining the program. The most staggering statistics, in terms of transportation habits, are the percentage of trips to work and total trips made in a vehicle. Only 7% of the respondents said that they drove alone to work, and almost all of the 7% listed that they use other commute modes such as bus or bicycle to commute as well. Driving alone made up only 4.1% of all trips made in an average month (of all members total). Personal vehicle use was reported to be higher during colder months. Almost 61% of all trips made by all members during a typical month were by bike or walking.

These statistics show a high commitment to alternative commute modes. Even before joining the carsharing program, 48% of the respondents said that they used mass transit a few times a week, and another 26% said that they used it almost everyday. Almost 71% said that they walk about the same, while another 60% said that they also bike about the same.

This commitment to alternative commuting before and after joining the program is a defining factor of carsharing in small cities, and may be more critical to smaller cities than to larger ones. Most smaller cities do not experience the same levels of congestion as larger cities, and often times do not have as extensive mass transit networks. Carsharing programs in smaller cities in the United States rely on members that may be able to afford a vehicle (the Boulder CarShare survey showed an

average income of $51,000), but want to use other modes in order to reduce costs and help the environment.

All of these attributes can be combined to form a suggested list of attributes of adopters of carsharing in small cities. Table 6.1 lists these attributes and their importance rated on a 1-5 scale; one is most important, and five is least important. This is a combination of characteristics of early and late adopters that will allow the carsharing company to target both groups in hopes of stimulating fast growth.

Table 6.1 Attributes of Target Population

Attribute	Importance
Commitment to alternative commute modes (high utilization of mass transit, walking, biking, or carpooling)	1
Low car ownership rate (<1 car per household)	1
Highly educated (Bachelor's or higher)	2
Have concern for the environment	2
2 or more persons per household	3
Want to save money on transportation	3
Live close to work	4
Have a household income of at least $50,000	4
Between the ages of 25 and 50	5
Rent their own home	5

6.2.2 Finding Target Locations

In addition to choosing a sector of the population in which to target, it is necessary to define what areas within the city should be targeted. The location of a carsharing vehicle will determine its usage. It is important to select an area that is well suited for carsharing for the implementation of the program. Expanding service to

other areas of the city can be done after the program is well established in the initial implementation location.

Each city has a unique form and function, and the composition of the optimal carsharing environment may change from city to city, especially from large cities to smaller ones. The regression analysis conducted in Chapter 3 of this report examined what characteristics of a city are important in determining the composition of the optimal carsharing environment. In terms of relating membership numbers to the characteristics of a city, the most important factors seem to be the mass transit rating (a number relating transit use to the number of transit options), percentage of people using mass transit, and the percentage of households with no vehicles. Other factors to note are the average commute time and the population density (these had lower correlation coefficients but had low probability values as well).

City form and function is best mapped on GIS. GIS analysis can help decision makers to determine where a carsharing program should be implemented by mapping census and land use data. In addition, programs that are currently in operation can use the data to determine where their members are located with respect to the location of vehicles as well as where new vehicles should be located.

The GIS and trip log analysis conducted for Boulder CarShare revealed some interesting spatial characteristics. Boulder CarShare has a network of six vehicles that are spread throughout the city. Typically, carsharing is thought to work best in mixed use developments as well as in areas with a high density of development. However, in Boulder, three out of the six vehicles are located in areas of low density residential development. In addition, almost half of the members also live in low density residential areas.

This GIS and trip log analysis revealed conflicting conclusions about how location of the members may affect the usage of the vehicles. The vehicle with the most use (mileage), as well as the vehicle that was used most consistently over the four months surveyed, was located in North Boulder around relatively low commercial and residential development. While this area had a low density of development, a large portion of the membership base resided in this area. Vehicle 106, located in North-East Boulder had only one living closer to it than and other vehicle, and was one of the vehicles used the least.

Although the GIS and trip logs showed a lower vehicle utilization for vehicle 106, the survey responses yielded no measurable connection between distance from a vehicle and the amount of times per month that the vehicle was utilized. Vehicles 101, and 103, the two highest used vehicles are both located in low density areas, and have a wide range of members spread out from ½ mile to almost 1.5 miles away from the vehicle (only four members lived within ½ mile of each vehicle). Vehicle 102, located in downtown Boulder had eight members living within ½ mile of the vehicle, but had a much smaller mileage per month than vehicles 101 or 103.

The location of the vehicles with respect to the members has to also be evaluated in terms of the purpose of vehicle use. Some members may join the program to use the vehicle for work trips such as meetings. These members may live close to one vehicle, but may work near another vehicle, and may use that vehicle more than the one located closer to their homes.

Most members noted being within walking distances of at least two bus routes. The GIS analysis shows that most of the carsharing vehicles and members are located along the Broadway corridor that runs North-South and passes through the

downtown area. This street is a major bus transit route. Since a majority of the members surveyed said they use mass transit at least a few times a week or more, it is apparent that the location of transit plays a critical role in the placement of vehicles and the location of carsharing members.

Similar to section 6.2.1, these factors are combined along with factors addressed in the literature review to form a rating of factors that are most important when determining a target location for carsharing vehicles. Table 6.2 lists these attributes along with their ratings; one is most important, five is least important.

Table 6.2 Attributes of Target Locations

Attribute	Importance
Access to two or more transit routes. (Transit corridors are most suitable)	1
Areas with low car ownership rates and high mass transit use (according to census data or surveys)	1
Areas that are walk-able/bike-able (small blocks, pedestrian and bike facilities)	2
Areas with moderate to high congestion levels (related to commute times)	2
Locations within 1 mile of potential (or existing) members	3
Areas with higher than average household incomes	3
Areas of mixed-use development	4
Areas with multiple transit options	4
High density of residential and commercial development	5
Areas with household sizes of two or more people	5

6.3 Establishing Partnerships

Establishing partnerships with other organizations is key to ensuring that a carsharing program in a small city reaches its full potential. Millard-Ball et al.,

identifies partner organizations as being critical to helping carsharing reach its full potential in the United States (2005). Partner organizations assist carsharing organizations in taking a solid first step into a community (Millard-Ball et al., 2005). In smaller cities, where the potential member base is limited and there is uncertainty about the public's initial acceptance of carsharing, partner organizations are critical to helping a new carsharing organization stay afloat.

Partner organizations can be involved in various aspects of a carsharing program. These organizations are divided into five different types (Millard-Ball et al., 2005):

- Local governments
- Transit agencies
- Employers and businesses
- Developers
- Universities

These organizations can be involved on the surface, by providing supportive policies, or they can be involved more fully by providing funding, technical support and equipment, or a solid membership base.

6.3.1 Local Governments

Local governments are essential in providing supportive policies, and sometimes a membership base, for a carsharing program. These are the most typical types of partnerships for carsharing organizations (Millard-Ball et al., 2005). Local

governments look to carsharing to reduce parking needs, average VMT, emissions, car ownership, and to reduce their own fleet size and expenses (Millard-Ball et al, 2005). Carsharing organizations look for the help of local government for supportive policies such as zoning variances, parking policies, and funding sources.

Most partnerships between carsharing operators and local governments have been initiated by the carsharing organizations (Millard-Ball et al,. 2005). However, many cities have initiated the idea of carsharing and have looked for operators to partner with in order to establish the program. Cities like Alexandria, VA and Wilmington, DE introduced the concept of carsharing during conferences and then sought out operators (Millard-Ball et al., 2005).

Partnerships with local governments are critical to start-up programs in small cities because of the need for funding and a solid membership base. Local governments that reduce their fleet size and adopt carsharing can provide a very large and stable membership base and cash flow. The City of Philadelphia was the first large city in the world to replace its vehicle fleet with carsharing, and has saved over nine million dollars over five years (Millard-Ball et al., 2005). The city of Wilmington, DE is also planning on reducing and eventually replacing its fleet with carsharing vehicles and has committed funding for that purpose.

In addition to providing funding through membership, local governments have also provided some public money for start-up costs. Approximately 60% of US carsharing operators reported receiving public money for start-up costs, and 30% reported continued funding through the first year of the program (Millard-Ball et al., 2005).

Local governments can also play a key role in the marketing of a carsharing program. Many local governments provide information to the public about the carsharing program through newsletters, community events, press releases, and on street parking spaces (Millard-Ball et al., 2005). These services are extremely important to start-up programs in small cities. These programs tend to be grassroots efforts that have limited funding. Advertising can be expensive, so local governments that provide marketing support can be extremely important to the initial success of a carsharing program.

In terms of important types of marketing, on street parking and word of mouth may be one of the best advertising methods. Carsharing organizations in Philadelphia, PA and Boulder, CO started with no funding for advertising. Both of these programs relied heavily on advertising through vehicles parked on the street. Approximately 15% of Boulder CarShare survey respondents said that they learned about the program by seeing the logo on a vehicle, and another 23% said they learned about it through a friend.

Finally, local governments can provide support by creating supportive policies. These polices promote carsharing through land use, zoning regulations and tax incentives. Supportive policies will be addressed in section 6.4.

6.3.2 Universities and Institutions

Universities and other large institutions can be another important partner organization for carsharing programs. Universities provide access to a large population of student and faculty that are generally more aware of environmental issues and impacts (Millard-Ball et al., 2005). In addition they offer a large driving

population with a low auto ownership rate. Universities also tend to have limited parking facilities.

Universities are more readily able to implement carsharing because they can control their own parking policies, and are able to market the program to the students and faculty because communication mechanisms are already in place (Millard-Ball et al., 2005). Many universities with carsharing hold on campus events where carsharing is introduced and explained. They can send out e-mails and newsletters to advertise directly to every member of the university community. MIT and Stanford place signs advertising carsharing in their shuttles, and the University of Pennsylvania provides information on carsharing to new students while discouraging them from bringing a car to campus (Millard-Ball et al., 2005).

A university can also support a carsharing program through parking provisions and fleet augmentation. Reserving prime parking spaces for carsharing vehicles can be one of the most important forms of advertisement. Some universities like MIT provides free parking spaces to Zipcar, while others such as Portland State University reduce parking fees (Millard-Ball et al., 2005). In addition to providing parking, universities also supply a steady membership base.

Most universities have a fleet that is used by various departments, which can be very expensive to maintain. Also, many universities do not charge the departments the full cost for the use of the vehicles. Some universities have considered promoting departments' use of carsharing in order to reduce or get rid of a fleet of vehicles. However, resistance to change and the perceived convenience of having a dedicated vehicle have held campuses back (Millard-Ball et al., 2005). More often, universities have promoted carsharing to their staffs by subsidizing

memberships which provide carsharing organizations with a predictable membership base and income. The University of Wisconsin bought 200 trial memberships for campus employees, which provided a $10,000 subsidy to the carsharing operator (Millard-Ball et al., 2005) Between 60% and 70% of those who participated in the trial membership went on to join the program (Millard-Ball et al., 2005).

Small cities with an urban university (or other similar institutions) campus are in an excellent position to implement carsharing. Universities will provide a steady base membership as well as access to a large number of students who do not have a personal vehicle. In addition, students tend to reside within a small, condensed section of a campus or community which makes it easy to determine the location of vehicles. Urban universities are preferable because they are intertwined with the community, which offers the chance for the carsharing organization to serve the community and the university. Suburban university campuses like the University of North Carolina at Chapel Hill are more contained and so carsharing is focused on the campus (Millard-Ball et al., 2005).

6.3.3 Businesses

Businesses are one additional type of partner that can offer a steady membership or income base. Typically, businesses are looking for ways to gain access to a vehicle that is cheaper and more efficient than owning a fleet or reimbursing employees for travel costs. In some instances, businesses have been able to replace or augment their fleets. Fleets tend to be very costly and are often under utilized. Carsharing provides vehicles when they are needed without the hassles of maintenance or insurance.

Businesses also join carsharing programs to help manage parking demand by reducing the need for employees to bring a vehicle to work. For example, if an employee needed a vehicle to get to a meeting during the day, they would typically have to drive into work, even if they normally use another commute mode. Carsharing allows the employee to travel to work by their normal commute mode, but still have access to a vehicle during the day to travel to the meeting. Carsharing is often advertised as a fringe benefit to new employees (Millard-Ball et al., 2005).

Businesses often contact carsharing organizations after seeing general marketing material. However; carsharing companies can reach out directly to businesses through interest meetings and other commercial events. Employers can choose from several different program models such as a dedicated fleet, a semi-dedicated fleet, or an open fleet. A dedicated fleet is typically more expensive, but provides guaranteed access to the vehicles. A semi-dedicated fleet is less expensive, but the fleet is made available to other carsharing members after standard business hours (Millard-Ball et al., 2005). So far most businesses use an open fleet system in which the employers pay just for the use of the vehicle, but there are no assurances as to the availability of a vehicle as the public has access to them at all times (Millard-Ball et al., 2005).

6.3.4 Transit Agencies

Carsharing is meant to work with a transit system to provide alternatives to using a personal vehicle for trips where mass transit is not a viable option. Transit agencies are partnering with carsharing organization in order to increase access to their stations, reduce vehicle ownership, and increase ridership. Carsharing is often used as a supplement to a transit program by providing a connection between rail

stations and a passenger's final destination (Millard-Ball et al., 2005). Carsharing can be used to tap into markets that were previously not served by transit by providing a link between a passenger's home and a transit station.

Carsharing organizations benefit immensely from partnerships with transit agencies. Since transit riders form the core of a carsharing program's membership base, carsharing operators can easily target their strongest market. Transit agencies advertise through their websites, newsletters, and advertisements on their buses, trains, and stations. King County Metro has added carsharing into its Commute Trip Reduction program and promotes the use of carsharing by partnering it with other commute modes such as a ferry or train (Millard-Ball et al., 2005).

Transit agencies can offer discounts for carsharing members that use their transit system. The bus company in Bristol, England offers 10% off prepaid fares for carsharing members, as well as a free three month pass for those who get rid of a personal vehicle (Millard-Ball et al., 2005). The Washington Metro Area Transit Authority is looking into integrating fare cards with Zipcar and Flexcar access cards in order to provide a seamless transition between carsharing and transit, as well as integrated billing (Millard-Ball et al., 2005).

Many transit agencies also integrate carsharing into their employer outreach programs. Working through the established relationship between a transit agency and employers can ease the integration of carsharing into the business market as well as easily attract downtown employers. King County Metro offers $35 worth of carsharing use when its FlexPass employer transit pass holders join Flexcar (Millard-Ball et al., 2005).

Parking is considered to be the main support that a transit agency can provide to a carsharing program (Millard-Ball et al., 2005). Like many of the other partners that aid by supplying parking, transit agencies often offer prime parking spaces around transit stations in order to increase access to the carsharing vehicles as well as to advertise the program. Some transit agencies offer free parking, but most now charge the carsharing operator a reduced, or sometimes a standard, fare for parking.

6.3.5 Developers

Developers are one of the partners that can provide a direct link to a membership base. Developers can integrate carsharing into their designs, and offer it as an amenity to residents or tenants. Some developers in urban areas have noted that carsharing is now becoming a standard amenity at many new apartment complexes (Millard-Ball et al., 2005). The relationship between carsharing operators and developers is a co-dependent one. Developers use carsharing to market their developments, while carsharing operators use developers to market carsharing to potential members.

Developers may also integrate carsharing into their designs in order to reduce the number of parking spaces required by parking ordinances (Millard-Ball et al., 2005). Parking, especially garage parking, is very expensive to construct, and any reduction in parking requirements can save developers tens of thousands of dollars per stall. Equity Properties in Seattle, Washington offers its tenants $250 to sign up with Flexcar as a way to mitigate parking needs and attract tenants (Millard-Ball et al., 2005). In addition to offering bonuses to sign on, developers can also subsidize

membership which may be necessary to convince a carsharing operator to provide services.

In addition to offering carsharing as an amenity, some developers view carsharing as a method to promote sustainability. Carsharing improves transportation and can help to maintain the attractiveness of downtown properties that are dependent on the transportation environment. Car-sharing can also be used to help developers obtain a Leadership in Energy and Environmental Design certification (Millard-Ball et al., 2005).

6.4 Obstacles to Entering the Market

Carsharing organizations, whether in a large city or a small city, face many challenges when attempting to initiate a new program. Acquiring reasonably priced insurance, finding funding for start-up costs and technology, passing carsharing supportive policies, analyzing market demand, and educating the public are some of the problems that start-up organizations face when trying to implement carsharing.

6.4.1 Insurance Obstacles and Possible Solutions

One of the largest barriers to any carsharing program is its ability to procure reasonably priced insurance. About 53% of carsharing programs indicated that they had difficulty finding insurance due to high costs (Shaheen, Cohen, & Roberts, 2005). High insurance costs affect smaller organizations more because of their typically limited funding. Insurance accounts for 20-40% of an operator's costs (Millard-Ball et al., 2005). US organizations typically carry $1 million in single limit liability insurance, but some have started to reduce this amount to $300,000 which

reflects the amount more typical of a personal automobile rather than a company fleet (Shaheen, Cohen, & Roberts, 2005).

Carsharing organizations have always faced challenges when trying to procure affordable insurance for their vehicles because carsharing is a relatively new concept. From the beginning, there were some firms that were willing to provide insurance, but only at a minimum (Shaheen, 2004). As interest in carsharing increased across the country, Hilb Rogal and Hamilton (HRH), a company that focused primarily on vanpool fleets, started to provide insurance to carsharing organizations (Shaheen, 2004). In addition, non-profits were able to obtain insurance through non-profit insurance companies. The Alliance of Nonprofits for Insurance, Risk Retention Group, and the Nonprofits' Insurance Alliance of California provided insurance to several non-profit carsharing fleets (Shaheen, 2004).

Prior to 2001, most carsharing organizations were able to get affordable insurance coverage through companies like HRH or non-profit alliances. However, in 2001, the insurance industry reported the worst rate of return in the sector's history due to factors such as the 9/11 terrorist attacks, rising medical and litigation costs, and the economic recession (Shaheen, 2004). These factors, along with higher jury awards in automobile liability cases, increased vehicle repair costs, and several fraud problems led to an increase in automobile insurance (Shaheen, 2004).

Some carsharing companies were forced to terminate because of renewal rates of 50% or more (Shaheen. 2004). One of the reasons for such high premiums is that shared-use vehicle services have not yet been assigned a risk class, and insurers are less likely to accept new risk categories. Without a classifiable insurance status, premiums will vary greatly from one carrier to another, fewer insurance companies

will be willing to explore the new market, and higher premiums will be built in to cover unknown risks.

As of July 2002, some carsharing organizations reported premiums from $1,200 to $6,000 per vehicle per year, with the majority of organizations paying between $4,800 and $6,000 (Shaheen, 2004). This amount can account for up to 48% of a carsharing organization's operating costs (Shaheen, 2004). These high rates have the ability to negatively affect the market for start-up organizations. Start-up organizations typically have limited budgets and often require outside assistance to cover insurance costs. Insurance carriers usually require a driving history check from the state, which may cost $15-$20 per driver and causes several days of delay before a new member is actually able to drive vehicles. This cost and delay discourages some new members (Brook, 2004).

Carsharing organizations are constantly trying to seek affordable insurance so that they can reduce the costs passed on to the user. Strategies to reduce insurance costs include:

1. *Risk-Rating and Actuarial Tables*: carsharing organizations must document accident histories, driver histories, fleet usage, and preventative actions, and share this information with other organizations (Shaheen, 2004). As more data is collected, these tables will provide insurance companies with data to more accurately assess the risk of a carsharing program.

2. *Advanced Technologies*: preventative measures such as automated seatbelts, antitheft devices, and vehicle tracking systems (Shaheen, 2004).

3. *Self Insurance*: would put more of the risk on the carsharing companies themselves and therefore lower their premiums to the insurance companies.

4. *Usage Based Insurance*: similar to traditional insurance rates in that it is based on driving record, vehicle, and location; however, the cost of the monthly premium hinges greatly on how much the vehicle is driven (Shaheen, 2004). This type of insurance requires the use of GPS tracking systems.

6.4.2 Accessing Advanced Technologies

Advanced technologies are vital to decreasing administration costs (Shaheen, 2004). Further improvement of customer service may come from interoperability of these advanced technologies. This type of improvement is much more important to those with aggressive growth objectives, but some organizations, especially small-scale operations, do not have the scale or the funds to continuously upgrade their technologies (Shaheen, 2004).

Currently about 56% of US shared-use vehicle organizations are employing Intelligent Transportation System (ITS) Technologies to improve vehicle access, member reservations, and data collection and have seen great improvement in operations (Shaheen, 2004). The use of smart cards and key fobs increases the ability of operators to track and bill members for their use. Automated reservations online, or through a touch tone phone, increase the convenience and speed at which a vehicle can be reserved, and also reduce the overall staffing needs. Data collection using vehicle tracking devices can also reduce the need for staffing, and can automate the billing process.

In order to lower the costs of technology and support the development and use of new technologies, carsharing organizations must work together. With these partnerships, the necessary funding and interest from technology manufacturers will encourage development. Larger providers could invest in research, develop applicable and feasible technologies, and combine their research with other providers to create

technology for industry-wide operations. This would also be beneficial by creating a standardization of technology and facilitating interoperability (Shaheen, 2004).

6.4.3 Marketing

Marketing carsharing is a significant challenge in the startup of a new company. Carsharing is an unfamiliar concept to most people, and providing a simple description of the service for promotional purposes is difficult (Brook, 2004). Many individuals who are not familiar with the service confuse carsharing with carpooling.

The cultural obstacles also provide difficulty when trying to market carsharing to the public. The car culture of America is focused on the independence a personal vehicle provides, which leads to high auto ownership rates and low transit use (Millard-Ball et al., 2005). As the price of fuel and insurance increases, and congestion increases travel times, that culture may change, but carsharing operators need to market the cost savings of carsharing and show that carsharing does not decrease personal freedom.

General marketing of carsharing should emphasize that the service is easy to use, affordable, and reliable (Brook, 2004). It should also focus on the availability of the vehicles. Partnering with transit agencies and municipal transportation offices can be a key to any company's marketing strategy (Brook, 2004). Carsharing can be marketed as part of a "transportation alternative" program advocated by these groups. Marketing should also focus on creating ongoing awareness of carsharing through the press, TV, and radio. This awareness is necessary to convince people that carsharing is a reasonable alternative to owning their own vehicle. Testimonials are another valuable marketing tool (Brook, 2004).

6.4.4 Financial Constraints

Partners are increasingly important as the cost of starting a new, and competitive, carsharing operation increases. One carsharing operator estimates that it costs about one million dollars to start a program in a new market (Millard-Ball et al., 2005). Grassroots efforts such as Philly CarShare and Boulder CarShare started with very constrained funds. Philly CarShare started with less that $30,000 (Lane, 2006), and Boulder CarShare started with volunteers, one vehicle, and practically no money. Philly CarShare has grown significantly due to increasing interest, and through new partnerships. However, in Boulder, where partnerships have not been formed, the CarShare program has expanded rather slowly (only about 50 members over 8 years).

Grants are also difficult to acquire and usually come with restrictions. Currently, there are no grants specifically designed for carsharing. King County Metro received a JARC grant; however, that can only be used for low income members. They also received an EPA grant but that only paid Flexcar for the difference in cost between a hybrid and a regular vehicle (Millard-Ball et al., 2005).

6.5 Policy Needs

All carsharing organizations need supportive policies enacted before attempting to implement a carsharing program. A proper environment for carsharing must be established prior to implementation to ensure that the organizations can reach their greatest potential. Supportive policies range from encouraging organizations to expand their program to untested markets, to parking provisions, to encouraging developers to incorporate carsharing into their designs (Shaheen, Cohen, & Roberts, 2005). These policies are often implemented at a local level, but federal funding

sources such as the Federal Transit Authority and the Environmental Protection Agency can also provide some support for carsharing organizations.

Parking provisions are the type of supportive policy that has been enacted the most (Shaheen, Cohen, & Roberts, 2005). Provisions for on-street as well as off-street parking are extremely important because they facilitate access to carsharing vehicles and lower operating costs. Some municipalities have created carsharing parking zones, allowed carsharing vehicles to ignore parking time limits, offered free or reduced off-street parking, assigned on-street spaces, or created universal parking permits (Shaheen, Cohen, & Roberts, 2005). Providing reserved on-street parking designated for carsharing is an important way for local government to support the carsharing organization (Brook, 2004).

Participant subsidies and tax credits can also have a large effect on the success and potential market for a carsharing organization. Currently there are two types of participant subsidies used in the US, those available to participants in a particular location, and those geared towards the low-income market (Shaheen, Cohen, & Roberts, 2005). These subsidies encourage expansion to untested markets. The Job Access Reverse Commute program, and the Congestion Mitigation and Air Quality Improvement program funds have been used to subsidize low-income members in some cases (Shaheen, Cohen, & Roberts, 2005).

Tax credits have been used in a few instances to support the efforts of carsharing organizations. For the most part, local and state governments have been responsible for issuing the tax credits (Shaheen, Cohen, & Roberts, 2005). These tax credits include (Shaheen, Cohen, & Roberts, 2005):

- Local and state tax credits to carsharing members

- Exception from rental car taxes
- Tax credits to employers and property managers
- Tax credits to non-profit carsharing organizations

Supportive policies do not have to directly affect the carsharing organization, but can provide benefits to outside influences such as automakers, corporations, and developers. There has also been a recent interest in policies that ease the zoning regulations for developers who incorporate carsharing into their designs. These policies include (Shaheen, Cohen, & Roberts, 2005):

- Reducing the number of parking spaces required by zoning regulations.
- Reducing the number of trips generated from the development.
- Allowing greater floor area ratios. This allows developers to build more densely on a particular site.

In California, automakers are eligible for additional zero emission vehicle credits for placing low-emission vehicles in carsharing fleets (Shaheen, Cohen, & Roberts, 2005).

Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

As carsharing becomes more of a main-stream transportation mode, and increasing number of cities, both large and small, will be looking to implement these programs. To date, a lot of research and summary have been conducted on programs in larger cities. These programs tend to be a lot bigger and more successful than small city programs. Many programs that have started in small cities have closed down due to lack of funding or small membership numbers. However; with a proper implementation strategy, carsharing can be successful in a wide variety of applications.

This chapter will present the steps of the implementation strategy based on results from the literature review, regression analysis, interviews with Boulder CarShare and Philly CarShare, surveys, trip log analysis, and GIS analysis. These steps are meant to be a guide for small cities to navigate the implementation process. This is not meant to develop huge programs that can rival those in larger cities. Rather, it is a guide to help start-up programs make an educated estimate of a feasible program size, and to help the program reach its potential. As discussed in Chapter 6, success should be defined on a program by program basis.

7.1 Identifying a High Level Champion

Millard-Ball et al., identifies the need for a strong local champion of carsharing as well as a group of initial members that have a strong commitment to the

success of the program (2005). A strong local champion will ensure that the program gets serious attention from the local government and other potential partners while being able to effectively communicate the message of carsharing to the rest of the city. A high level champion will not only help with the policy needs of a carsharing program but also gather greater public support, and effectively communicate with businesses and other potential partners in order to gain funding for the implementation.

In addition to a high level champion, there also needs to be a group of initial volunteers that have a strong commitment to the program's success. This is especially important for grassroots efforts. The high level champion needs a support base in order to be able to effectively introduce carsharing into the city. These volunteers are essential in small cities because there may be little motivation for the general public to adopt carsharing right away.

Small cities must first secure the high level champion and the volunteers in order to make a case for carsharing. If a small city can not identify these people, the chances of a successful carsharing program are slim.

7.2 Identify a Target Market

Identifying a target market is the second most important step in developing an implementation plan for carsharing. It will identify what types of people may join the carsharing program, where best to locate the vehicles, and if there are any interested partners.

7.2.1 Identify Potential Partners

As discussed in the previous chapters, there are a wide variety of potential partners that can aid a start-up carsharing program in a variety of ways. Small cities need to identify these partners first, as they will provide a base membership, base revenue, and possibly some start-up funding for the carsharing program. These partnerships are critical to growing the program and can provide for a low risk environment for the implementation of carsharing. Figure 7.1 shows a hierarchy of relationships that should be established before carsharing is implemented.

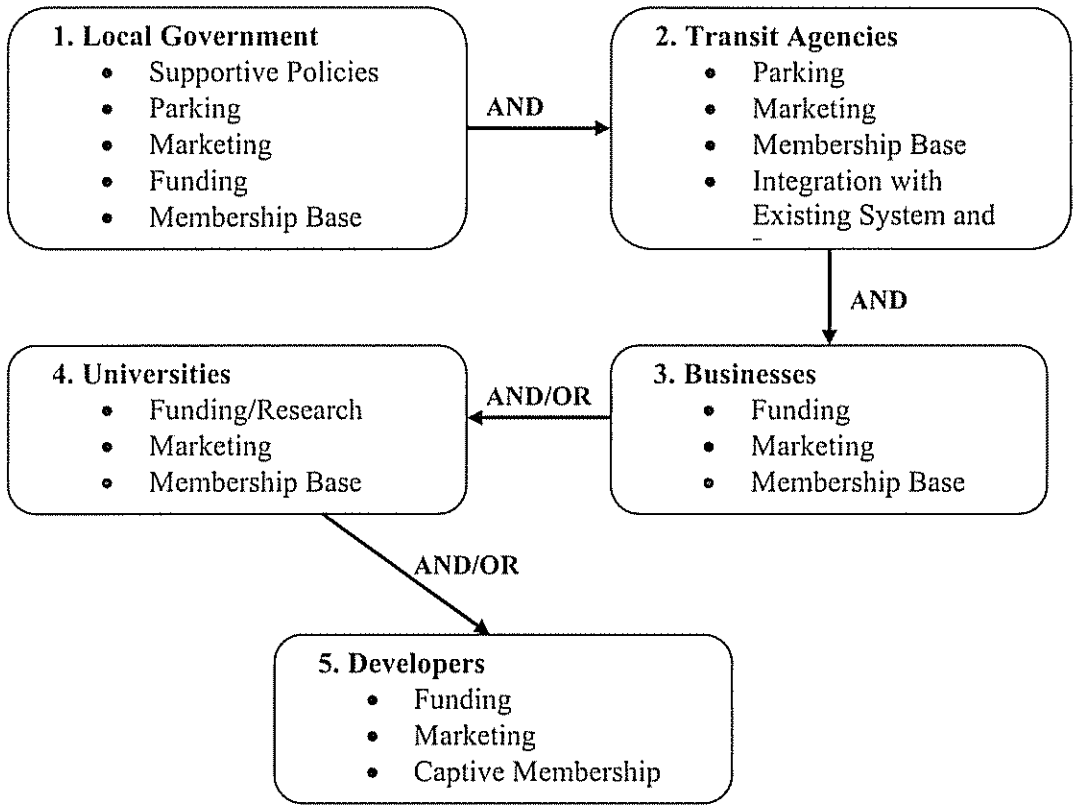


Figure 7.1 Hierarchy of Partnerships

Small cities have to develop a partnership with the local government. It is unwise to ignore this necessary relationship. Local governments provide the supportive policies that are needed to form a carsharing environment as well as supplying a membership base, funding, and marketing support. Another essential partnership is with transit agencies. Since carsharing is supposed to work with transit, it is necessary that the transit agency makes an effort to integrate the carsharing program into its policies and marketing. In some small cities, the local government may control the transit. In this case carsharing organizations must ensure that carsharing is supported in the transit arena as well as in the policy one.

After establishing those first two critical partnerships, small city carsharing organizations should look for another type of partnership; with a business, university, or developer. The carsharing organization can consider partnerships with one or all of the remaining types of partners. If the local government does not augment or replace its fleet, these other partnerships become critical to providing a relatively secure base membership. Businesses may be the easiest to form partnerships with because they have a lot to gain by joining carsharing (replacing a fleet, augmenting a fleet, or avoiding purchasing a fleet).

Universities may be a little more difficult because of funding and insurance constraints. However; universities offer the best access to a large amount of highly educated individuals with a low car ownership rate. In addition, universities may also consider fleet replacement or augmentation. Developers are also important partners, although not as critical as the other types of partners. They can provide a captive membership base by integrating carsharing into their developments. However; in the initial implementation stages of a carsharing organization, developers must

contribute a lot of money to the carsharing organization in order for them to provide access to vehicles in areas that are not the best suited for the initial implementation of carsharing.

7.2.2 Identify a Target Population

After a series of partnerships are developed, it is necessary to identify the target population in which to market the program in its initial stages. In addition, it may be necessary to evaluate the public's knowledge of, and interest in, carsharing. This can be done in a variety of ways, including public interest surveys and community events. In some cases, surveys can be difficult or expensive, especially if public interest in carsharing is low, or if the public is unsure of what carsharing is. Possibly the most cost-effective way of educating and evaluating the public is to have a informational table at local community events. This is especially important for grassroots efforts. Providing information and conducting surveys at community events is an easy and effective way to promote the idea of carsharing.

Each individual city has its own unique characteristics which may slightly change the target demographics. The target market should have the following characteristics:

1. A commitment to alternative commute modes (a high utilization of mass transit, walking, biking, or carpooling).
2. Low car ownership rate and a household size of two or more adults.
3. High educational attainment (Bachelor's or higher)
4. Concern for the environment and for the costs of transportation.
5. Have a household income of at least $50,000.

6. Between the ages of 25 and 50.

7.2.3 Identify a Target Location

There are many studies that identify a need to locate carsharing in high density areas as well as mixed-use areas. These areas provide the most access to the widest variety of potential members and tend to be areas with more mass transit access. Refer to Table 6.2 for the attributes of target locations. When considering the locations in which to target carsharing there are three ways to evaluate them:

1. Placement of Vehicles Based on GIS Analysis: To evaluate census tract data regarding incomes, population density, transportation habits, and other demographics. Also, to evaluate land use patterns and identify mixed use and high density areas. In this method, members may be targeted because they reside in or around areas identified by the GIS analysis rather than their individual demographics or interest levels.

2. Placement of Vehicles Based on Partners: If partnerships are established that require vehicles to be located around the partners, then the placement of vehicles must occur within walking distance of those partners.

3. Placement of Vehicles Based on Member Locations: In some cases it may be possible to map member locations and try to identify the best placement of vehicles that provides the best access to those members.

7.3 Identify a Start-Up Model

The first two steps (7.1 and 7.2) are important because they define whether there is a demand for carsharing, and how large that demand is. If any of the above steps fail, then it is possible to assume that carsharing is not feasible at that time, and can be re-evaluated at a later date. However, assuming that the start-up carsharing organization has identified a champion, partners, a target membership, and some possible target vehicle locations, the next step would be to outline an operational structure.

There are six types of models that have been implemented in the US. Out of all the possible models, the grassroots efforts or municipal lead seem to be the most common types of models in small cities. Boulder, CO is an example of a grassroots effort, while Wilmington, DE is an example of a municipal lead. This report recommends the use of the grassroots for use in small cities; however, the municipal lead model may be applicable in some locations.

7.3.1 Grassroots

The grassroots model is one of the most common carsharing start-up models. It has been used in Philadelphia, Boulder, and San Francisco, among many other cities (Millard-Ball et al., 2005). In this model the support of partners is critical in providing the start-up funding as well as supportive policies. These efforts are usually started by a group of volunteers that are concerned for the environment and are seeking a way to reduce personal auto travel. These volunteers, led by a strong champion, can easily gain the support from local social and environmental groups. These efforts are usually more focused on environmental and social benefits so there may be more of a conscious effort to link carsharing to transit, and to place vehicles in low income neighborhoods (Millard-Ball et al., 2005).

In addition, they tend to have more control over the formation of the carsharing program and are able to more readily identify the areas within the community that may be best served by carsharing. Since these efforts are relatively small, and are started by members of the community, they tend to represent the most economically viable locations (Millard-Ball et al., 2005). Grassroots efforts also tend to gain the support of the community easier because they are members of the community. Casual meetings, community events, and word of mouth can be the

easiest and most successful types of advertisements for the program. In many cases the grassroots efforts have identified an adequate membership base even before seeking partners or funding.

Typically grassroots efforts start with limited funding and require the assistance of partners to help the program get off the ground. In most cases these are non-profit groups, although some have gone on to be for-profit ventures after the program has matured.

7.3.2 Municipal Lead

The municipal lead model is another viable option for start-up carsharing organizations. These are typically public agencies which may issue an RFP, provide the necessary resources for a community group, or provide support for an existing firm to move services into the city (Millard-Ball et al., 2005). This model may be best suited in combination with the grassroots model. A municipal lead will almost guarantee a high level of commitment from the city in terms of marketing, supportive policies, funding, and membership. Many municipal leads are started because of an agency's desire to expand transit services and to reduce their own personal fleet.

This approach may be useful for cities that have tried, but failed to start a carsharing program because it provides a base revenue and membership in which to grown upon. These carsharing organizations can be non-profit or for-profit.

7.4 Acquire Funding

While there have been many carsharing organizations such as Boulder CarShare and Philly CarShare that have started with little or no funding, it is necessary for start-up carsharing organizations to obtain funding from various sources.

Funding is most often provided by a partner such as a city government or business. Having multiple partnerships increases the potential for significant funding.

Some grassroots organizations such as Boulder CarShare have started with no funding and only the support of the volunteers, but the program has grown rather slowly and does not offer the same amenities or quality of vehicle offered by other, highly funded organizations. Philly CarShare was also a grassroots effort that started from money provided by its volunteers; however, it later partnered with the City of Philadelphia and other businesses and was able to grow quickly.

Carsharing organizations need funding in order to purchase vehicles and technologies, as well as to pay for staff members. While small city organizations are going to typically have fewer vehicles at the time of implementation, funding can help promote the program and help to provide attractive technologies and other amenities that quickly attract new members.

There are federal grants that can be obtained through agencies such as the Federal Highway Administration, and the Environmental Protection Agency, among others. However; many of these grants come with restrictions for use, which may make it difficult for a start-up organization to utilize these funds. Partnering with local governments and transit agencies to insert carsharing into a Transportation Demand Management program is one of the best ways to acquire governmental funding for carsharing.

7.5 Marketing

Marketing can be one of the most critical, yet most expensive aspects of carsharing. Many small city programs had little money at the implementation stage and found it difficult to provide extensive marketing programs. However; there are

low cost methods of advertising that can have high yields. Programs like Boulder CarShare and Philly CarShare spent little to no money on marketing and relied on people seeing their vehicles on the street and word of mouth as the main forms of advertising. Both of these organizations note that this method was more than adequate to help the program get off the ground.

Again, partners are essential in this role. Local governments, transit agencies, universities and businesses provide direct access to potential members. Local governments and transit agencies can incorporate advertisements for carsharing in newsletters, e-mails, websites, and in transit facilities. Universities and businesses also can easily advertise the service to their students and employees.

Community events can also provide a low cost method of advertising. Volunteers for the carsharing organization can easily promote the program by distributing brochures and talking to potential members. Visibility in the community is essential for carsharing organizations in small cities, especially if they are grassroots efforts.

7.5.1 Focusing Marketing Strategies

Many small cities do not have the same amount of congestion, parking problems, transit access, and low auto ownership that larger cities do. The goal of the marketing campaign for programs in small cities is to promote the environmental and social benefits of the carsharing program. Cost savings comparisons between driving and carsharing should also be included. Carsharing should be promoted as a balance between transit and personal vehicle ownership that can significantly reduce transportation bills, and allow households with two vehicles to sell one and replace it with carsharing.

Another important piece of the marketing puzzle is how to attract and keep members. Susan Shaheen offers social marketing theory as one way to approach this problem (2004). This behavioral adaptation process is an essential theory within social learning and social marketing. It is a four stage process a person goes through in order to completely adopt a new product or behavior. The four stages include pre-contemplation, contemplation, action, and maintenance. Figure 7.2 shows the process that carsharing organizations in small cities should follow.

The first stage, pre-contemplation is referred should generate interest and excitement in the new program. This should begin up to 6 months before the program starts. The purpose of this step to is inform the public in the target areas about carsharing with a focus on the target members outlined in section 7.2.2.

The second stage is the promotion stage of the program, which should be implemented as soon as the program begins. This stage is designed to reinforce the decision of the current members to join the program, while also convincing members that may be "on the fence" to join the program. Offering trial program fees or rewards to new members may help to convince potential members that are unsure about the program.

The third stage is re-evaluation. This stage should begin two to three months after the program has started and continues for the length of the program. The purpose of this stage is to evaluate the changing needs of the existing members as well as evaluate the needs of new members as the program changes from early adopters to the more standard type of member.

The final stage, maintenance, is designed to keep members interested in the program and to offer small rewards to reinforce their decision to join. Carsharing

organizations can offer small gift certificates for meeting certain membership lengths, and also send out informational emails regarding how much members have saved compared to the average driver.

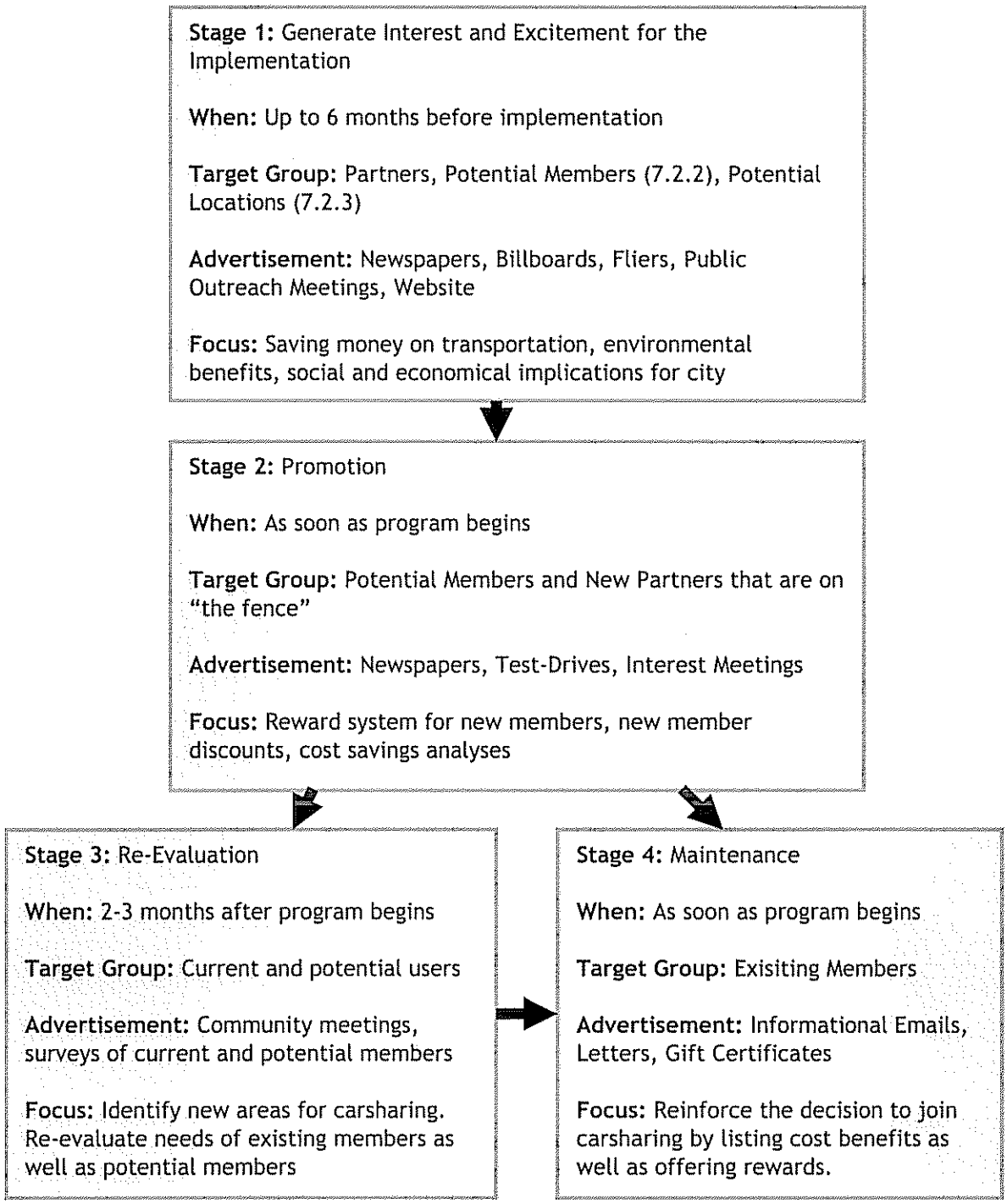


Figure 7.2 Marketing Strategy

7.6 Developing an Implementation Plan

Small cities are often faced with the uncertainty of the potential of a carsharing program. Existing carsharing companies are reluctant to provide services to small cities because of the small markets and the high financial risks. Start-up organizations in small cities need to have an established implementation plan that outlines rules for implementation, maintenance, monitoring, and expansion. These implementation programs should act like plans for a pilot program.

Designing a plan to act like a pilot program will help to control the evaluation and expansion of the carsharing organization. The pilot program plan should outline where the vehicles should be placed, and how members and vehicle will be monitored. It should last no less than 6 months and no more than 18 months. No more than 5 vehicles should be purchased for the initial phase of the program, and these vehicles should be placed in the target locations that offer the best chances for program success. Members should be monitored throughout the span of the pilot program from the time they join until the end of the pilot program period. Vehicles should also be monitored through GPS tracking devices or trip logs.

Operating the implementation plan like a pilot program will also establish rules for how to close the program if it does not meet its goals. Goals of membership, utilization, and revenue should be established. The theory behind a pilot program is that if carsharing does not work in an area that is most suited for it, it will not work anywhere in the city and should be abandoned.

If the program reaches its goals before the end of the pilot program, the program can be terminated early, and services can be expanded to where they are needed. However; even after the pilot program is over, the carsharing organization

should still regularly survey its members and analyze travel patterns in order to improve services and attract new members.

7.6 Evaluating the Pilot Program

The most important function of the pilot program is to collect data on how the system is performing and to address what the future demand might be. The program should be evaluated based on five major measures of effectiveness (MOEs); transit ridership, user costs/savings, changes in user vehicle miles traveled (VMT), changes in membership demographics, and revenue generated. These evaluation methods should also be used throughout the life of the actual carsharing program, if one is established after the pilot program.

Member surveys will likely be the most important method for gathering information on the opinions of the users. A series of seven surveys should be developed and distributed throughout the life of the pilot program at pre-determined membership milestones. All members should receive a survey prior to starting the program in order to determine their transportation habits before using carsharing. This, combined with future surveys will help evaluate changes in VMT and travel time.

Surveys should be distributed to members after one, two, three, six, nine, and twelve months for a twelve month program. In addition an exit survey should be given to those members who leave the pilot program early. These surveys will form the basis for a trend analysis of the program's performance as well as allowing program administrators to examine the changing needs of its members. All the surveys should ask similar questions regarding:

- transit ridership

- travel patterns
- trip durations and destinations
- opinion of carsharing
- changes in user needs
- willingness to continue membership given changing variables (such as fees)

Increasing transit ridership is a cornerstone of any carsharing program. Although small cities are not expected to experience the same benefits as larger cities such as San Francisco and New York, smaller cities are expected to see an increase in transit ridership as a result of carsharing implementation. People that join the program to use the vehicles during the work day are excellent candidates for increasing transit ridership because they can access transit to get to work and use carsharing for work trips. Transit numbers should be monitored throughout the duration of the program. It will be possible to determine increases in transit due to carsharing by combining transit data with survey data.

A small cross section of the membership should be selected for personal interviews. These interviews will help to obtain more in-depth feedback from the users which may help to sculpt a future program.

Each vehicle should be equipped with a GPS tracking device. This device is typically used for billing purposes but it may also be used to gather information on the types of trips being made with carsharing. The GPS analysis should be conducted on a monthly basis and consist of an origin-destination analysis. This type of analysis will help administrators to determine where people are traveling using carsharing, to analyze user costs given the typical cost of car ownership, and to determine VMT

trends over the life of the program. Preferably, an average of 10-20% VMT reduction should be observed; any less and the program should not continue until the system is re-evaluated.

Changes in revenue and membership should be relatively easy to evaluate. Ideally, the pilot program should experience an increase in membership throughout the 12-month period. Depending on the success of the program it may be necessary to increase the number of vehicles on the street before the pilot program concludes. More vehicles should be added when all of the following criteria are met:

1. A vehicle to member ratio of at least 1:20. (With three cars, there should be at least 60 members).
2. A vehicle utilization rate of at least 40%. The vehicles should be in use for about 8 hours per day on a typical weekday.
3. A member retention of at least 60% per month. This will be assessed through interviews with members and surveys.

7.7 Conclusion

Carsharing can be implemented in small cities if start-up organizations are careful in how they implement the program and fully evaluate the needs of the community as well as the city and other partners. Figure 7.3 is a checklist for implementing carsharing in a small city. If a start-up organization can answer yes to these questions, then there is no reason why carsharing should not be implemented in that city.

1. Is there a high level champion of carsharing and is there a group of committed volunteers?
2. Can a partnership be formed with local governments, transit agencies, and businesses, universities, or developers? Can a secure base membership be established with any of these partners?
3. Is there a source of funding for the start-up costs?
4. Is there a sector of the population of the city that is highly educated, environmentally conscious, and that shows a commitment to using mass transit?
5. Is there a mass transit system or Transportation Demand Management Program that carsharing can be integrated into?
6. Are there areas within the city that have the characteristics outlined in Chapter 6, such as low vehicle ownership rates and higher than average mass transit use?
7. Is there support for a grassroots effort for carsharing?

Figure 7.3 Checklist for Implementation of Carsharing in Small Cities

The purpose of this report is not to become the only reference for the implementation of carsharing in small cities. It is hoped that this document is used as a reference guide along with other references, and should be combined with common sense and an evaluation of conditions on a city-to-city basis. The interior chapters of this report should be used as an example of what can be done with data that is relatively cheap and easy to collect, and that can be easily analyzed and present valuable findings about the operation of carsharing organizations. Essentially, this document should be used as an example of a possible implementation strategy and evaluation method for a carsharing organization.

There is a continuing need for research in the field of carsharing. A standardized approach to collecting and analyzing data is necessary to help clear the fog around some of the characteristics and operations of carsharing organizations. As carsharing becomes more of a main-stream form of transportation, data will increase,

especially in the arena of small city applications. This document is a preliminary look into small city carsharing organizations, and more research should follow.

Appendix A

REGRESSION DATA

Key to Variables

Variable	Definition	Units
Y1	Number of members	Number
Y2	Percentage of the population that are members	Percentage
X1	Population of city or county	Number
X2	Percentage of the population between the ages of 18 and 65	Percentage
X3	Percentage of residents employed in professional occupations	Percentage
X4	Per Capita Income	US Dollars
X5	Average household size	Number
X6	Average commute time	Minutes
X7	Percentage of people commuting using mass transit	Percentage
X8	Percentage of people that walk to work	Percentage
X9	Percentage of households with no vehicles	Percentage
X10	Mass transit rating	Number
X11	Carsharing operator value	Number
X12	Population density	Persons per Square Mile

City	Operator	Y1	Y2 (%)	X1	X2 (%)	X3 (%)	X4	X5	X6
Ann Arbor, MI	Ann Arbor Community Car Coop, Zipcar	360.00	0.31%	114498	75.30	57.30	26419	2.21	19.80
Aspen, CO	Roaring Fork Valley Vehicles	57.00	0.98%	5804	79.50	59.66	40680	1.94	12.80
Arlington, VA	Flexcar, Zipcar	3800.00	2.01%	189453	61.90	77.19	37706	2.15	27.30
Austin,TX	Austin Carshare	60.00	0.01%	672011	70.80	52.23	24163	2.34	22.20
Bellingham,WA	Community Carshare of Bellingham	14.00	0.02%	69057	73.40	41.03	22801	2.13	16.60
Boston, MA	Zipcar	22520.00	4.32%	520702	68.90	54.92	30167	2.23	28.80
Boulder, CO	Boulder Carshare	65.00	0.08%	83432	75.50	66.42	32326	2.14	18.80
Chicago, IL	I-GO, Zipcar	7520.00	0.28%	2701926	63.50	43.03	23449	2.65	34.30
Chapel Hill, NC	Zipcar	160.00	0.33%	48715	76.90	52.47	24133	2.22	18.40
Cleveland, OH	City Wheels	103.00	0.02%	414534	61.10	35.02	14825	2.33	25.80
Detroit, MI	Motor City Carshare	6.00	0.00%	836056	58.90	32.60	15042	2.69	25.70
Eugene, OR	Eugene BioCarShare	9.00	0.01%	142716	68.00	47.22	21685	2.25	16.90
Hoboken, NJ	Zipcar	520.00	1.35%	38557	80.50	71.80	43195	1.92	34.70

City	Operator	Y1	Y2 (%)	X1	X2 (%)	X3 (%)	X4	X5	X6
Ithaca, NY*	Ithaca Carshare	165.00	0.56%	29287	84.50	42.82	13408	2.13	14.30
Los Angeles, CA	Flexcar	1360.00	0.01%	9519338	62.30	15.75%	20683	2.98	29.60
Madison, WI	Community Car	200.00	0.10%	208054.00	72.90	58.29%	23498.00	2.19	18.30
City	Operator	Y1	Y2 (%)	X1	X2 (%)	X3 (%)	X4 (USD)	X5	X6 (min)
Minneapolis	hOurCar, Zipcar	360	0.09	382618	68.90	52.64	22685	2.25	21.70
Montgomery County, MD	Flexcar, Zipcar	1800	0.21	873341	61.90	66.71	35684	2.66	32.80
New York, NY	Zipcar	26080	0.33	8008278	64.10	40.96	22402	2.59	40.00
Oakland, CA	City Carshare, Flexcar, Zipcar	1520	0.38	399484	64.50	43.61	21936	2.60	31.10
Philidelphia, PA	Philly Carshare	1200	0.08	1517550	60.60	38.89	16509	2.48	32.00
Portland, OR	Flexcar	5680	1.07	529121	67.30	49.44	22643	2.30	23.10
Princeton, NJ	Zipcar	80	0.56	14203	80.60	38.62	27292	2.20	20.30
Prince Georges Cnty, MD	Flexcar, Zipcar	1760	0.22	801515	61.90	26.41	23360	2.74	35.90
San Diego, CA	Flexcar	1760	0.14	1223400	65.50	47.45	23609	2.61	23.20
San Francisco,CA	City Carshare, Flexcar, Zipcar	16608	2.14	776733	71.80	56.68	34556	2.30	30.70

City	Operator	Y1	Y2 (%)	X1	X2 (%)	X3 (%)	X4	X5	X6
Santa Monica, CA	Flexcar	120	0.14	84084	71.00	65.88	42874	1.83	25.00
Santa Barbara, CA	Flexcar	80	0.09	92325	66.40	51.57	26466	2.47	16.70
Seattle, WA	Flexcar	7320	1.30	563374	72.40	57.43	30306	2.08	24.80
Washington, DC	Zipcar, Flexcar	19832	3.85	515118	67.70	55.73	28659	2.16	29.70
Wilmington, DE			0.00	72664	61.50	41.01	20236	2.39	22.90

City	Operator	X7 (%)	X8 (%)	X9 (%)	X10	X11 (ppsm)	X12
Ann Arbor, MI	Ann Arbor Community Car Coop, Zipcar	7.40	6.14	9.50	2.00	4231	1.00
Aspen, CO	Roaring Fork Valley Vehicles	11.80	13.74	12.40	1.00	1675	0.00
Arlington, VA	Flexcar, Zipcar	23.30	5.60	8.50	4.00	7323	2.00
Austin,TX	Austin Carshare	5.00	2.50	7.80	2.00	2138	0.00
Bellingham,WA	Community Carshare of Bellingham	3.60	6.80	10.20	1.00	2372	0.00
Boston, MA	Zipcar	32.30	13.00	34.90	5.00	11865	1.00
Boulder, CO	Boulder Carshare	8.30	9.00	8.70	2.00	3686	0.00
Chicago, IL	I-GO, Zipcar	25.26	5.70	28.80	5.00	12252	2.00
Chapel Hill, NC	Zipcar	6.49	15.10	11.30	2.00	2466	1.00
Cleveland, OH	City Wheels	12.00	4.00	24.60	2.00	6566	0.00
Detroit, MI	Motor City Carshare	7.15	2.80	21.90	2.00	7411	0.00
Eugene, OR	Eugene BioCarShare	4.55	6.10	10.60	1.00	2965	0.00
Hoboken, NJ	Zipcar	57.20	10.30	38.30	5.00	30239	1.00
Ithaca, NY*	Ithaca Carshare	7.87	41.20	24.60	2.00	5360	0.00
Los Angeles, CA	Flexcar	10.20	2.90	12.60	2.00	7427	1.00
Madison, WI	Community Car	7.20	10.70	11.80	2.00	3309	0.00
Minneapolis	hOurCar, Zipcar	14.55	6.60	19.70	3.00	6710	1.00
Montgomery County, MD	Flexcar, Zipcar	12.60	1.90	7.50	3.00	1762	2.00
New York, NY	Zipcar	52.80	10.40	55.70	5.00	23705	1.00

City	Operator	X7 (%)	X8 (%)	X9 (%)	X10	X11 (ppsm)	X12
Oakland, CA	City Carshare, Flexcar, Zipcar	17.40	3.70	19.60	3.00	6635	3.00
Philidelphia, PA	Philly Carshare	25.40	9.10	35.70	5.00	11736	0.00
Portland, OR	Flexcar	12.30	5.20	14.00	3.00	3507	1.00
Princeton, NJ	Zipcar	4.90	35.60	13.70	1.00	2453	1.00
City	Operator	X7 (%)	X8 (%)	X9 (%)	X10	X11 (ppsm)	X12
Prince Georges Cnty, MD	Flexcar, Zipcar	11.90	2.20	10.50	2.00	1651	2.00
San Diego, CA	Flexcar	4.18	3.60	9.50	1.00	3428	1.00
San Francisco,CA	City Carshare, Flexcar, Zipcar	31.10	9.40	28.60	5.00	15502	3.00
Santa Monica, CA	Flexcar	4.10	4.40	10.70	1.00	10470	1.00
Santa Barbara, CA	Flexcar	4.50	6.20	9.50	1.00	4865	1.00
Seattle, WA	Flexcar	17.60	7.40	16.30	3.00	6153	1.00
Washington, DC	Zipcar, Flexcar	33.20	11.80	36.90	5.00	9884	2.00
Wilmington, DE		11.98	7.60	26.80	2.00	6623	0.00

Appendix B

BOULDER CARSHARE MEMBER SURVEY

Dear Boulder CarShare Member,

Please take a moment to complete this survey regarding your experiences with carsharing in Boulder, Colorado. The information gathered in this survey will be kept confidential and will be used to support a research project as well as to provide feedback to Boulder CarShare.

Once you have completed the survey please mail it in the attached self-addressed stamped envelope provided. As a token of our appreciation, all members who complete the survey and mail it by March 7th will be entered to win one of two $20 credits to be applied to future carshare bills.

PERSONAL INFORMATION

First, we would like to gather some general information about you.

1. Please give us your name or BCS reservation PIN #: _____
(We'll use this information only for the purposes of awarding the two, $20 credits)

2. Do you currently consider yourself to be an active member of Boulder CarShare?

____ Yes ___ No

If you are NOT currently an active member:

a) Please list your approximate dates of membership: _____

b) Why are you no longer an active member? (Select all that apply)

___ Moved further away from a BCS vehicle location
___ Bought a car
___ Was given a car
___ Too expensive
___ Carsharing was not a convenient option
___ Did not like the selection of vehicles available
___ Simply didn't need the service (I walk, bike or use transit most all the time)
___ Other

If you have used the carshare service within the past 6 months, but do not consider yourself to be an active member, we would still greatly appreciate it if you would complete the following survey.

3. Age: _____ Gender: Male Female

4. What is your educational background? (Check one)
   ___ Some High School
   ___ High School Diploma
   ___ Some College
   ___ College Degree
   ___ Some Graduate School
   ___ Graduate Degree

5. Do you rent or own your home (circle one)?
   Rent Own

6. Which best describes your household type:
   ___ Married or equivalent, with children (# of children: ___)
   ___ Married or equivalent, no children
   ___ One adult, with children (# of children: ___)
   ___ Live alone
   ___ Live with unrelated adults
   ___ Other (Please specify: _____)

7. How many people over the age of 16 live in your household? ____

8. How many adults in your household have driver's licenses? ____

9. How many people in your household are members of Boulder CarShare? _____

10. Work Status:
    ___ Full-time employed
    ___ Part-time employed
    ___ Student
    ___ Not working
    ___ Other: Please specify _____

11. Annual Household Income (circle one):

<$30k $30-45k $45-60k $60-75k $75-90k >$90k

TRANSPORTATION HABITS

Next we would like to ask you about your transportation habits before and after joining the carshare program.

12. How long have you been a member of Boulder CarShare?

_____ Years _____ Months

13. What type of vehicles do you, or others in your household own? (Please enter the quantity owned next to the type of vehicle)

Number Owned Prior to Joining the Program	Type of Vehicle	Number Owned After Joining the Program
	Small Sedan (ex. Ford Focus, Honda Civic)	
	Mid-Size Sedan (ex. Ford Taurus, Toyota Camry)	
	Minivan	
	Sports Car	
	Pick-Up Truck	
	Small SUV (ex. Honda CRV, Ford Escape)	
	Mid-Sized SUV (ex. Ford Explorer, Chevy Trailblazer)	
	Large SUV (ex. Ford Excursion, Chevy Suburban)	
	Hybrid Vehicle	
	Other (please list): _____	

14. Which, if any, of the following statements were true about you shortly before you joined Boulder CarShare? (Check all that apply):

___ I was actively looking to decrease my car ownership
___ I was passively looking to decrease my car ownership
___ I was actively looking to acquire a car
___ I was passively looking to acquire a car
___ My car died
___ My car was feeling like a burden
___ My not having access to a car, or second car, was sometimes feeling inconvenient for me or others
___ I was renting a car a lot

15. Since joining Boulder CarShare, I: (Check all that apply.)

___ Acquired a car
___ Got rid of a car
___ Decided not to acquire a car
___ Have strongly considered getting rid of my car

16. Do you live in the city of Boulder? ____ Yes ___ No

17. Do you work in the city of Boulder? ____ Yes ___ No
If not, where do you work? _____

18. How do you usually get to work? (Check the main mode)

___ Walk
___ Bicycle
___ Bus
___ Carpool
___ Motorcycle / scooter
___ CarShare
___ Drive alone
___ Other (specify): _____

19. How many miles do you live from work? _____

20. How many bus routes are within walking distance of your home? _____

21. Please enter the approximate number of times you use each of the following modes of transportation per week. Take **all** of your trips into account (not just work-related travel).

_____ Walk

_____ Bicycle
_____ Bus
_____ Carpool
_____ Motorcycle / scooter
_____ CarShare
_____ Drive alone
_____ Other (specify): _____

22. On average, how often do you use a carshare vehicle?
___ Less than once a month
___ 1-3 times per month
___ About once a week
___ Several times a week
___ Almost every day

23. How did you first find out about Boulder CarShare?
___ Friend
___ Logo on BCS Vehicle
___ Web site
___ Newspaper article
___ Tabling event
___ Other (Please Specify): _____

24. Prior to joining the program, how often did you travel more than 5 miles away from your home per week (excluding trips to work)? (Circle one)

0 1-3 4-6 7-9 >9

25. How many times do you travel more than 5 miles away from your home now (excluding trips to work)? Circle one.

0 1-3 4-6 7-9 >9

26. Prior to joining the program, how often did you use mass transit? (Circle one)

Never	Rarely (a few times a month)	Often (a few times a week)	Always (almost everyday)

27. Since joining Boulder CarShare, I . . .

	1 = More	2 = About the Same	3 = Less
Walk	1	2	3
Bike	1	2	3
Take Public Transit	1	2	3
Take a Taxi	1	2	3
Borrow a Friend's Car	1	2	3

Drive	1	2	3
Consolidate my Trips	1	2	3
Forgo Trips	1	2	3

28. I joined Boulder CarShare because . . . (check all that apply):

___ It helps me save money on transportation.
___ It helps the environment.
___ I like the carsharing philosophy.
___ I needed access to a car.
___ I couldn't afford to own or maintain a personal vehicle.
___ I wanted to eliminate the hassles of owning a car.
___ Other:_____

29. How strongly do you personally value each of the following potential benefits of car sharing?

	1 Extremely Important	2 Very Important	3 Moderately Important	4 Slightly Important	5 Not Important
Affordability	1	2	3	4	5
Convenience	1	2	3	4	5
Fewer hassles	1	2	3	4	5
Personal freedom	1	2	3	4	5
Improved productivity	1	2	3	4	5
Environmental friendliness	1	2	3	4	5
CarSharing philosophy	1	2	3	4	5

30. Please indicate the primary reason you joined the program by circling it above.

31. What do you see as the least attractive feature of carsharing? (Choose one)

___ The reservation process is not convenient.
___ It is too expensive.
___ The vehicles are located too far away from my home or office.
___ I have frequently experienced that cars are not available when I need them.
___ I am concerned that cars will not be available when I need them.
___ Other:_____

32. How close is a carshare vehicle to your home (circle one)?

___ Within a Few Blocks
___ Less than half a mile (I can walk or bike)
___ More than half a mile (I have to bike, take transit or carpool)

33. How many times per month do you use the carshare service? _____

34. How many times per month do you use carsharing for the following trips?

a.	Commute to work	_____/month
b.	Work-related activities (meetings, etc.)	_____/month
c.	Social	_____/month
d.	School	_____/month
e.	Personal business (e.g. to bank, etc.)	_____/month
f.	Grocery Shopping	_____/month
g.	Other Shopping	_____/month
h.	Recreation	_____/month
i.	Dining	_____/month
j.	Other: _____	_____/month

35. What would you do if the carshare service was discontinued?
(Check all that apply, and then circle the mode you would use most often.)

_____ Walk or bike more
_____ Use mass transit more
_____ Use taxis more
_____ Borrow a friend's car
_____ Carpool / get rides from friends/family
_____ Rent a car
_____ Buy a car
_____ Other:_____

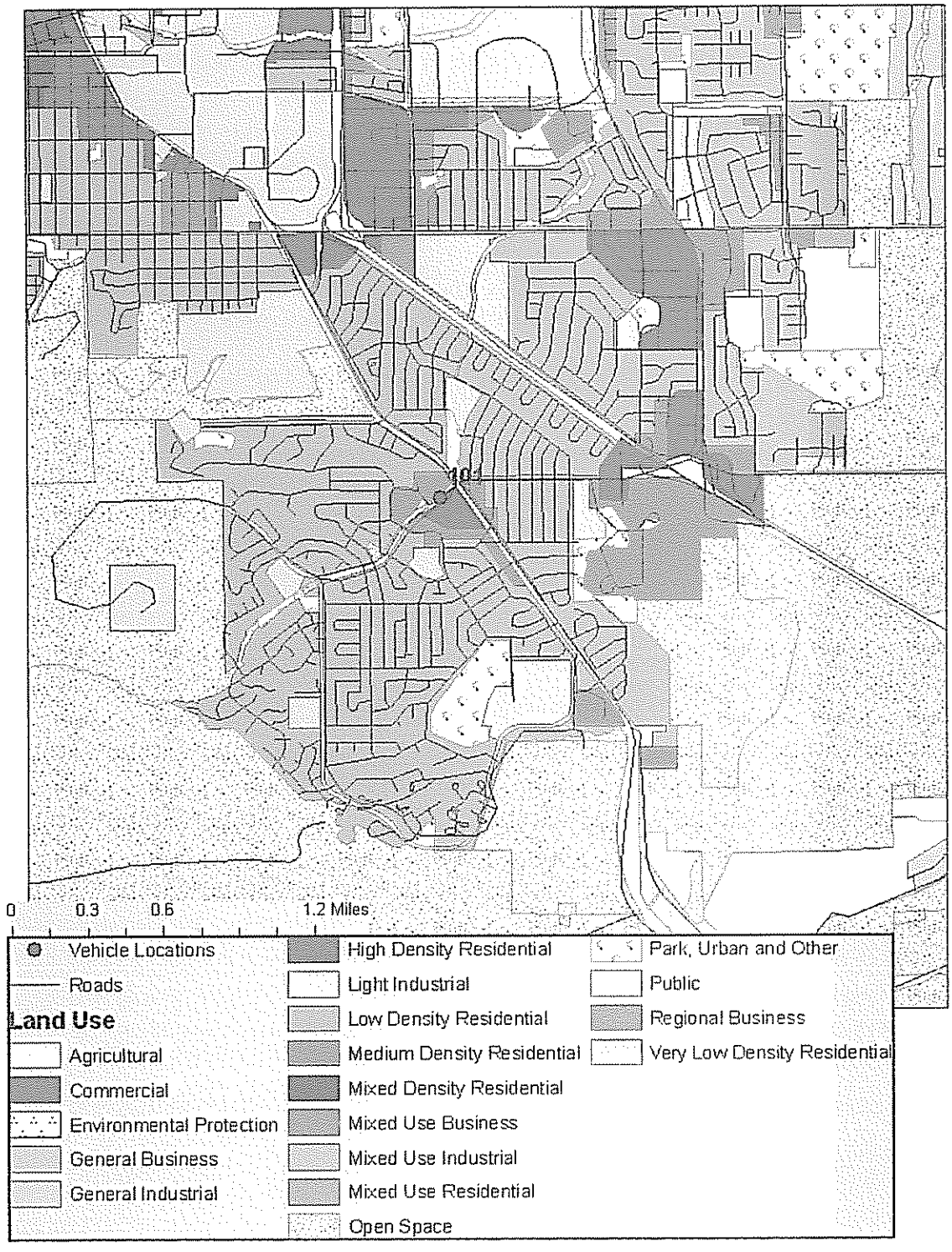
36. If I were looking for a new apartment or house, the location of Boulder CarShare vehicles would:

___ Be important to my location decision
___ Be somewhat important to my location decision
___ Not be a factor in my location decision

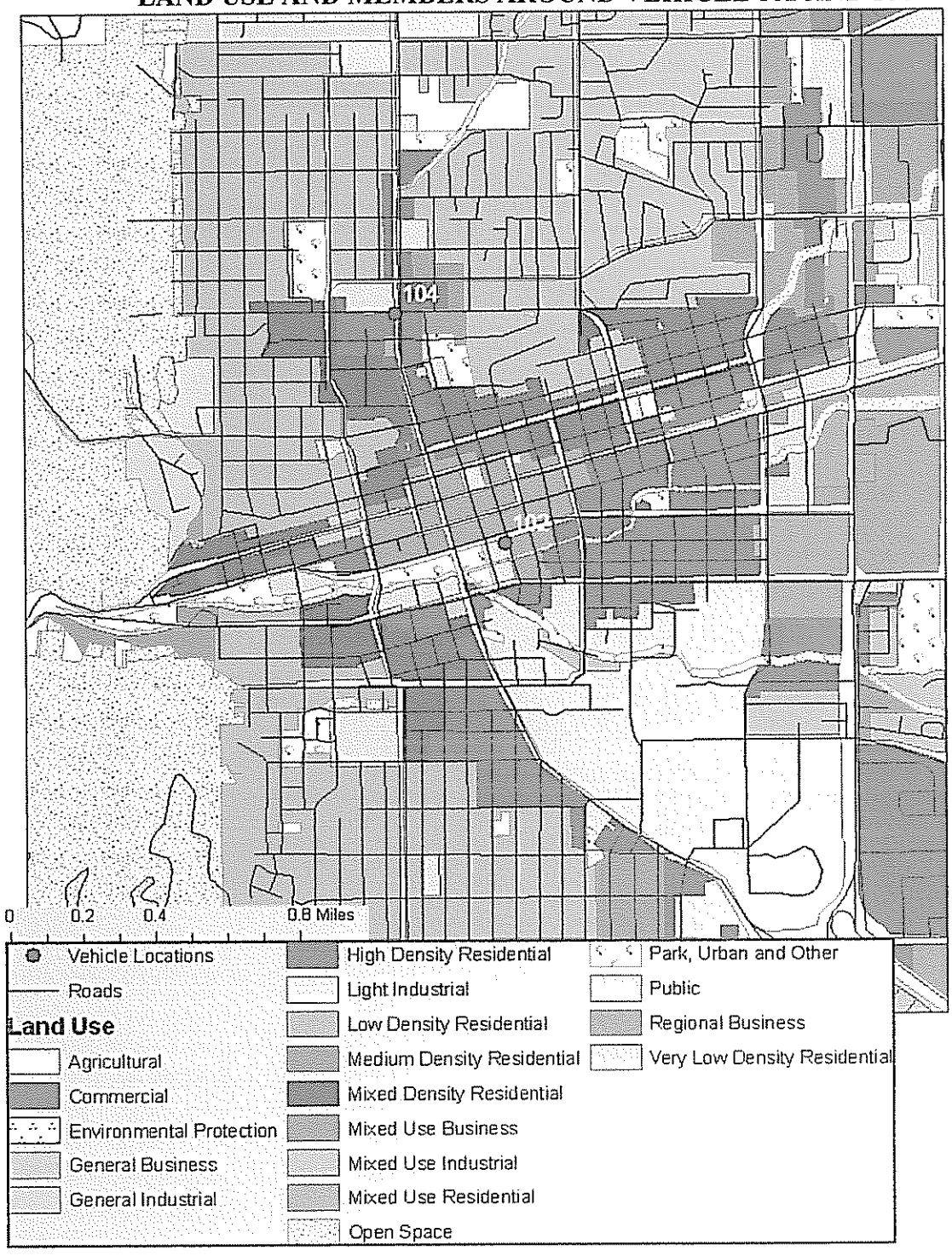
Appendix C

GIS MAPS

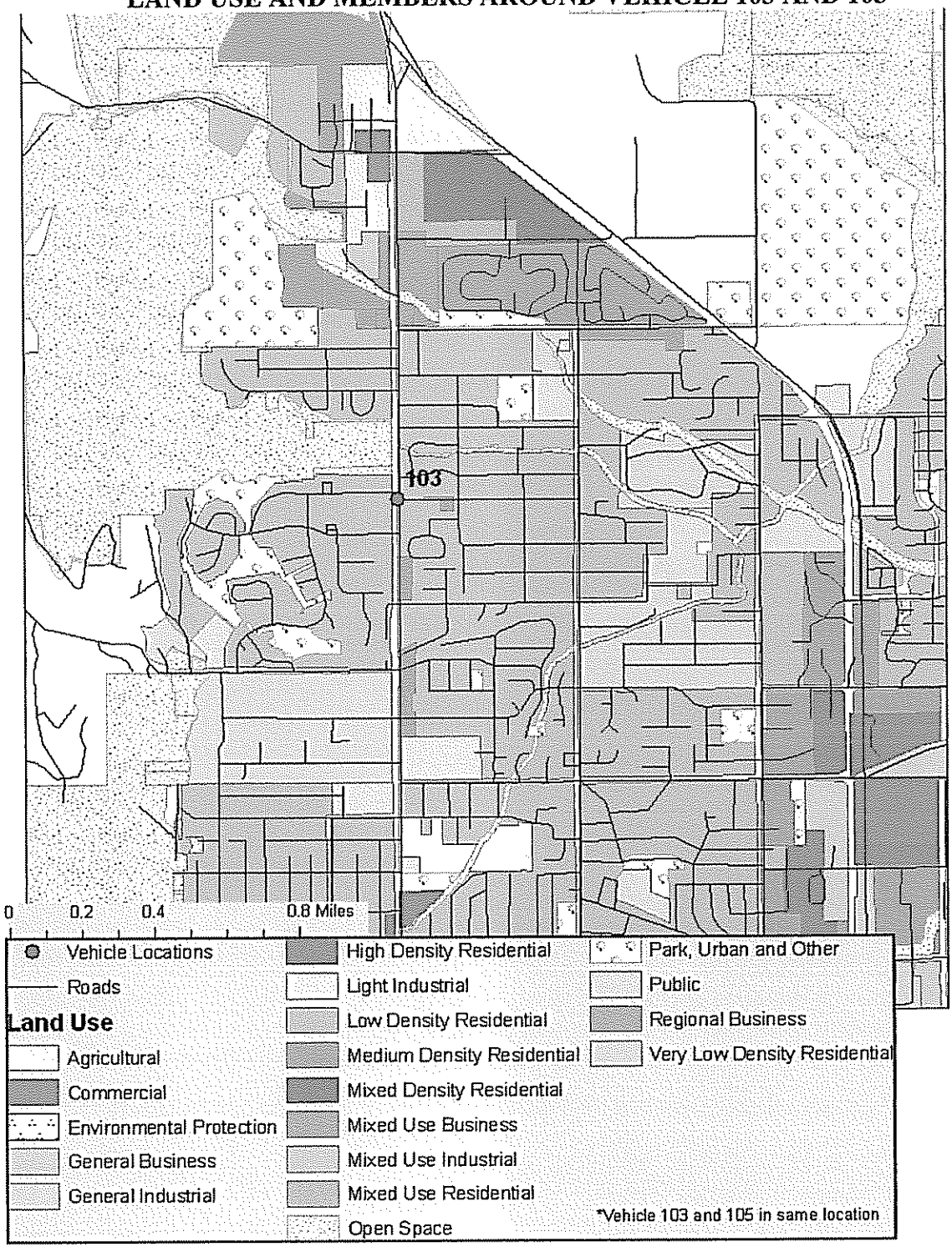
LAND USE AND MEMBERS AROUND VEHICLE 101



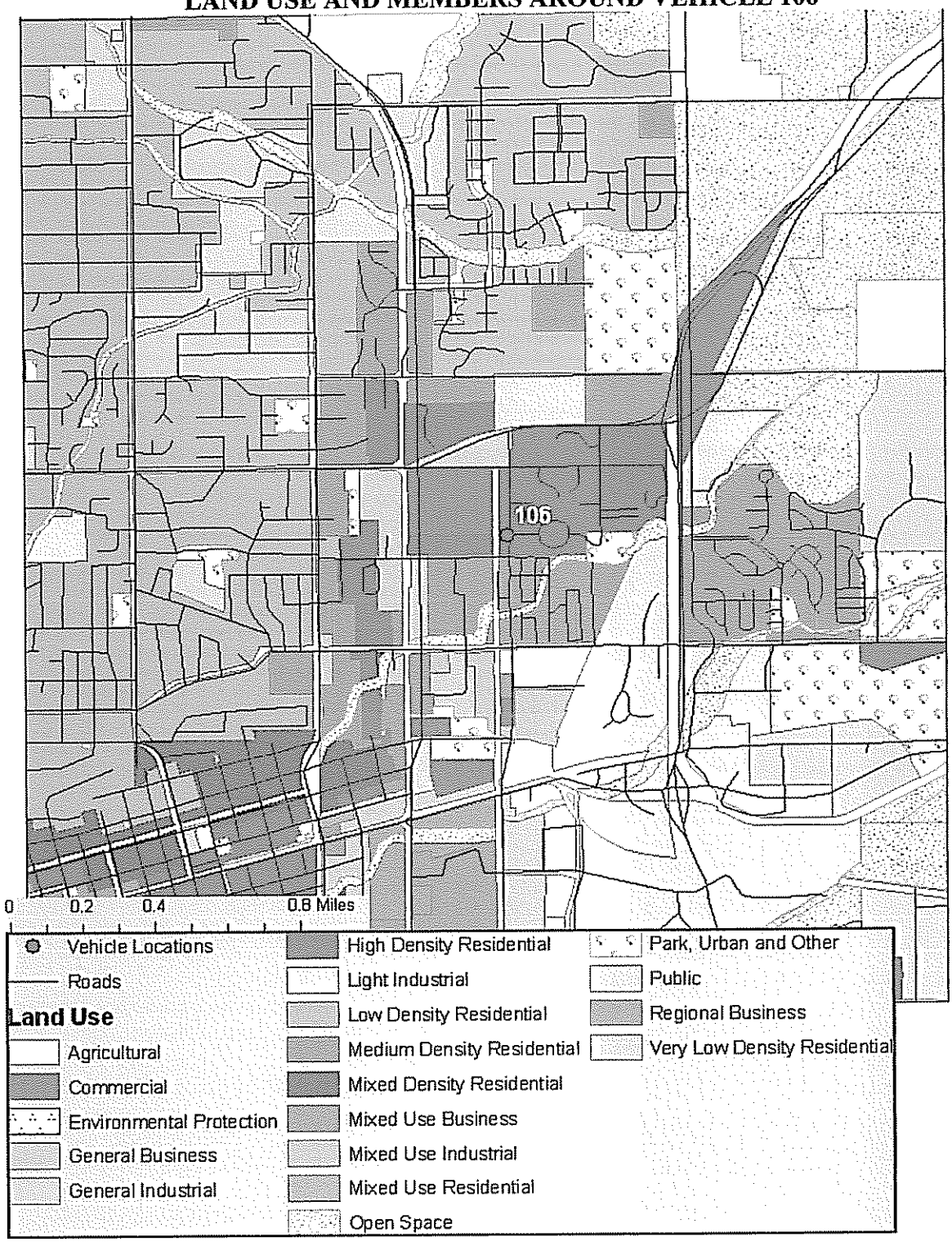
LAND USE AND MEMBERS AROUND VEHICLE 102 AND 104



LAND USE AND MEMBERS AROUND VEHICLE 103 AND 105*



LAND USE AND MEMBERS AROUND VEHICLE 106



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