American Commute Travel Behavior and the Possibility of Modal Split Management by Private Enterprises.

Theoretical foundation, methodological approaches, empirical research, and transportation demand management development in Columbus, Ohio.

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DEDICATION

To
my parents,
Charlotte Lier-Hirning and Dr. Gerhard Hirning,
who made all of this possible,
for their endless encouragement and patience.

And also to
my husband,
Steven Richard Carr,
who provided me with a peaceful harbor
during the times I felt distressed,
for his endless patience and support.

"You live and learn. At any rate, you live."
– Douglas Noel Adams

"I don't want to get to the end of my life and find that I have just lived the length of it.
I want to have lived the width of it as well."
– Diane Ackerman

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Preface

Because the majority of the empirical research was conducted between 2004 and 2006, I would like to comment on some of the changes I have observed in both people's behaviors and governmental thinking since then. I attribute these changes to two main issues: Energy and environment.

With oil speculation raising the per barrel cost of oil combined with Hurricane Katrina reducing much of the refining capacity of the United States, gas prices increased rapidly in a short amount of time to an all-time high in 2008. Higher costs of fuel forced many Americans to travel less and use alternative modes of transportation. The result was an unprecedented increase in transit ridership in the United States. Although gas prices have dropped since, transit ridership was sustained at a higher level than before the oil shortage, exemplifying the assumptions made in this paper and by authors of similar topics: Higher costs of driving result in higher usage of alternative modes.

While the reduction in vehicle miles traveled had many positive effects, such as less congestion, cleaner air, and fewer crashes, not everyone who wanted to drive less was given that choice. Due to the existing transportation infrastructure and disperse land use patterns, many residents are unable to use other modes of transportation to get around. This lack of alternatives is evident to President Obama and the U.S. House Transportation Infrastructure Committee who is charged with developing the 2009 surface transportation bill. One of the emphasis items of this bill will be the provision of a nationwide multi-modal transportation system. Even in the State of Ohio, with a new Director of Transportation, many local governments are shifting their focus from highways to other modes. It is a hopeful time, and research such as the one conducted for this thesis can serve as guidance to make this vision a reality.

Table of Content

List of Figures

List of Tables

List of Maps

List of Appendices

Glossary of Abbreviations

AAA	American Automobile Association
ACT	Association of Commuter Transportation
AEP	American Electric Power
AIC	Anti-Image-Covariance
AMPO	Association of Metropolitan Planning Organizations
BBR	Bundesamt für Bauwesen und Raumordnung (English: Federal department for architecture and regional development)
BTS	Bureau of Transportation Statistics
BWC	Best Workplaces for Commuters
CAAA	Clean Air Act Amendments
CBD	Central Business District
CCOHS	Canadian Center for Occupational Health and Safety
CDC	Centers for Disease Control and Prevention
CMAQ	Congestion Mitigation Air Quality
COTA	Central Ohio Transit Authority
CTPP	Census Transportation Planning Package
CTR	Commute Trip Reduction
CUTR	Center for Urban Transportation Research (University of South Florida)
DOT	Department of Transportation
EPA	Environmental Protection Agency
ETC	Employee Transportation Coordinator
ETP	Employer Transportation Plan
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GIS	Geographic Information System
GRH	Guaranteed Ride Home (also known as Emergency Ride Home)
HOV	High Occupancy Vehicle
ILS	Institut für Landes- und Stadtentwicklung (English: Institute for urban and regional planning)
ISTEA	Intermodal Surface Transportation Efficiency Act

KMO	Kaiser-Meyer-Olkin Criterion
MORPC	Mid-Ohio Regional Planning Commission
MPO	Metropolitan Planning Organization
MSA	Metropolitan Statistical Area
MVV	Münchener Verkehrsverbund (English: Munich transit agency)
ODOT	Ohio Department of Transportation
P&P	Park and Pool
P&R	Park and Ride
PCA	Principal Component Analysis
SAFETEA-LU	Safe Accountable Flexible Efficient Transportation Equity Act: A Legacy for Users
SIP	State Implementation Plan
SOV	Single Occupancy Vehicle
STP	Surface Transportation Program
STPP	Surface Transportation Policy Project
TAZ	Traffic Analysis Zone
TDM	Transportation Demand Management
TEA-21	Transportation Equity Act for the 21st Century
TEP	Transportation Enhancement Program
TMA	Transportation Management Association
TRB	Transportation Research Board
UMTA	Urban Mass Transportation Act
UMTAA	Urban Mass Transportation Assistance Act
U.S. DOT	U.S. Department of Transportation
VMT	Vehicle Miles Traveled
WCSS	Work Commute Satisfaction Survey

Definitions

Alternative modes

The term alternative modes refers to all forms of transportation other than driving alone in a motor vehicle. These alternative modes include carpooling, vanpooling, public transportation, biking, walking, or telecommuting.

Carpooling

Carpooling consists of two or more commuters riding together to and from work. A carpool can either be arranged by alternating drivers each week or by having a primary driver with passengers who contribute to gas and parking costs. Carpooling can occur five days a week or only when it is convenient.

Commuting

In the context of this thesis, commuting refers to the process of traveling between a place of residence and a place of work.

Guaranteed Ride Home (GRH)

Guaranteed Ride Home (GRH) is a program that provides commuters who regularly carpool, vanpool, bike, walk, or take transit to work with a reliable ride home when unexpected emergencies or unscheduled overtime occur. Employees can participate in this program up to four times a year. In Columbus, the commuter will be reimbursed 90 percent of the cab fare, including a fifteen percent tip.

Public Transportation (or Transit)

Public transportation (or transit) refers to various forms of shared-ride services, including buses, trolleys, trains, and subways, which are intended for conveying the public. In the Columbus Metropolitan Area, public transportation is served by the Central Ohio Transit Authority (COTA).

Single Occupancy Vehicle (SOV) / Solo driver

Single Occupancy Vehicle (SOV) refers to a privately operated vehicle whose only occupant is the driver. The drivers of SOVs use their vehicles primarily for personal travel, daily commuting, and for running errands. SOVs contrast with high occupancy vehicles (HOV) which carry many passengers.

Telecommuting / Telework

Telecommuting or telework refers to people working at least one or more days per month from home and communicating with the office by phone, computer, or fax.

Vanpooling

Vanpooling consists of seven to fifteen commuters who ride together to and from work in a passenger van that is often provided by a commuter vanpool service. The vanpool program is ideal for employees traveling long distances in heavy traffic conditions on the way to work. The route, time, and van size is determined by the vanpool group. Passengers pay one low monthly fare that includes the use of the van, gasoline, parking expenses, mileage, insurance, and maintenance. The volunteer driver is generally allowed to ride for free and is also permitted limited personal use of the vehicle.

Prelude: Americans and their car

In February 2005, ABC News published a news poll entitled "Traffic in the United States: A look under the hood of a nation on wheels." This poll was conducted as a telephone survey with a random national sample of 1,204 adults, including 750 commuters (Langer 2005).

Since the survey did not ask participants to provide information about their sociodemographics and housing location and was only conducted with a small sample size, its results must be questioned as to whether or not they are representative of all Americans. Nonetheless, some of the numbers produced from the survey can still provide general insight into attitudes and the type of measures that need to be undertaken to stop the growth of vehicle use.

ABC News summarized the results by stating that most Americans have a tendency to enjoy their commute, despite the increased congestion and delays associated with traveling by automobile. However, a closer look at the data revealed that most of those commuters who enjoy their travel to work tend to have short or easy routes to their place of employment and often do not work in the city, but rather in a suburban or rural area where traffic congestion is lower.

In fact, the study indicated that a significant percentage of commuters altered their lifestyles as a direct result of their work commute, with 14 percent of the interviewees changing or quitting their current job, 20 percent moving closer to work, and 60 percent leaving home/work earlier or later in the hope to avoid rush hour. Hence, commuters seemed quite willing to change their travel habits in order to decrease their likelihood of contending with traffic delays. Yet, the changes commuters incorporated into their commutes usually involved taking alternate routes or relocating, and very rarely a switch to other modes of transportation. Statistically, most commuters are unsupportive of changes in transportation policies that would facilitate alternative modes, such as high occupancy vehicle (HOV) lanes or tolls, and instead favor choices that involve road improvements, such as widening roadways or reducing travel time through coordinated traffic signal timing or increased speed limits.

While public transit is available to 60 percent of Americans, only ten percent regularly use it and just four percent make use of it for their daily commute. More than 90 percent of the study's respondents stated that driving is more convenient than using public transit options, indicating that convenience is the main reason for commuting by automobile.

Although two thirds of the survey participants showed concern for their health in regards to the effects of auto exhaust, 40 percent do not believe that their own driving is to blame. This lack of claim for responsibility correlates with results of other studies that are based on Festinger's cognitive dissonance theory that follows the idea of making excuses to justify one's actions, such as 'My driving itself does not cause any environmental or health damage' (Bordens and Horowitz 2002:216f).

The results of the ABC News study suggest that it is difficult in the United States to change people's attitudes and behavior towards using modes of transportation other than their own vehicle. The automobile seems to be by far the preferred mode of transportation, particularly because of its ability to provide flexibility. So is there even a chance for other modes to compete?

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*"In a society where people are given freedom of choice,
it is inevitable that some people will opt for choices
not consistent to transportation planners' goals." - Loo 2002:216*

1 Introduction

The Environmental Protection Agency (EPA) calculated in 2001 that a "typical household spends nearly twenty percent of its income on driving costs – more than it spends on food" (Stutzer and Frey 2003:4). Every day, over 200 million American cars consume eleven percent of the daily global oil production (Mouawad and Wald 2005). In the United States, private cars are used for 97 percent of land passenger travel while in Western Europe personal cars are used for 84 percent of land travel, and in Japan for more than 60 percent (United Nations 2007:16).

Increasing high gasoline prices have increased concern among Americans (Mouawad and Wald 2005). But while the rising fuel costs have sparked awareness and interest in alternative ways of commuting to work, most individuals continue to drive alone (Manuse 2005). This strong dependence on cars not only impacts traffic congestion but also hinders sustainable development and worsens air quality through engine emissions. Motor vehicle emissions are the primary source of ozone-causing pollutants, accounting for about 30 to 40 percent (BWC 2008, Recker and Parimi 1999:357, Plaut 1998:194f).

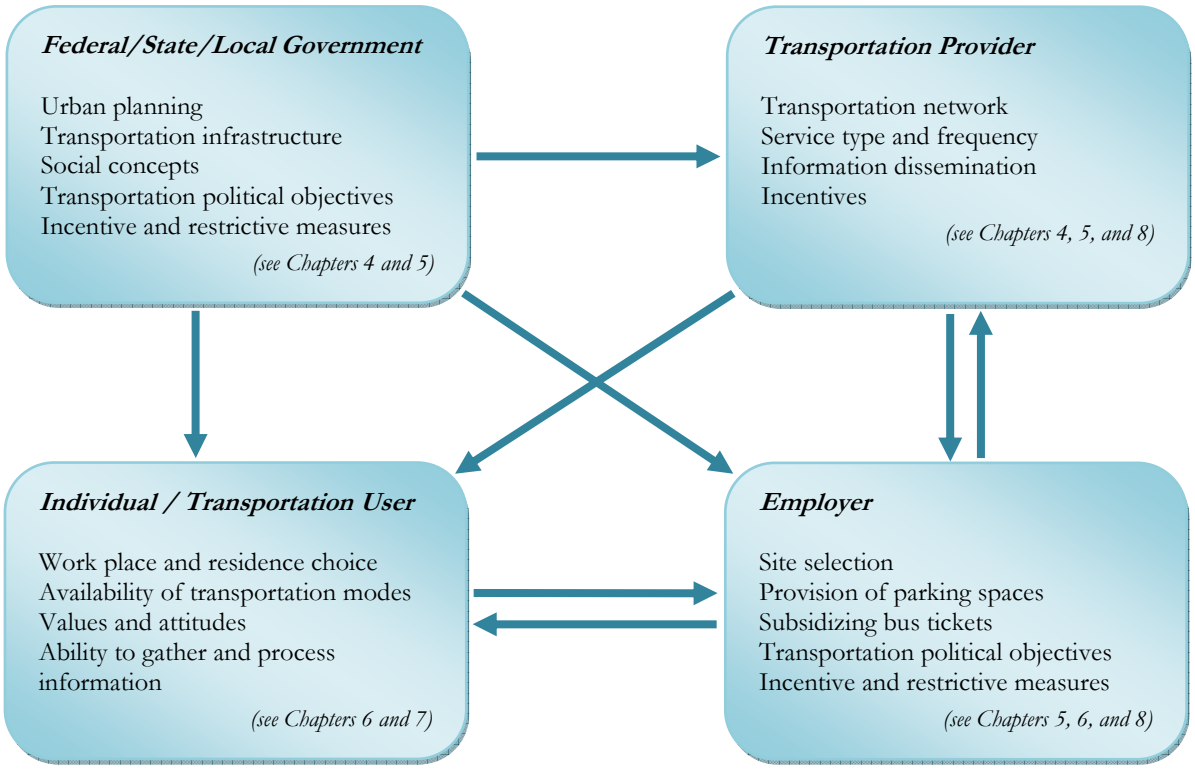
Air quality and traffic congestion are two pressing problems faced by many urban areas, resulting in economic loss and high environmental pollution levels (Hanson 1995:20). While efforts have been made to address these urgent issues, the prevalence of solo driving persists. Altering the behavior of solo drivers is challenging given the auto-dependent nature of American urban patterns and a love for the car. In the United States particularly, the car is perceived as superior to other modes of transportation due to its ability to satisfy the need for convenience and flexibility. It is difficult for other means of transportation, such as buses or carpools, to compete with these attributes, particularly in low-density developments.

Academic researchers, policy makers, and practitioners are keenly interested in identifying means of affecting modal shifts among commuters, if not reducing total distance traveled. Among the methods that have been attempted are restrictive policies, such as implementing parking fees or road tolls, and incentive policies, such as offering reduced bus passes. Most of these have proven to be only marginally effective and still do not produce the desired outcomes (Meyer 1999, Baldassare et al 1998). Therefore, some empirical studies have concluded that people are resistant to changing their travel mode (Bamberg et al 2003, Moeller and Thoegersen 2003, Curtis and Headicar 1997, among others).

In contrast to Europe, the federal U.S. government and the individual states are not always taking the lead in attending to the need for reducing the number of vehicles on the roadways. Transportation planning policies and objectives differ from state to state. While some states are already actively involved in transit planning and designing for a multi-modal infrastructure, others are still reacting and recovering from urban sprawl. Except for cities with major population density and a well structured and long established transit system, such as New York, Chicago, San Francisco, or Boston, urban planning and thus travel behavior is strongly focused on cars. Based on the overall American concept of 'Freedom of Choice', U.S. state

governments are often limiting the amount of laws and regulations and provide individual regions and cities with the flexibility to plan their county or municipality based on their own policies (see chapter 4). When only minimal federal or state restrictions are given, other players may be needed to influence transportation planning towards more sustainable development and environment. The various players who can influence transportation planning are illustrated in Figure 1-1.

Figure 1-1: Influential players in transportation planning



Source: Own design.

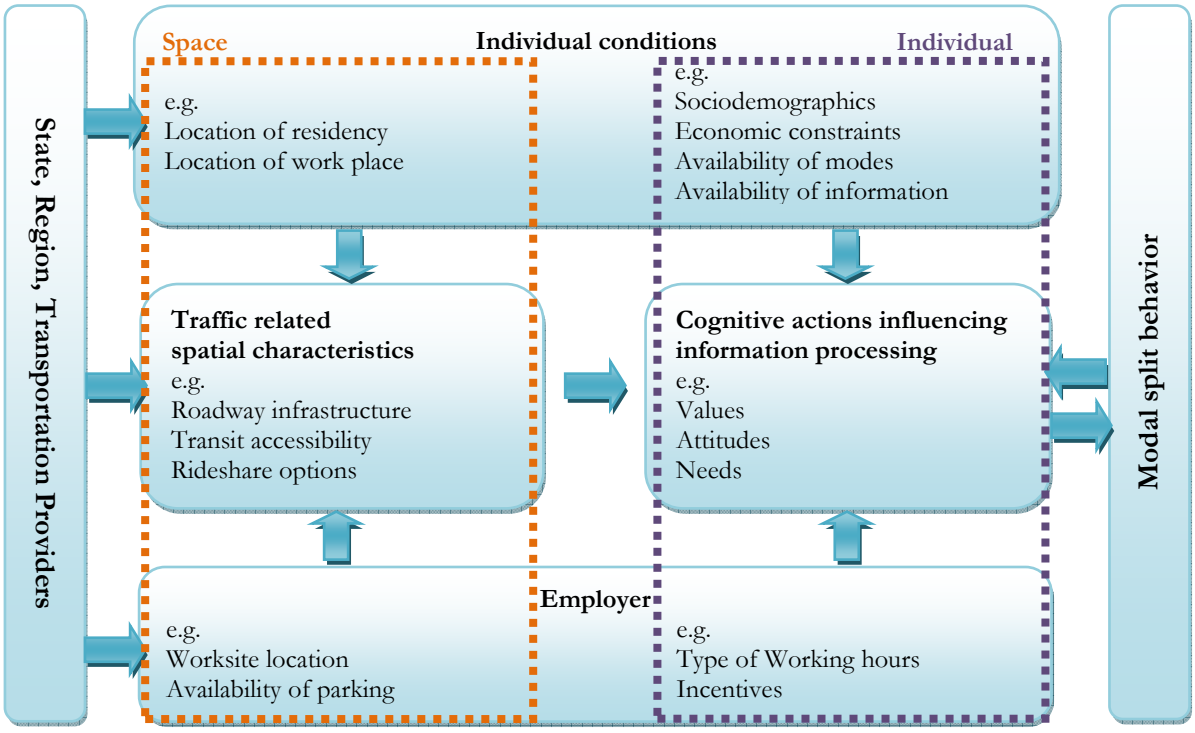
Of these players, transportation providers, such as public transit organizations or private ridesharing services, strongly depend on federal and state funding support. Private companies, on the other hand, are in a more flexible position to spend their money. The reasons for businesses to utilize their own resources to address mode choice are numerous (also see section 1.2.2). For one, employers are always looking for ways to increase productivity and job satisfaction. Therefore, providing employees with a variety of options to get to work that are cost effective, flexible, and reduce stress and tardiness is not only beneficial to the individual worker but also to the company itself. The company is incentivized by the outlook of saving money, both through reducing the number of needed parking spaces and through increasing its recruitment and retention levels. In addition to improving the general accessibility to and from the firm's location, employers are motivated by receiving (inter-)national recognition for their efforts. Supporting alternative modes of transportation and sustainable land use planning places companies in a leadership position regarding environmental friendliness. This 'labeling' increases their overall image as a caring employer. Another advantage that private businesses carry is that they are solely responsible for their property and facilities. The fact that they often

operate their own parking system can facilitate the implementation of restrictive countermeasures to driving alone by providing more costly or less parking.

Businesses are also the largest generator of repetitive commute trips. Urban planning and transportation research has always put much emphasis on work-related trips due to several factors: 1) work travel is usually responsible for the biggest proportion of trips; 2) most people travel within the same time frames to and from work, causing traffic congestion during morning and evening peak hours; 3) people tend to cover more distances for work than for any other purpose (Hanson 1995:19); and 4) work-related trips are in most cases very repetitive, providing the opportunity to change behavior by forming new habits (see chapter 2).

Suburb-to-suburb commutes are the dominant routes to work in America today (Baldassare et al 1998:115, Winters 2000:2f). However, the high density of employees within a small concentrated area, the recent trend of many cities towards re-urbanization, and the availability of intermodal transportation bundling within a Central Business District (CBD) facilitate the possibilities of impacting travel behavior for companies that are located downtown. Therefore, suburb-to-CBD or central-city-neighborhood-to-CBD commuters are easier targets when it comes to holistic transportation concepts aimed at changing the modal split and are studied within this research.

Figure 1-2: Model of modal split behavior



Source: Own design.

When it comes to influencing mode choice and identifying appropriate strategies to do so, it is necessary to understand today's travel behavior and the various attitudes people carry towards the different modes of transportation. Mode choice is a very complex matter and is influenced by a variety of sources. These sources are either related to spatial components or to the individual. Policy choices and urban planning regulations shape and guide both urban design

and transportation planning. In return, the individual decision-making is affected by the type of roadway infrastructure and the accessibility of different transportation modes. The processing of information is further impacted by personal values, attitudes, and needs. Private companies can shape this decision process through their site choice, the type of working hours offered, and the type of incentives and restrictions given in regard to car travel (e.g. subsidizing job tickets or offering expensive parking). The model of modal split behavior is illustrated in Figure 1-2 and serves as the basis for the conducted research.

It comes as no surprise then that studying travel behavior and mode choice is a challenging topic. The subject matter has been researched in numerous different ways (see chapter 2). However, many of the existing approaches to exploring commuter behavior, including the extent to which it occurs and the spatial relationship between home and work locations, are not comprehensive enough measures. While today several articles exist that empirically study car usage habits and the difficulties in getting people to switch modes (Moeller and Thoegersen 2003, Goodwin 1997, among others), they do not seem holistic. Most studies merely describe certain aspects of travel behavior but do not tell the whole story.

Louviere and Hensher's (2001:127) proposition that various key events operate as 'triggers' to raise the likelihood that a user will make certain types of travel-related choices confirms that there is a need for studying travel behavior in more depth. Disaggregate data and qualitative research methods are well suited for such an approach. Although qualitative research methods do not always produce statistically representative results, they are appropriate for gaining the necessary understanding for those factors that influence the behavior. Conjoint analysis, in particular, is well fitted to detect influential factors that contribute to making the decision of using a product, or in the following case, a transportation service. Conjoint analysis "aims to estimate the importance a person attaches to different features of this service, without direct questioning. This helps to determine the optimal features for the service, assess what service consumers will choose, and estimate the weight people will give to various factors that underlie their decisions" (Chakrapani 2004:135ff).

The design of a survey and the structure of the questions are therefore key to a good research approach, but so is the type of data analysis. Utilizing advanced statistical methodologies, including regression, cluster, and factor analysis, is necessary for finding answers to different concepts and marketing approaches that work best in various settings. Detecting specific target groups can provide the needed information to customize transportation modes and strategies.

The following research is based on these previous assumptions: a) U.S. federal and state involvement in transportation planning and addressing modal split is limited; b) self initiative of employers to implement strategies that reduce single occupancy vehicle (SOV) travel is beneficial both for the company and the employee; c) work-related trips are the most common and repetitive ones and therefore most appropriate for studying and developing countermeasures; d) companies located within the CBD are provided with the most possibilities in regard to transportation options; and e) comprehensive survey design and advanced statistical analysis is still scarce in the scientific literature but would aid in the understanding of commute travel behavior and the development of marketing strategies.

The research described was conducted with employees of a major American company in Columbus, Ohio (subsequently often referred to as Columbus only). It was found that an insufficient and outdated public transportation system and rapid new low-density developments are the challenges transportation planners are facing when trying to reduce the high use of car travel in Columbus (see chapter 5). These characteristics are not only typical for Columbus but also for many other American metropolises. The paper discusses past and current research on travel behavior and managing travel demand (see chapter 2). It further describes problem-specific methodologies for creating and analyzing a survey in the field of transportation and travel behavior (see chapter 3). The research topic is discussed for the United States in general and as a case study for a private employer in Columbus in particular (see chapters 4 and 5). The study is applied as exploratory research within a rather qualitative approach to demonstrate the potential usefulness of multivariate analysis methods in addressing the influential factors of travel behavior, particularly for commuters who solo drive to work. The research at hand is based on a comprehensive questionnaire aimed at studying not only sociodemographic and socioeconomic characteristics of employees but also the value employees place on certain transportation attributes (see chapter 6). An additional goal of the research is to determine the variables that provide the best information about travel behavior and allow for target group segmentation (see chapter 7). The results are used to design possible marketing strategies for the downtown employer (see chapter 8). Chapter 9 summarizes the findings and gives recommendations on future research of this kind.

1.1 Leading to Today's Congestion Problem

Despite the increasing environmental pollution and the efforts of many organizations to raise awareness, the number of cars on the roads is still growing. Even though the growth rate for jobs and travel was slow in 2003 for the 85 urbanized areas in the United States, 3.7 billion hours of travel delay and 2.3 billion gallons of wasted fuel were caused by congestion. In comparison to 2002, these numbers have increased 21 percent for hours and 30 percent for gallons, and lead to a total cost of more than $63 billion (Schrank and Lomax 2005:1ff). In fact, Americans have more motorized mobility and Vehicle Miles Traveled (VMT) than anyone else in the world. The nation's total VMT increased by more than 33 percent between 1981 and 1992, while the number of trips increased by nearly 25 percent (Recker and Parimi 1999:358). Cars per capita have been increasing since the 1960s, along with the number of licensed drivers, especially within the female population. Today, more cars are used to serve the same number of riders, resulting in a significant shift from walking and transit to automobiles (Hanson 1995:18f). In many metropolitan areas, residents have become (even though unhappily) used to traffic jams, crashes, and other delays when commuting to work.

Several trends are observed in most Western countries that led to the high demand of car travel. These trends can broadly be summarized into changes related to spatial growth and changes related to lifestyles. Rapid suburbanization of housing and employment has resulted in more trips to work, longer commutes, and frequent travel to low-density workplaces, making it challenging for public transit to follow (Baldassare et al 1998:99, Hanson 1995:8,23). The continued spatial diffusion and specialization of facilities results in covering greater distances to

reach shopping, educational, and entertainment centers. Spare time activities, for example, play an important role in today's lifestyle and result in additional travel complexity and an expansion of activity space (Eliasson and Martinez 2001:327). Due to the growing demand for space, more and more recreation centers and shopping malls are being built in suburban areas along high-speed arterials (BBR 2000:75). "The car [now] enables people to enjoy the benefits of non-central locations, without the need to sacrifice their stake in the urban labor market and thus, dispersion leads to higher car use" (Goodwin 1997:452).

Along with urban development, a change in lifestyles has occurred over the past decades. According to Smit (1997:123f), not only the decrease of birthrates but also the growing female workforce led to an increased number of cars per household and to an increase in commute travel. According to the U.S. Census (2000), 61 percent of women work today compared to only 38 percent in 1960. The increase in income from single-earner to dual-earner families led to a rise in household vehicle ownership. The average number of cars per household went up from 1.03 in 1960 to 1.69 in 2000. With the trend of an increasing number of females in the workforce comes the trend of people getting married later in life. Economic pressures, such as housing costs or the difficulties of finding a job, lead to the "prolonged-nest-phenomenon" where adult children are living with their parents or with friends other than their life partner through their twenties (Lee-Gosselin and Pas 1997:16). This trend results in multi-car households and to SOV usage as the dominant form of travel for household members due to the varying activity patterns. In general it is the flexibility and spontaneity of car travel that gives people greater control over the use of their time.

Simultaneously to the rise of multi-person households, traditional household structures declined with an increasing number of single parents. The complex activity patterns of families are difficult to implement with the limits of public transport while more weight is placed on their use of time. At the same time, safety issues and family responsibility are high priorities for women, and the car offers them the privacy and convenience they need (Goodwin 1997:452, Pas 1995:74, Horner 2004:171).

These trends briefly highlight only some of the reasons for high motorized car travel in the United States today. Unfortunately, the continuing increase of traffic congestion will have several serious consequences. For one, companies will experience problems in recruiting educated staff due to the low accessibility of their firms. On a greater scale, this issue will impact the economic wealth of a country and again the standard of living. According to Pas (1995:57), poor infrastructure will be partly responsible for a decline in the economy's productivity and hampering competitiveness of the U.S. in the global market. In addition to economic loss, the environment will suffer greatly. It is therefore imperative to address these mobility-related issues now.

1.2 Tackling Today's Congestion Problem through Transportation Demand Management

The recent trend of "more people in even more vehicles traveling to more places" has increased the importance of transportation demand management (TDM)[1] (Winters 2000:2). While many planners and engineers still believe that adding additional lanes or providing transportation technologies can help reduce congestion, others have come to realize that these strategies only facilitate car travel and lead to an increased number of cars on the roads, therefore missing its target (Berman and Radow 1997:1213). Researchers in particular have recognized the potential of TDM measures, especially in regards to reducing traffic congestion and vehicle emissions (Shiftan and Suhrbier 2002, Recker and Parimi 1999, Plaut 1998, among others).

TDM refers to a series of measures promoting alternatives to the SOV for reducing traffic congestion and improving air quality, by maximizing the use of the existing transportation infrastructure. These measures include carpooling, vanpooling, public transportation, walking, bicycling, telecommuting, or compressed work weeks. The primary goal is to reduce the number of cars on roadways with much emphasis placed on work-related car trips (Berman and Radow 1997:1213).

While Meyer (1999) gives a very comprehensive overview on the historical evolution of TDM, the following sections are intended to only highlight the major milestones that led to TDM as it is today. A brief overview of the national policies that influence the (non-)shaping of TDM and the importance of player involvement outside the federal and state government with emphasis on employers is described.

1.2.1 National Policies Influences

Influenced by the oil embargo in the 1970s, TDM was fairly widespread in the United States at that time (see also chapter 4). The limitation in mobility caused by the energy crisis led the federal government to permit the local and state governments to financially support ridesharing programs with federal highway monies (Rye 1999:23, Meyer 1999:575f). An essential part of these projects were comprehensive evaluations (Berman and Radow 1997:1213) as well as the development of non-profit organizations to offer ridesharing programs to local employers (Meyer 1999:577).

In the early 1990s, by establishing the Clean Air Act Amendments (CAAA), the American government realized the danger of air pollution and actually mandated a TDM program for the most polluted cities in the United States where companies were required to implement such programs (Shiftan and Suhrbier 2002:145, Winters 2000:4, Rye 1999:24f, Berman and Radow 1997:1213). In the mid 1990s, the program was terminated due to the belief that firms cannot be forced to provide TDM, and that it would "be an infringement of individual liberty and/or an unjustified burden on businesses in difficult economic times" (Rye 1999:25). Reasons for

[1] TDM is often referred to as Mobility Management in Europe.

employers to continue to participate in TDM included the need to recruit and retain workers, and the pressure to limit traffic impacts on new residential developments (Rye 1999:23).

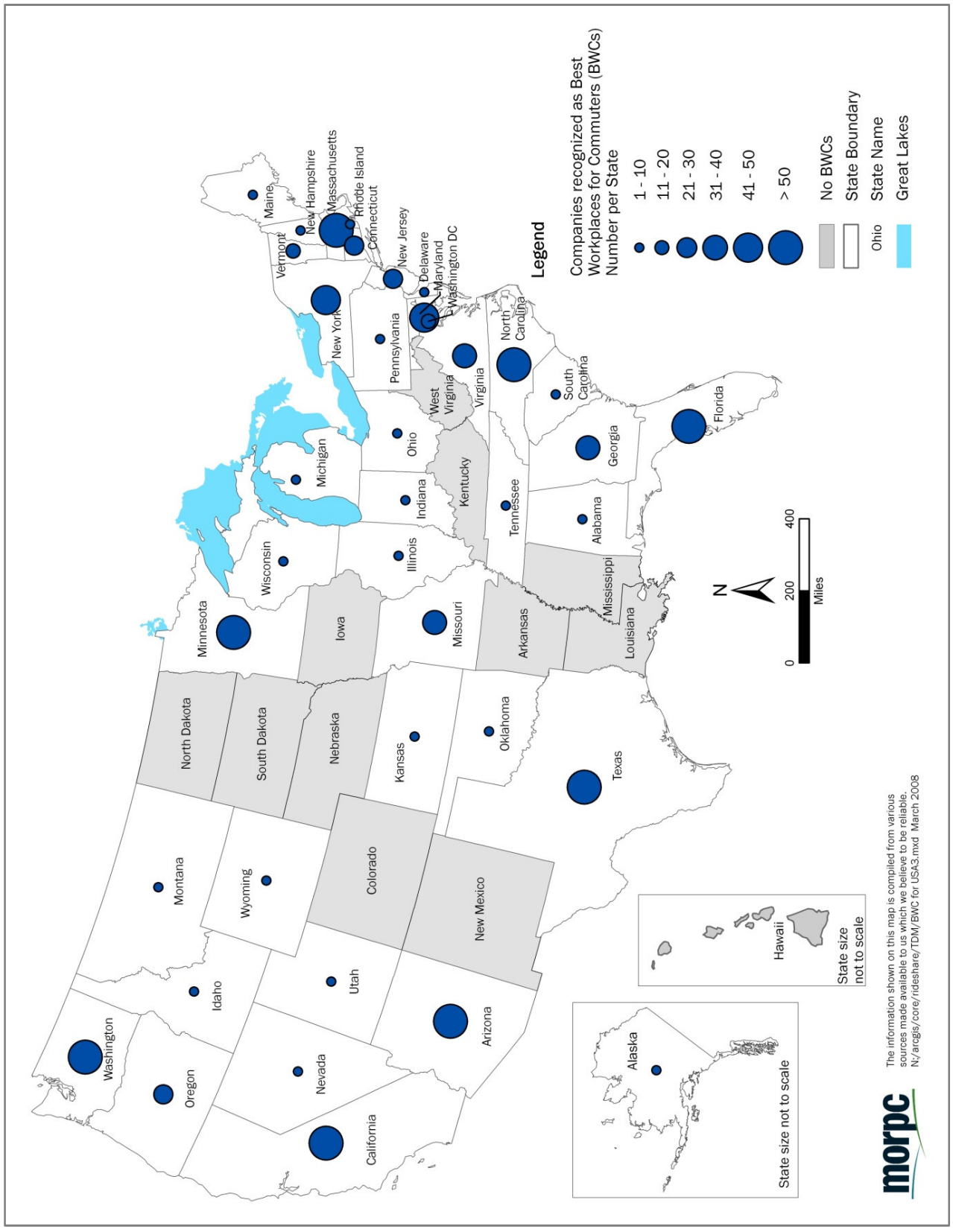
The CAAA and the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 tackled the problem of increasing vehicle emissions with a package of policies that integrated transportation control measures such as telecommuting, flexible work hours, congestion and parking charges, ridesharing, no-drive delays, and the expansion of public transportation and environmental planning (Recker and Parimi 1999:358). The transportation bills that followed, the Transportation Equity Act for the 21st Century (TEA-21) and the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), continued to provide opportunities for TDM programs.

While these transportation bills suggest the need for intermodal transportation planning, it is not federally mandated. Similarly, few land use planning requirements to limit low-density developments exist. In contrast, urban sprawl was often seen as a positive economic indicator for a city. In accordance with the American concept of 'freedom of choice', the choice of residence location generally has very little to do with the available transportation options to the residence. Instead, the home is primarily chosen for idealistic reasons, such as escaping from the dangers in the cities, providing increased safety for their children, or lifestyle preferences in general (Lee-Gosselin and Pas 1997:16f, Eliasson and Martinez 2001:327).

In order to accommodate the need to travel larger distances, most of the annual federal transportation budget is therefore still used for highway or bridge construction, while only a small percentage is assigned to public transportation projects (see chapter 4). In fact, Wachs (1995:285) feels that "consensus, power, money, and political salience are far more likely to be the determinants of transportation policies than are analytical methods or theoretical arguments." Currently, there are only a few states, such as California, Washington, and Oregon, that have taken the initiative to pass so-called Commute Trip Reduction (CTR) laws. These laws require all state agencies as well as businesses with 100 or more employees in very populated areas to develop commuter programs with the goal to reduce the number of vehicle trips traveled (Winters and Zhou 2007:3f).

Through the CAAA, Metropolitan Planning Organizations (MPOs) have also been pressured to implement TDM strategies in areas that do not meet national air quality standards (Shiftan and Suhrbier 2002:145f, Meyer 1999:585). MPOs are regional planning entities that provide a forum for local officials, transit providers, and state agency representatives to come together and cooperatively plan to meet a region's current and future transportation needs. Each MPO establishes its region's eligibility to receive federal and state tax dollars for transportation projects. MPOs carry the lead responsibility for developing transportation plans and programs for urbanized areas with a population of 50,000 or more (AMPO 2007). Therefore, many MPOs have established rideshare programs financed through federal Congestion Mitigation Air Quality (CMAQ) dollars. But depending on the political nature of the region, these programs may have only a marginal impact and are often not deployed holistically.

Map 1-1: Employers recognized as 'Best Workplaces for Commuters' by U.S. State, 2008



Source: MORPC, own design. Based on Census 2000 and BWC 2008 data.

Since mandatory programs from a federal level were not implemented, the EPA and the U.S. Department of Transportation (U.S. DOT) introduced a voluntary program called *Best*

Workplaces for Commuters (BWC) in 2003 that makes TDM a national goal. The program publicly distinguishes employers that offer commuter benefits to their employees. By providing TDM strategies, companies often address issues such as limited or expensive parking, traffic congestion, employee recruiting and retention, or environmental impacts associated with drive alone commuting.

The participation in the program earns companies who offer at least one primary benefit, such as subsidized transit or vanpool passes, and at least three secondary benefits, such as shuttles to transit stations, carpool matching, or reserved rideshare spaces, the designation of being a BWC. This award is symbolic of their efforts in supplying an environmentally and employee-friendly workplace (BWC 2008). Additionally, it is possible to become a district leader for a geographically defined region, such as for a given city's downtown. As a Best Workplace for Commuters District, an area can exceed the minimum requirements and significantly lower commute travel and thus, air pollution.

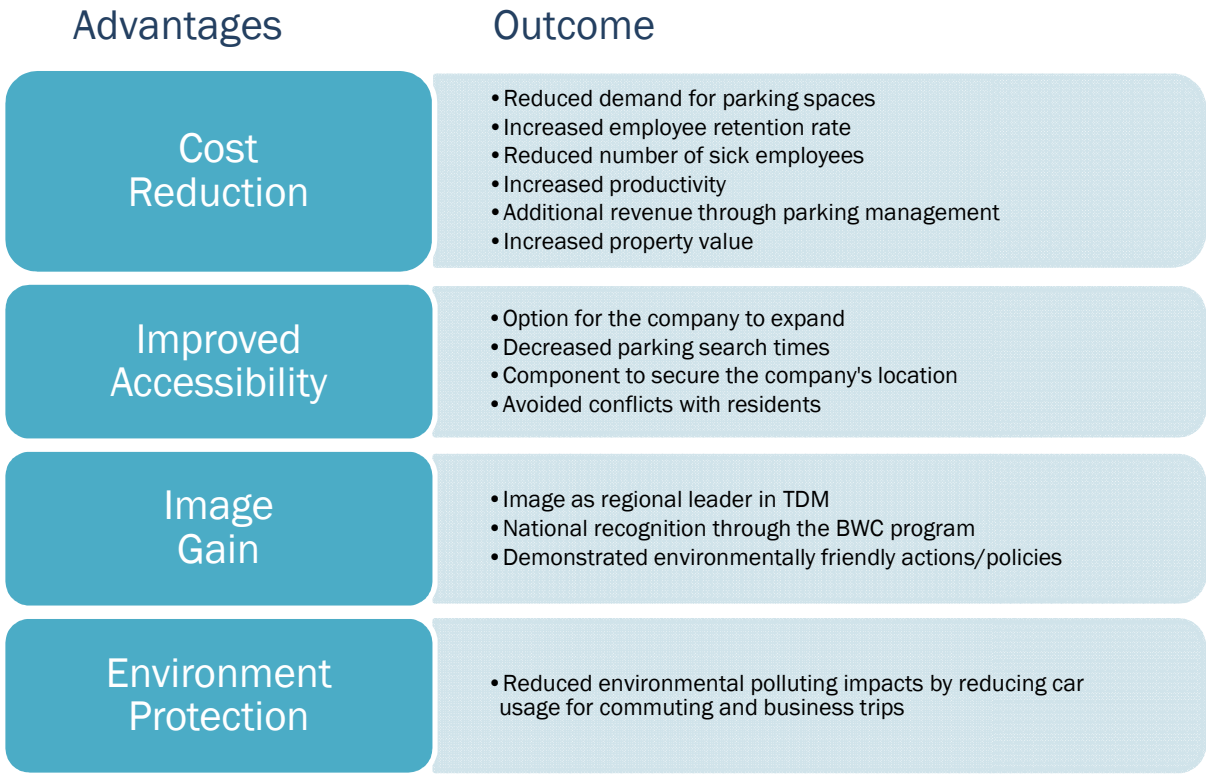
Nearly 600 employers across the nation, representing more than 1.2 million employees, were already participating as BWCs in 2008 (see Map 1-1). Five organizations in Ohio have received this recognition; two are in Columbus itself and include the local transit authority and the Defense Finance and Accounting Services. The benefits from such designations include gaining national recognition from the EPA and media, attracting and retaining new tenants and/or employees, and cooperation with local transportation providers. The program assists these efforts by providing access to tools and marketing strategies to make the TDM projects successful. Only recently, the Center for Urban Transportation Research (CUTR) assumed management responsibilities for the BWC program (BWC 2008).

A very useful federal research program in regard to transportation planning is the decennial census. This census includes a so-called Census Transportation Planning Package (CTPP) that observes travel behavior nationwide. It is a large transportation dataset available for all major metropolitan areas of the United States, containing detailed information on journeys to work, such as demographic data, mode of travel, travel time, or travel flow between destinations (CTPP 2000). This data is often used to determine the population and land growth of a region, the prevalent traffic flow, and the primary mode of transportation. Since every citizen is required to complete the census surveys, the data obtained is considered highly representative of the nation. Chapters 4 and 5 illustrate its usefulness for studying travel demand and mode choice.

1.2.2 Employer Involvement in Transportation Demand Management

Aside from national regulations, programs, and federal funding allocations, part of what makes TDM successful is the availability of competitive modes, the involvement of employers, and the interest of the individual user (see Figure 1-1). A partnership with private businesses has proven crucial in the implementation of TDM strategies both in several European countries and in the United States (Schreffler 1996). The potential utility of TDM for private companies can be summarized with four keywords: cost reduction, improved accessibility, image gain, and environmental protection (see Figure 1-3).

Figure 1-3: Advantages and positive outcome of TDM for private companies



Source: Summarized based on Bäumler and Müller 2003 and Klima-Bündnis 2003:10f, own design.

Most people are not aware that there are other options to driving alone and that sharing a ride or using transit will benefit them. Increased productivity and job satisfaction, decreased stress and tension, increased health and well-being, potentially more leisure time, and a reduced risk to be involved in traffic crashes are all beneficial aspects of not driving alone. Additionally, auto insurance, parking, gas, maintenance, wear and tear on personal vehicles, and road tolls can add up to a considerable amount of money for the average commuter driving alone. Thus, using alternative modes can save the employee money by sharing expenses with others or eliminating personal vehicle-related expenses altogether (Ott and Gerlinger 1992:169ff, BWC 2008). "In fact, if half of all employers in the United States offered commuter benefits […], American workers would save about $30 million in gasoline costs every working day or $7.5 billion each year" (BWC 2008). However, these benefits need to be made transparent to the workers. The most effective way to do so is through the employers because those that provide transportation benefits to their employees tend to be successful in increasing alternative mode ridership and are rewarded with tax breaks (ACT 2004).

Employers need to start or continue to be actively involved in TDM and participate in an (inter-)national movement to reduce the number of commuters driving alone to work. Research on travel behavior is crucial in this regard. Only if the commuters who place the demand are consulted can effective TDM measures be chosen. Consulting the target audience is necessary to determine which potential measures will most likely alter their travel choice and to form a new way of traveling and another habit. In general, TDM programs are deemed effective if they are created with the worksite's characteristics and its employees' demographics and travel patterns in mind (Berman and Radow 1997:1214f). It is for these reasons that

employer-based research and TDM seems most effective in changing modal splits. When federally and state mandates fail, working with private businesses seems most appropriate in gaining support for TDM measures from the local transportation providers and the individual commuters.

1.3 Research Objective

Current TDM research focuses on large metropolitan areas where congestion and emission levels are at their highest. However, few studies have been conducted in large cities with pending traffic problems. Differences in congestion levels between equally sized cities result from variations in land design, geographic features, weather, number of vehicle breakdowns, or decisions in transportation investment levels (Schrank and Lomax 2005:4). Though the apex of the congestion problem has yet to manifest itself in various cities across the United States, it is nonetheless important to identify problems early on and seek solutions in order to prevent severe travel delays while enhancing air quality. Therefore, part of the research is to study the commuting habits and transportation values of employees in a city at risk for serious congestion problems. In this case, the research was conducted in Columbus, Ohio.

There are several objectives to this paper. One goal is to evaluate existing TDM theories, study results, and statistical analysis methods to help determine the type of research needed that can provide the most insight into the internal and external factors that influence travel behavior and thus the choice of driving alone to work (see chapters 2 through 5). Based on these findings, a comprehensive survey is conducted with employees at a downtown company in order to gain better understanding of these questions (see chapter 6). Using the results of this research, advanced statistical analysis methods are applied to uncover specific target groups for whom customized marketing strategies can be created (see chapters 7 and 8).

One major part of this research was to gain the cooperation of a private company. As previously mentioned, working with private employers allows the researcher to gain easy access to employee information, such as housing distribution and working hours. It also allows for a better understanding about the company's (surrounding) infrastructure, which then provides further explanation of travel behavior. In addition, employers are more likely to financially support such research if the study results include concrete recommendations for their site. The company, where the following research was conducted, was selected for its large number of employees, its setting in a downtown district, and its accessibility by car and bus. A more detailed selection process is described in chapter 5.

1.3.1 Scientifically Positioning Transportation Demand Management Research

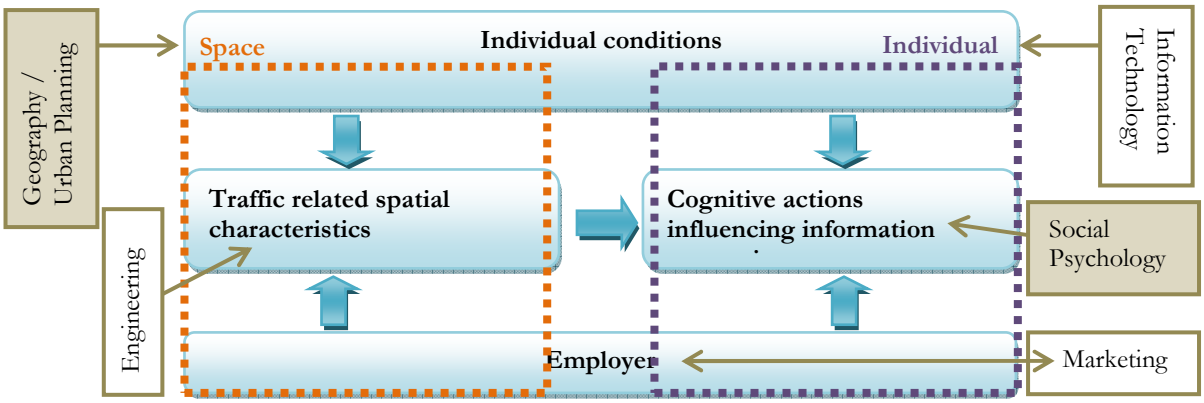
In regard to conducting research, TDM does not simply rely on one particular science. Instead, only interdisciplinary research, combining a variety of study fields, can provide answers to the different research questions related to developing strategies on how to reduce the number of cars. For example, we know today that TDM is much more complex than just studying spatial relationships and that it is necessary to extend our knowledge from purely aggregate data and

spatial activities to behavioral research in rather disaggregate form. In this respect, TDM has become a vivid research topic for social geographers who tend to work with and through other disciplines. Such disciplines include land use planning, engineering, transportation modeling, psychology, information technology, and marketing.

Figure 1-4 illustrates that, when focusing on traffic congestion and the different modes of transportation, land use planning and engineering play an important role. While urban planners study and make recommendations for the development of cities and city structures, such as the ratio between residential to industrial facilities or the walkability of a neighborhood, engineers are responsible for designing and implementing roadways, train tracks, or sidewalks. Both fields should work together to provide the optimal transportation solution for a particular area. Transportation modeling uses the data collected through traffic counts, census, or other surveys to provide planners and policy makers with information that predicts future urban and traffic growth. Such models can also provide estimates on how residents would behave if certain factors, such as new bus lines, more sidewalks, or work models were implemented.

Psychology, as it relates to transportation, studies the social, cultural, and behavioral factors that influence transportation-related choices. This discipline is crucial to any type of research that attempts to understand the reasons that underlie human choices, such as personal constraints, emotions, attitudes, or perceptions. Work- and lifestyles are continuously changing and can have a great impact on transportation needs and preferences. Psychological and social theories can therefore provide answers to questions related to human behavior.

Figure 1-4: Multidisciplinary approach to address modal split



Source: Own design.

The decision-making process is also greatly affected by the information available. In order to make educated decisions, information technologies are critical. The advancement in technologies in general has already had a large impact on travel behavior as it is today. For example, Lee-Gosselin and Pas (1997:19) argue that because of travelers now using higher speed, they can extend their activity to more remote areas while the time loss remains the same as before. For reasons that enhance urban economic development rather than improve personal mobility, most countries promote road transport informatics or intelligent vehicle and highway systems (Lee-Gosselin and Pas 1997:19). In the United States, technologies that are specifically aimed at reducing car travel often focus on telecommunications, such as internet,

cell phones, or personal data assistants, in order to attract people to work from home or telecommute.

Cross-disciplinary interactions are seen as fertile ground in the search for solutions to societal problems. Therefore, the presented research can be described as spatial-behavioral, studying activity patterns both in space and for the individual. The conceptual approach consists primarily of a combination of geography, urban transportation planning, and psychology. Within this approach, the type of commute patterns and the spatial distribution of housing, public transportation, and carpool opportunities are observed. Next to external factors, such as housing location or availability of public transportation, the reasons why people choose the car over all other modes is discussed. Therefore, a large part of the research demands behavioral psychology to assist in answering questions about how behavior is influenced and how it can possibly be altered. However, in order to provide specific strategies for increasing alternative mode usage, spatial analysis is a complementary component. The science of marketing is also addressed as the final piece to successfully promote and increase the usage of alternative modes.

1.3.2 Statistical Methodological Approach

In order to conduct travel behavior research, aggregate models are most commonly applied. It was not until the mid 1970s that discrete-choice models started to become more popular as alternatives to aggregate modal split models (Lee-Gosselin and Pas 1997:4f). At that time, psychometric scaling techniques were more commonly applied by travel behavior researchers as a tool to gain insight into the perceptions of travelers and to quantify the main factors for choosing a transportation mode. By that point, activity-based techniques also advanced and studies demonstrated that mode choice is often determined by personal or situational constraints (see chapter 2).

More recently, stated preference models are viewed as an effective tool to ask respondents to make tradeoffs between travel choices, similar to those that they face in real life (Stopher and Zmund 2001:305). This method is used in the survey described in this thesis. More specifically, an extensive survey of selected car commuters with the same work destination using conjoint analysis elements is conducted. Using choice-based conjoint analysis, trade-off scenarios are given to the participant to obtain more realistic information about the importance they place on transportation attributes. The respondents express preference by choosing from a set of concepts. A comprehensive survey with integrated conjoint analysis elements has not been widely used as a tool to help identify the characteristics of solo drivers, including their transportation service attribute preferences and perceptions.

The main study sample consists of only SOV commuters from a large company in Columbus. The survey is designed to assist in revealing behavioral attitudes and perceptions towards different transportation modes, by trying to detect all hesitations and obstacles (or personal constraints) on why alternative modes of transportation are not being used. Applying advanced analytical methods, the group is studied in respect to the characteristics that may be responsible for a higher likelihood to switch transportation modes. This survey is complemented by a quantitative online questionnaire which surveys all employees in regards to their travel choices,

travel times, and interests in alternative modes at the selected site (see Chapter 6). Regression, cluster, and factor analyses are applied to obtain specific target groups and key variables for marketing purposes and future research (see Chapters 7 and 8).

1.4 Thesis Structure

This thesis is structured into nine chapters (see Figure 1-5). The first five chapters describe the need for TDM research, previous study approaches and strategies, the value of problem-specific survey methods and statistical analyses, federal and local urban and transportation planning, and the research area. Chapter 6 illustrates the study results based on the modal split model of Figure 1-2. Chapters 7 and 8 evaluate the research results to develop possible marketing strategies for specific target groups and to provide guidelines for employers interested in implementing TDM. The final chapter summarizes the results and discusses future research possibilities.

Figure 1-5: Thesis structure

			Research Topics			
	Content		**Theory**	**Methodology**	**Empirical Results**	**Marketing/ Implementation**
Empirical Research Process	**Problem Statement**		1. Introduction			
	Literature Review		2. Theoretical approaches			
	Study Methods			3. Problem-specific methodology		
	Description of Study Area	General	4. Land use and transportation planning in the U.S.			
		Site specific	5. Study site and research object			
	Description of Survey and Results	Spatial & situational context			6. Empirical Results	
		Personal & cognitive context			7. Forming Target Groups	
		Decision-making strategies				8. Marketing TDM
	Conclusion		9. Critical Review and Outlook			

Source: Own design.

"Intuitively, it makes sense that if we know something about a person's attitudes we should be able to predict his or her behavior." – Bordens and Horowitz 2002:174

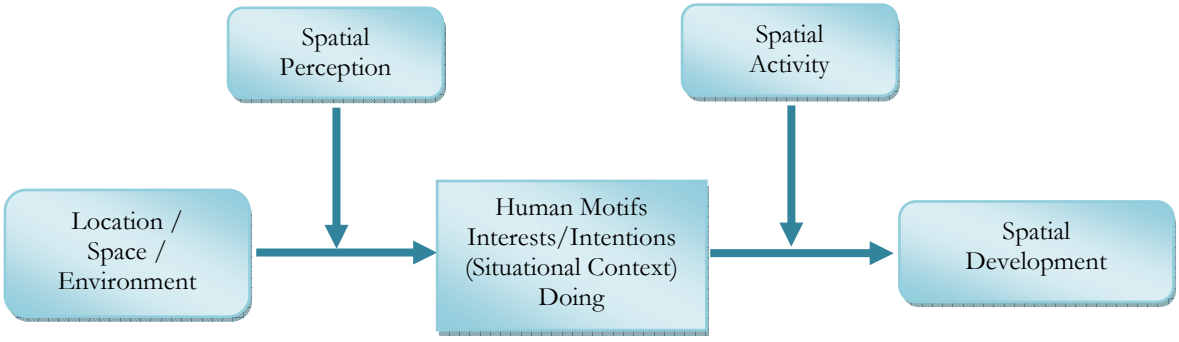
2 Theoretical Approaches for Explaining and Influencing Modal Split

A great variety of theories and secondary research exist that attempt to explain travel distribution, travel behavior, and travel decision-making. This chapter discusses those theories and hypotheses in regard to the research topic. It is important to keep in mind that most theories in this paper relate to the American transportation planning policies. Since federal and state governments provide only limited regulations for land use planning, much focus is placed on the involvement of other non-government players (see Figure 1-1) and the decision process for travel behavior (see Figure 1-2). Within this chapter, the cognitive framework and the perception of the spatial environment and the various transportation mode attributes that are controlled through cognition and affection is described. The chapter also depicts various models for decision-making and illustrates the measures that could influence modal split.

2.1 Spatial and Behavioral Theories

The physical structure of urban environments undeniably exerts significant influence on travel behavior. In fact, many professionals in the transportation industry argue that land use controls are the most effective means for ensuring sustainable transportation systems. Until recently, transportation planners have focused on traffic as a reaction to the spatial separation and differentiation of land use, also known as spatial-oriented theories. This perspective assumes that travel needs and route and mode choice are controlled by the existing structural context. The models used to describe, explain, and forecast traffic come from unjustified homogeneous premises and imply that the transportation user acts constitutional. The observed deviations from reality were only seen as disturbing factors and could be left unattended (Bösch 1989, see Figure 2-1).

Figure 2-1: Spatial-oriented theory



Source: Based on Bösch 1989, own design.

The hypothesis, believed by many national transportation planners, that controlling land use is efficient in influencing travel behavior, is only a necessary requirement for sustainable traffic development. Lee-Gosselin and Pas (1997:8ff) argue that the relationship between land-use and

transportation is still very complex. They refer to it as a 'chicken and egg' problem, meaning that it is still unclear if transportation affects land use or vice versa.

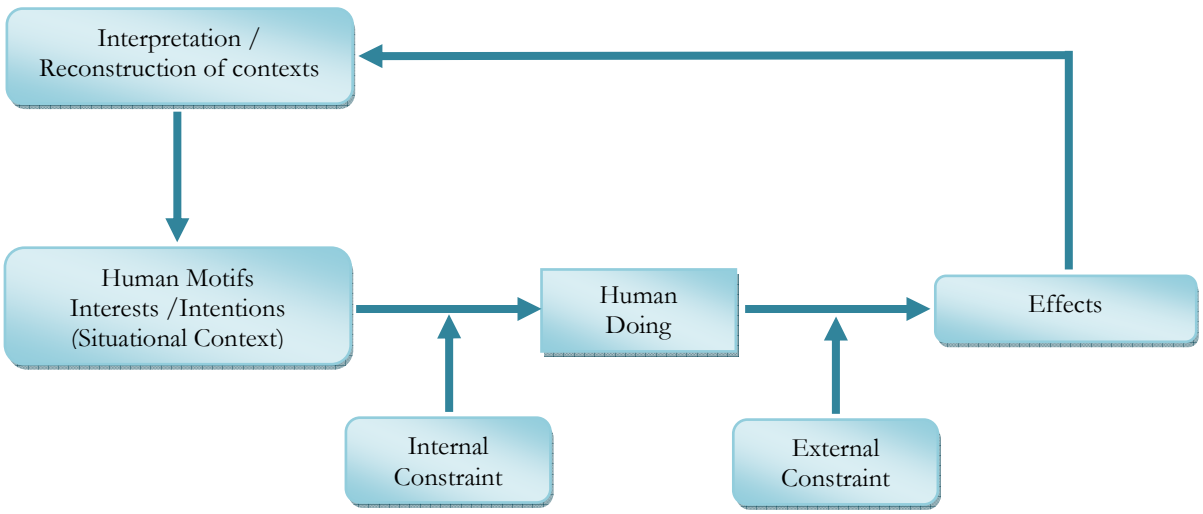
Although it is possible to characterize the movement of commuters within cities using simplified models based on origin and destination characteristics, such as gravity models, it becomes obvious that another non-observable environment exists in addition to the external objective one (McNally and Kulkarni 1997, Pas 1995:54ff). It is therefore important to also study the relevant internal variables that help explain the objectives and perceptions underlying people's movements.

Internal variables, such as personal and situational constraints, significantly influence travel behavior. Hence, mode choice depends not only on origin, destination, or sociodemographic characteristics, but also on individual's motives, interests, and intentions. To better identify people's motivations and perceptions regarding transportation and land use, all of the possible influential factors for mode selection should be studied, including internal and external constraints, attitudes towards different modes of transportation, importance of transportation attributes, and sociodemographics (Held et al 1981:387ff). The notion that internal constraints on an individual level need to be addressed in addition to the analysis of exogenous forces is vital for developing effective policies (Golledge and Stimson 1997:4ff).

Thus, the hypothesis that land use is the primary factor influencing mode choice must be complemented or replaced by the hypothesis that individual travel behavior can only be altered if all influential factors for the action are known, such as norms, motifs, or interests that can be effective in any society. This notion replaces the spatial-oriented theory with the behavioral-oriented theory (see Figure 2-2).

It is important to note that constant re-evaluation of the outcome, utilizing the individual's internal and external values and constraints, is undertaken by each decision-maker. As such, Figure 2-2 describes a continuous process. However, the mental effort needed for making the decision can be reduced by forming habits as described in section 2.2.

Figure 2-2: Behavioral-oriented theory



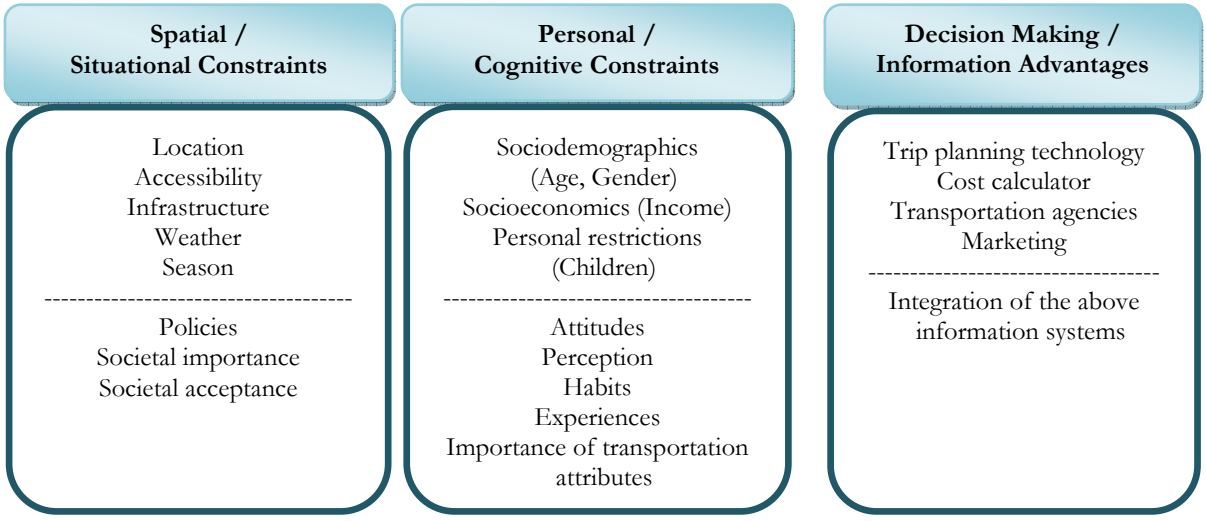
Source: Based on Bösch 1989, own design.

The belief that, in addition to the analysis of exogenous forces, internal constraints on an individual level need to be addressed and studied is supported by several authors (Golledge and Stimson 1997:4ff, Held et al 1981:400ff, among others). Held et al (1981:386ff) state that due to the changes within society, traditional demand models are not alone sufficient anymore to answer traffic problems since they cannot provide information about the behavior of each individual. Not only personal attitudes but also societal acceptance are factors that will influence mode choice behavior. Furthermore, personal restraints, such as work or family, seem to play an important role in travel behavior, emphasizing the importance of considering people's needs when implementing TDM strategies.

Figure 2-3 illustrates the different influential factors for mode choice on an individual level. Mode choice depends on the individual's (not directly observable) motifs, interests and intentions. These are influenced through internal constraints, such as income, gender, age, or personal attitudes and perceptions. However, the action based on these factors can again be altered by external constraints, such as location accessibility, land use patterns, or weather. In addition, it is important to provide informational tools that are easy to understand in order to facilitate the decision-process for mode choice and enable easy and secure access to all modes.

Spatial and behavioral theories of travel behavior can therefore not be treated independently but must be studied together, and urban planning and travel demand management should be complementary processes (Golledge and Stimson 1997, Boarnet and Crane 2001, Holcombe and Staley 2001). In regard to TDM, this notion means that gravity models or analysis through Geographic Information Systems (GIS) are still needed for planning alternative modes since their feasibility often depends on housing location, existing transit lines, or the highway system. But in order to market those modes and change people's travel choices, social and psychological research and theories are necessary to understand the decision-making process which is based upon values and constraints.

Figure 2-3: Influential factors on mode choice



Source: Own design.

Marketing strategies that target the individual's values, perceptions, or sociodemographics, as well as policies that make car use less attractive, are important when promoting alternative

modes and compact land use. This understanding also means that sidewalks and biking paths need to be created to enable people to use those non-motorized modes. In high density areas specifically, public transportation has to be supported through safe and secure bus stops and frequent service times.

The following section discusses different aspects of personal and cognitive constraints based on psychological and social theories. It summarizes those theories in an effort to explain travel behavior and to provide an indication of how to influence and change this behavior.

2.2 Psychological and Social Theories

Despite the fact that most individuals perceive increased traffic and pollution as great problems, it often does not result in behavioral changes (Gatersleben and Uzzell 2003:289). Why?

As mentioned previously, understanding and explaining travel behavior is a very complex matter, and psychological theories about attitudes and behavior, and especially theories that offer possible means of influencing behavior, can contribute to finding answers (Moeller and Thoegersen 2003, Bordens and Horowitz 2002, Bamberg et al 2003, Kickner 1998, among others). Based on cognitive social psychology theories, route and mode choice call for a cognitive connection between a location and a targeted destination, and thus are not free of contortion, stereotyping, and selective perception (Kickner 1998:26f). How we perceive things is usually controlled by our motivation, needs, attitudes, and values. The motivation will guide our behavior with certain strength and into a certain direction. Motifs need to be activated before they can be effective. The emotional component functions as a base for any type of goal-oriented behavior. Attitudes are part of the cognition process and mirror the state of a relatively permanent readiness to accept or not accept an idea or a subject in certain situations. They are usually learned through socialization but can be altered through learning processes. As such, discovering the factors that influence our attitude about transportation and travel behavior, may they be personal, situational, or informational, will help understand which TDM measures to implement. In fact, Golob and Hensher (1998:16) state that "individual's attitudes and opinions are powerful prescriptors in influencing government policy."

Others, including Moeller (2002:4), suggest that travel mode choice is often influenced by habits because they "require little mental effort to execute." Repeating behavior in a stable and supporting environment helps to form habits, especially when receiving a rewarding outcome. Motivation is assumed to be the trigger. Habits decrease the volume of cognitive effort in decision-making for the individual and help perform the behavior with growing automatism (Moeller and Thoegersen 2003:4). Unfortunately, changing habits is very difficult because it requires more effort, such as time and comfort costs, to make new decisions (Bamberg 2000:196). Also, new decisions are only feasible if sufficient information about alternatives is available. More of the decision process is described in section 2.3.

Moeller and Thoegersen's (2003:2ff) Danish study found that car-use habits are responsible for the difficulty of changing people's intentions to commute by public transportation. They revealed that past behavior can predict the use of buses or trains much better than the attitude

people carry towards using those modes and towards how they can satisfy their transportation needs. The study also supported the theory by Bamberg et al (2003) that intentions and behavior are strongly correlated (Moeller and Thoegersen 2003:5ff). However, Fujii and Kitamura (2003:83ff) found by studying 43 students (23 experimental, 20 control group) at the Kyoto University in Japan that temporary incentives, such as the introduction of a one-month free bus ticket, resulted in both a more positive attitude towards bus use as well as more frequent bus use after the intervention. While these results are insufficient for a generalized statement, they suggest that such changes have the potential to modify an attitude or habit.

Another reason for the resistance to modal change is described by Huey and Everett (1996:65) as the "concept of reinforcement delay." The authors argue that the benefits of using alternative modes of transportation, such as saving gas, decreasing pollution, and reducing traffic, are important assets. However, the public transit user does not immediately recognize those 'rewards.'

Huey and Everett (1996:67f) conducted a survey with approximately 150 senior-level undergraduate students at a large American state university. The questionnaire was organized in three sections: a) to write three benefits for each of five means of travel when commuting to work; b) to rank the benefits on a scale from '1' being immediately received to '5' being much later received; and c) to indicate if the receiver of the benefit is you or society. Sociodemographic data was collected in addition to the survey. Table 2-1 visually demonstrates the lack of immediate reinforcement for public transportation systems and the need to create an awareness of the disadvantages, or so-called punishers, of private vehicles (Huey and Everett 1996:65).

Table 2-1: Relationship between two different travel modes and the time to a reinforcing or punishing consequence

	Immediate Events		**Delayed Events**	
	Reinforcers	**Punishers**	**Reinforcers**	**Punishers**
BUS	Read paper Talk with friends Less parking concerns	Long travel times Crowded Noisy Walk to stop Wait at stop Crime perception Exact fare	Better air quality Reduced congestion Social interaction Individual savings Less stress traveling	
	Reinforcers	**Punishers**	**Reinforcers**	**Punishers**
CAR	Freedom Short travel time Convenience Fun of driving Status Comfort Privacy Choice of travel time	Parking problem Gas prices	Accumulation of equity	Air pollution Traffic congestion Purchase costs Maintenance costs

Source: Based on Huey and Everett 1996:65, own design.

The authors assume that there are "immediate received benefits and delayed benefits as well as factors that are received directly by you and others that are received by society" (Huey and

Everett 1996:68). Based on their results ["there is a relationship between consumer behavior and the perception of the time between travel mode use and the benefits or disadvantages given to the individual," p.69], they provide various ideas on implementing marketing strategies for public transportation. It is commonly known that a misperception often exists between travel time and travel costs. Therefore, public transportation agencies should pick up on this issue and increase financial benefits, especially by facilitating payment options on-board, such as credit card use or monthly billing, and by making traveling more comfortable, such as vending machines or newspapers on-site.

Another view on the social dilemma of car use is described by Steg and Vlek (1997:466). The authors state that there exists a conflict between collective and individual interests. Their study attempted to test the role of problem awareness in willingness-to-change car use. Steg and Vlek (1997:470ff) thought of problem awareness as a "crucial condition for attempts to make people voluntarily reduce their car use." Their study of 539 car user interviews in the Amsterdam region revealed that most participants did not see their own car use as a major problem for society, and only 30 percent of all respondents were actually willing to decrease car travel. Even though most participants realized that car use depicts a problem, they were not willing to give up the advantages that come with car use. Instead, most interviewees evaluated the problems as less serious so that they did not have to feel guilty about contributing to air pollution and traffic congestion. As mentioned in the prelude, this behavior is a phenomenon known in social psychology as Festinger's 'cognitive dissonance' theory. It describes a displeasing state of arousal that occurs when inconsistency exists among attitudes and behavior. People try to reduce or eliminate this agitation by either changing their attitude or their behavior (Bordens and Horowitz 2002:216f). In the case described above, car drivers who do not want to give up their vehicle usage will reduce their guilty feeling by stating to themselves that their individual behavior has no direct impact on air pollution.

Wright and Egan (2000:292) describe car use on a more emotional level. The authors state that cars are often perceived as "extensions of the human body, making us more powerful and energetic" (p.289). Comparing it to Maslow's pyramid of needs, the automobile seems to satisfy needs on all levels. Due to the many personal advantages a car offers, it will be very challenging to de-market the car as a concept for SOV travel reduction described by Wright and Egan (2000:287ff). The authors considered three different strategies in order to decrease traffic: 1) discouraging travel by any mode; 2) discouraging people from buying cars; or 3) discouraging people from using their cars. To plan such a campaign, the authors fall back on the theory of planned behavior as briefly described in section 2.3.

Gärling and Young (2001:220) state that strong emotions are often responsible for choices that might not be in our best interest. In addition, feelings or attitudes of uncertainty can greatly influence travel behavior. According to the authors, the affective states of a decision-maker need to be addressed in order to enhance the understanding of choice processes as well as the prediction of its outcome.

Steg (2005:148f), too, states that car use cannot only be explained by its instrumental functionalities, such as speed or flexibility. Instead, the symbolic and affective factors must also be taken into consideration (see Table 2-2).

Table 2-2: Instrumental versus non-instrumental factors for driving the car

Instrumental	Symbolic	Affective
Functionalities Gas mileage Type of transportation	Status and prestige Luxurious brand Expressing yourself	Loving to drive Dream-car Freedom Independence

Source: Based on Steg 2005:157ff, own design.

Steg's studies about the various motives for car use were conducted in the Netherlands and empirically demonstrate that non-instrumental motives play a significant role in car use. Even though this idea applied more to non-work-related trips, such as shopping and leisure, great evidence was also found for work-related trips (Steg 2005:151ff). This result implies that commuter mode choices are not necessarily made through functional or utility comparisons, hampering TDM professionals' and transit agencies' efforts to influence travel behavior. It also suggests that it is important to study the perception and attitudes of alternative modes to change its image by marketing them with more positively affective and symbolic meanings.

In conclusion, psychological and social research is necessary to identify the factors that have led to the decision of using a particular mode and why these influencing factors have occurred in the first place. Only when we understand people's attitudes and the importance they place on transportation service attributes, can alternative modes be marketed successfully. Addressing the part of the modal split model that deals with the individual (see Figure 1-2) is therefore critical in influencing travel behavior. However, this knowledge of internal and also external constraints needs to be embedded into theories that describe the human decision process so that employers and policy makers can assist solo drivers in making new ones.

2.3 Theories and Models for Decision-Making

Most utility models assume that consumers have full access to information on all relevant product attributes and that the values of these attributes are equally and objectively measurable for everyone (Kickner 1998:24f). As such, a consumer would always make his decision based on maximum utility. This model was altered by Simon in the late 1950s who stated that humans behave within a bounded rationality of a complex world. "Behavior thus generated may appear to be economically or spatially irrational, but it merely reflects the outcomes of variations in individual ability to cope with and store information that is fragmented and incomplete while operating under severe time constraints. The result is that humans *satisfice*, taking a course that allows achievement of limited goals and is 'O.K. for me at that time.' […] It was largely out of this model of a *satisficer* that the behavioral approach in human geography developed" (Golledge and Stimson 1997:8).

Kickner (1998:24f) reformulates the Simon's principle of Limited Rationality: Every person has certain expectations for his/her travel and thus tries to find alternatives that fit or exceed those expectations. In general, people choose the first satisfying alternative that they encounter

during their search. However, attitudes, personal goals, and emotions can influence individual's expectations of possible alternatives (Kickner 1998:25, Gärling and Young 2001:220).

One of the oldest models of decision-making is known as the *Theory of Planned Behavior* by Ajzen and Fishbein (1980). This model is still commonly applied to predict the likelihood of behavior by determining the strength of intention. It consists of three steps, and if all these factors apply, the probability of continuing a behavior, such as driving a car, should be high:

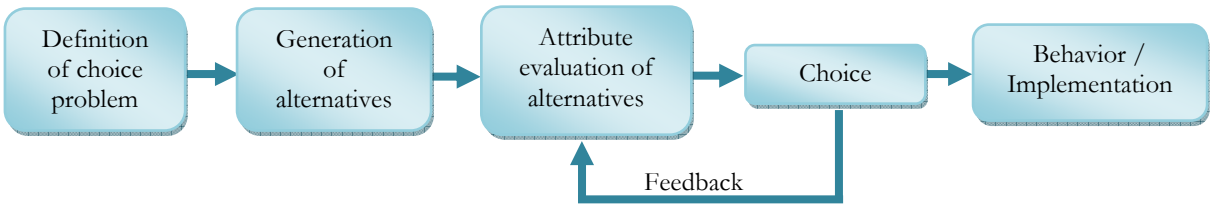
A. Attitude toward behavior (not toward the object), such as 'Driving the car harms the environment but it is so convenient.'

B. Subjective norm (how others will evaluate the behavior), such as 'All my friends and neighbors drive their car.'

C. Perceived behavior control (belief that behavior is hard or easy to accomplish), such as 'It costs too much time to walk to the bus stop.'

According to Ben-Akiva and Lerman (1985:31ff), a theory of individual choice behavior has to be descriptive, abstract (not necessarily specific), and operational, meaning that the results can be measured. They discuss 'choice' as an outcome of a sequential decision-making process which, through positive evaluations, forms a repeated behavior (see Figure 2-4).

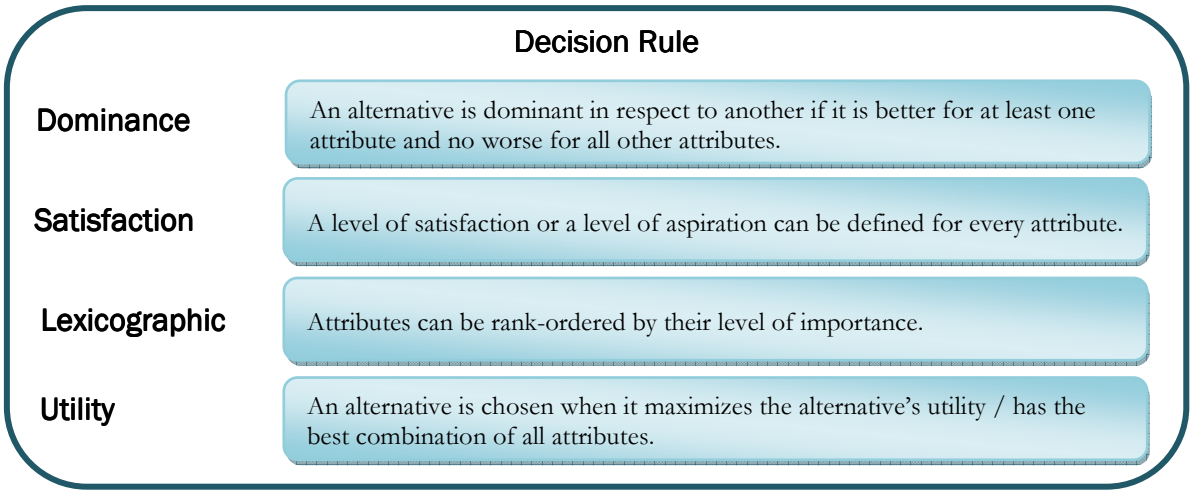
Figure 2-4: Decision-making process



Source: Based on Ben-Akiva and Lerman 1985:31ff and Golledge and Stimson 1997:8, own design.

Ben-Akiva and Lerman (1985:33ff) also describe the internal mechanism when making a decision and refer to it as the 'Decision Rule' with four different categories (see figure below).

Figure 2-5: 'Decision Rule': Choosing between alternatives

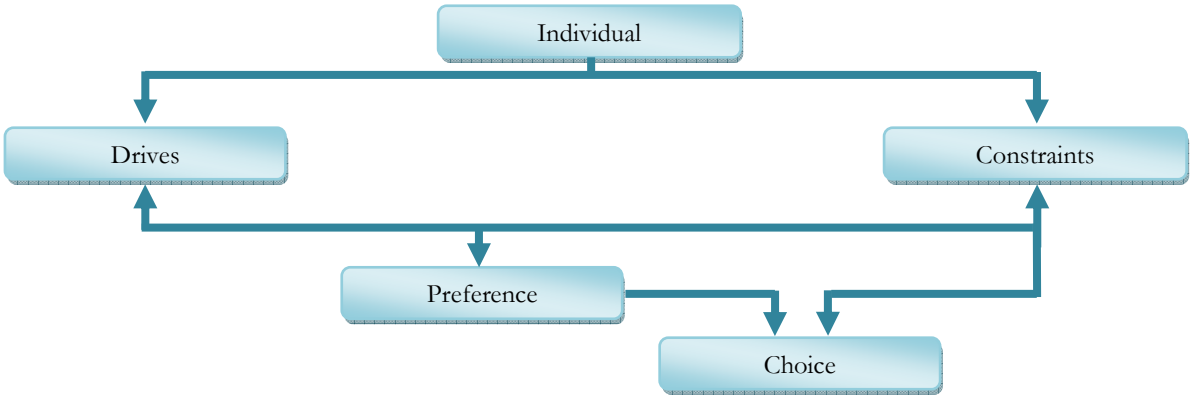


Source: Based on Ben-Akiva and Lerman 1985:33ff, own design.

Mokhtarian and Salomon (1997:36ff) describe a very basic model of decision-making that is mainly influenced by 'drives' and 'constraints.' The authors suggest that for an alternative mode to be considered (in their case telecommuting), a certain degree of dissatisfaction about various aspects of life has to be present. In the search for a solution, drives are the motivators for finding one and are defined as positive internal constructs (e.g. saving money). Constraints, on the other hand, are factors that inhibit the action to be carried out and refer to exogenous factors (e.g. availability of modes) which can also only be temporary. The basic concept is outlined in Figure 2-6.

The authors find that sociodemographic and socioeconomic factors are not sufficient enough to describe the decision-making process. Instead, internal factors, rather than external ones, determine the likelihood of a commuter considering alternative modes (Mokhtarian and Salomon 1997:48f).

Figure 2-6: Basic conceptual structure for decision-making



Source: Based on Mokhtarian and Salomon 1997:37, own design.

Bamberg (2000:196) explains that the reason why changing a habit is so difficult lies in the effort it takes to make new decisions, such as time and comfort costs. New decisions are only easy to make if enough information is available. In one of his studies, Bamberg shows that forming a so-called implementation intention increases the chance of changing the habit. An implementation intention means that a person gives him- or herself a goal-oriented behavior for a future situation. By making this conscious intention, the person feels more obligated in achieving his or her set goal. In regards to changing the transportation mode to work, it could look like this: 'I intend to take the bus to work when I don't have to pick up my child after work.'

According to Moeller (2002:7ff), two types of methods to break a habit exist. The first one relates to altering the habit by initiating a more conscious decision-making process. The same steps as getting into a habit are required for elimination. The second method relates to changing the habits by altering the supporting features of the context in which the habitual actions are performed, such as the individual's goals or important situational features. Policies could include reduced speed limits, raised gas taxes, or high parking costs. In conclusion to Moeller's paper, two recommendations were made: Change the contextual factors to make

driving no longer rewarding and alter the attitudes or the image of alternative modes to make them more acceptable to society (Moeller 2002:13f).

In regard to the topic of this thesis, individual mobility information could be an essential factor for influencing mode choice. In order to make good decisions, it is important to know about all possible alternatives and to have full access to the information needed. While the previous sections summarized spatial, social, and decision-forming studies and theories in an effort to explain travel behavior and choices, the next section describes a variety of measures aimed at reducing solo driving.

2.4 Measures to Influence Travel Behavior

Understanding how travel behavior is formed is only part of the solution in creating increased alternative mode usage. Without knowing which types of TDM measures are available that can help the individual in choosing the alternative that best meets her or his needs, marketing concepts cannot be developed. Therefore, this section reviews and evaluates such measures based on incentives, information technology, and the players who should be involved.

In general, alternative mode usage can be promoted through restrictive measures, incentives, and/or information technology. While restrictive measures are aimed towards making car use unattractive, the other two measures are usually targeted to promote a particular alternative mode. Restrictive measures therefore apply to all alternative transportation options and include, but are not limited to, the following players and actions:

Federal government:	Increasing gasoline taxes
State government:	Levying road tolls
Local government:	Reducing parking possibilities, such as no or expensive parking within city
Employer:	Levying parking fees
All:	Increasing traffic (although not directly controllable)

Bamberg et al (2000:502ff) conducted a study on the effectiveness of measures to reduce car travel. They asked transportation experts, such as professors, public transit managers, or politicians, to evaluate 56 measures based on behavioral effectiveness, cost, and time until implementation. Overall, the three most effective measures estimated were: a very strong increase in gas prices, free fares for public transportation, and the expansion of rail systems.

Most surveys that study pull (incentives) and push (restrictions) factors aimed at reducing car usage find that incentives, particularly the improvement of public transportation, are more acceptable than negative measures, such as pricing (Gatersleben and Uzzell 2003:390). However, Meyer (1999:588ff) points out that the measures that are most likely to increase travel costs for SOV usage tend to be most effective in reducing solo driving.

In an interesting approach, Litman (2008:2ff) argues that North American motorists should actually demand the increase of fuel prices instead of complaining about them. However, the increase in fuel prices should come from an increase in taxes which is used to improve the overall transportation system, including the subsidy of fuel-efficient vehicles, sustainable modes, and more accessible land use patterns to give consumers a variety of choices. In return, not only the environment but also the economy would benefit from such action.

Table 2-3: Examples of restrictions, incentives, information technology, and possible players to increase alternative mode usage

Modes	Restrictions	Incentives	Information Technology	Possible Player(s)
Public Transit	Levying parking fees or road tolls; reducing parking possibilities; implementing parking regulations; or increasing in gasoline taxes.	• Roofed bus stops • Vending machines at bus stops • High service frequency (see a) • Bus route change (see a) • Subsidized bus passes (see a) • Short walking distance to/from bus stop • Shuttle service • Preferential bus lanes • Park and Ride (P&R) facilities • Free newspaper	• Electronic trip planner • Digital time tables at bus stops • Automatic payroll deduction • TVs in buses and at bus stops • Traffic signal priority • Wireless Internet access • Electronic signs indicating free P&R spaces	• Public transit provider • City/Urban planning • Employers
Carpooling		• Park and Pool (P&P) areas • Reserved parking spaces • Company cars • HOV lanes • Get-togethers	• Flexible rideshare service (see b) • Dynamic message signs indicating P&P and number of free spaces	• Ridematching agency • City/Urban planning • Employers
Vanpooling		• P&P areas • Reserved parking spaces • Subsidized vanpool seats • Company vans • HOV lanes	• Automatic payroll deduction • Vanpool route optimization • Dynamic message signs indicating P&P and number of free spaces	• Ridematching agency • City/Urban planning • Employers
Biking		• Safe biking paths • Safe and roofed bike lockers • Showers and dressing rooms • Repair service • Company bikes • Housing near employer sites	• Electronic bicycle maps • Automatic traffic signal recognition	• City/Urban planning • Employers • Health Agencies
Walking		• Safe walking paths • Easy access to buildings • Good lighting • Housing near employer sites	• Automatic traffic signal recognition	• City/Urban planning • Employers • Health Agencies
Tele-commuting		• Free Internet access at home • Company computers • Work from home	• Secure data transfer • Teleconferences • Webcams	• Employers
For all modes	Levying parking fees or road tolls; reducing parking possibilities; implementing parking regulations; or increasing in gasoline taxes.	• Employee Transportation Coordinator (ETC) / personal assistance • Free parking x-times per month • Guaranteed Ride Home (GRH) program • Monthly drawings • On-site employee services, such as shipping, movie rental, dry cleaners	• Online multi-modal traveler information system (see c) • Online banking and shopping	• Transportation agencies • City/Urban planning • Employers • Districts (see d)

Source: Based on Feigl and Vennefrohne 1999, Beeke and Schäfer-Breede 1999, ILS 2000, Müller 2001, and Berman and Radow 1997, own design.

Notes to Table 2-3:

[a] *Improving public transportation* can be exemplified by a German bank called Bausparkasse Schwäbisch Hall. Up until 1993, the majority of the bank's employees drove to work by car. However, due to capacity limits of parking spaces as well as complaints by the residents nearby, a project was initiated called 'Auch ohne Auto mobil' (translated as: One can be mobile without a car, too!). Its objective was to substantially improve the accessibility by public transportation (Schütt 1996:117f). In order to get the city as well as private bus companies to participate and cooperate, the bank guaranteed that at least 15 percent of their staff would use the bus. Therefore, a reformation of the entire bus route system and a drastic change in transit service frequency was undertaken to improve the accessibility by bus to the company for almost every employee. Informational and marketing strategies as well as restrictive parking management persuaded 2,800 of the 3,500 employees to subscribe to the partly subsidized bus ticket, or so-called Job ticket (Kühnel 2003).

[b] A *flexible ridesharing service* focuses on employees with flexible working hours (Holzwarth et al 2000:549ff). Thus, next to long-term booking, employees can daily, even hourly, check current offers and demands and book their ride. Therefore, booking the trip to work can be separate from booking the trip back home. This allows bookings or changes on short notice when working overtime is necessary, for example. By providing the exact home addresses, GIS technologies calculate the best and quickest routes as well as P&P areas for each match. Information on when and where to meet are given either by email or cell phone. And for emergency services, a 24-hour phone hotline is available to ensure that everyone gets home safely and on time. In case of an emergency or if no match is found, a GRH program takes place.

[c] *Travel Information System.* Because information is not always easily available for every transportation mode, transportation users often act upon subjective assumptions when making a mode choice. In order to increase transit usage or carpooling, improvements in information services are necessary. It is important to present the user with detailed information about all modes that could be used for the entire requested trip (from door to door). The Munich public transportation agency called Münchener Verkehrsverbund (MVV) in Germany provides an online information service that integrates all means of transportation. The website allows users to search for the most efficient mode in regard to their travel route and schedule. Through the search tool, users can enter their personal preferences in regard to maximal number of transfers or total travel time. In addition, specifications regarding the needs for people with limited mobility are taken into consideration. The search results displayed by the internet system contain a variety of trip alternatives and provide information about transfer possibilities and the accessibility to transit stops. Route specific travel maps are also produced. Additionally, the total trip length, including walking minutes and cost per trip, is listed (see MVV 2007). Such travel information systems facilitate the search for the optimal transportation option and minimize the decision-making process.

[d] *District-wide integrated TDM programs.* Montgomery County in Maryland (Washington D.C. metropolitan area) can be used as an example for area-wide employer-based TDM. In 2002, the County Council passed legislation, mainly known as Bill 32-02, which obligates businesses that are located in one of the county's four Transportation Management Districts and employ more than 25 full- or part-time workers to organize and execute traffic mitigation plans. The goal of these plans is to create measures to decrease traffic and specifically single car use (Schwartz 2004:1). Eight strategies were identified as required parts of a company's mitigation plan. These strategies include the designation of an ETC, marketing and promotion of alternative modes of transportation, and the participation in an annual commuter survey where 80 percent of all employees should participate (Schwartz 2004:3). Within the first year of this legislation being in effect, the requests for carpool, vanpool, and transit information increased by over 600 percent. In addition, the free assistance provided by the Transportation Management Districts to the local employers helped tailor their plans to the needs of their employees. Studies conducted by Montgomery County have shown that 30 percent of employees who now take advantage of the transit subsidy programs used to drive alone (Schwartz 2004:7f).

Although knowing about the possible TDM measures is helpful, it alone will not achieve the actual implementation. In this respect, employers can be a valuable asset. However, overcoming the resistance of employers to make transportation 'their problem' and receiving the resources needed to implement certain strategies can be difficult and often demands good private-public relationships as well as organized marketing (Rye 1999:15ff).

Once an employer is willing to participate and implement a so-called Employer Transportation Plan (ETP)[2], several factors can influence the success of such a plan. These factors include the competence of the person appointed to consult transportation needs on an individual basis, information that addresses the individual's trip to work, frequent publication of goals and results, the introduction of a parking charge, and finally the commitment of management (Rye 1999:21f). In addition, it is essential to better understand people's lifestyles as well as their attitudes and perceptions towards transportation modes in order to establish both the availability of services and the appropriate marketing (Watts and Stephenson 2000:449f). Table 2-3 provides examples for each alternative mode by restrictions, incentives, and possible players.

2.5 Summary

Many researchers and practitioners have come to the conclusion that solely relying on spatial theories to explain travel behavior is not sufficient anymore. Instead, psychological and social theories need to be consulted as well, making urban planning and social research complementary processes. This notion greatly supports the comprehensive modal split model described in Figure 1-2.

For the research at hand, many of the previously mentioned theories are needed. For example, studying land use and land patterns is especially important for estimating the number of employees who could potentially take the bus due to their residence proximity to an existing bus stop, or for improving service frequency of bus lines to high populated neighborhoods. Complementing these estimates are surveys about the characteristics, attitudes, and travel needs of employees regarding their mode choice and trip patterns to create appropriate marketing campaigns and information channels.

As the literature review demonstrated, disaggregate and qualitative data analysis has become more common in recent years as a means to study the various elements of TDM. However, a comprehensive in-depth analysis that tries to take all influential factors into account has not been widely applied. Therefore, the presented research considers spatial, behavioral, and information technological elements in order to create a better understanding of travel behavior and potential marketing concepts. As previously mentioned, one of the main goals is to study the impact of attitudes towards the various transportation modes that lead an employee to drive alone to work. Often, attitudes and perceptions inhibit individuals from choosing certain

[2] Employer Transportation Plans (ETPs) are packages that include a variety of TDM measures with the attempt to address employees' emotions and social values to change travel behavior (Watts and Stephenson 2000:435, Rye 1999:15). Depending on the size of the company, its location, working patterns, and socioeconomic status of the workforce, certain measures, such as organized carpooling, are easier and cheaper to implement than other measures, such as subsidizing bus tickets.

modes of transportation, as do personal constraints, such as picking up children or carrying luggage. For commuters to accept and adopt new travel choices, the transportation options need to be perceived in a more positive and advantageous way (Gatersleben and Uzzell 2003:389).

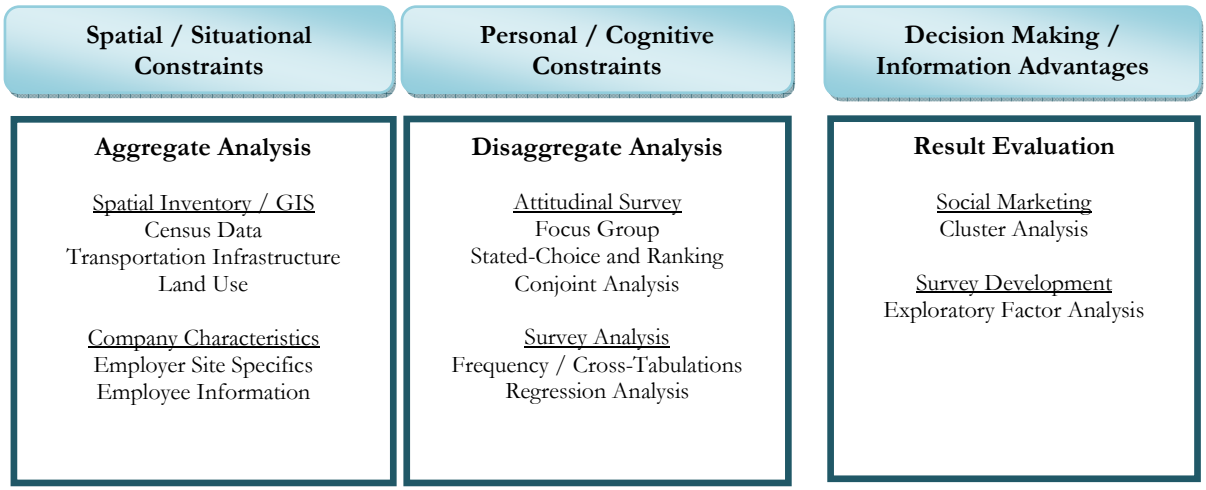
The literature review also illustrated that making new decisions takes much time and effort, preventing quick behavioral changes. Most individuals try to minimize the effort of making a decision every day and tend to form habits. Understanding this behavior leads to the conclusion that for employers and policy makers to be successful, it is important to interrupt the repeated behavior so that the individual is challenged to make a new decision and form a new habit, which ideally would result in using alternative modes. In this regard, the importance of social marketing is addressed in chapter 8.

"Qualitative research is […] vital to understanding the complexity of travel behavior, which rests upon the subjective beliefs and behaviors of the individual person."
– Poulenez-Donovan and Ulberg 1994:1

3 Problem-specific Methodology

One of the greatest challenges in conducting scientific studies is to find the right research methodology for both the survey design and the survey analysis so that good statistical results can be produced. In regard to TDM, Figure 1-2 and Figure 2-3 illustrated that it is important to examine travel behavior from a holistic perspective that takes spatial and individual constraints into account (also see Crane 1998:5). Building on the previously discussed theories and studies, the methodologies used for this research can be divided into those that address the spatial and situational context, those that address the behavioral and attitudinal aspects of the individual SOV commuter, and those that provide information to create marketing strategies for TDM (see Figure 3-1). Such research that includes a variety of data sources and multiple statistical methods to study a single problem is referred to as "triangulation" (Golledge and Stimson 1997:12f). Triangulation was also used for the described project.

Figure 3-1: Research methodologies to study influencing factors of mode choice



Source: Based on Figure 2-3, own design.

A great variety of survey methods exists in the field of TDM, such as activity diaries, employer and employee questionnaires, or interviews with transportation agency officials. The CUTR at the University of South Florida acts as a national TDM and telework clearinghouse (University of South Florida 2007). Therefore, the reader shall be referred to the center's website for a listing of the many survey techniques for TDM. From this point on, only the methods and analysis tools that seemed most relevant to the presented topic and for employer-based research are discussed. The following sections highlight and describe those survey and analysis tools.

3.1 Understanding the Survey Content

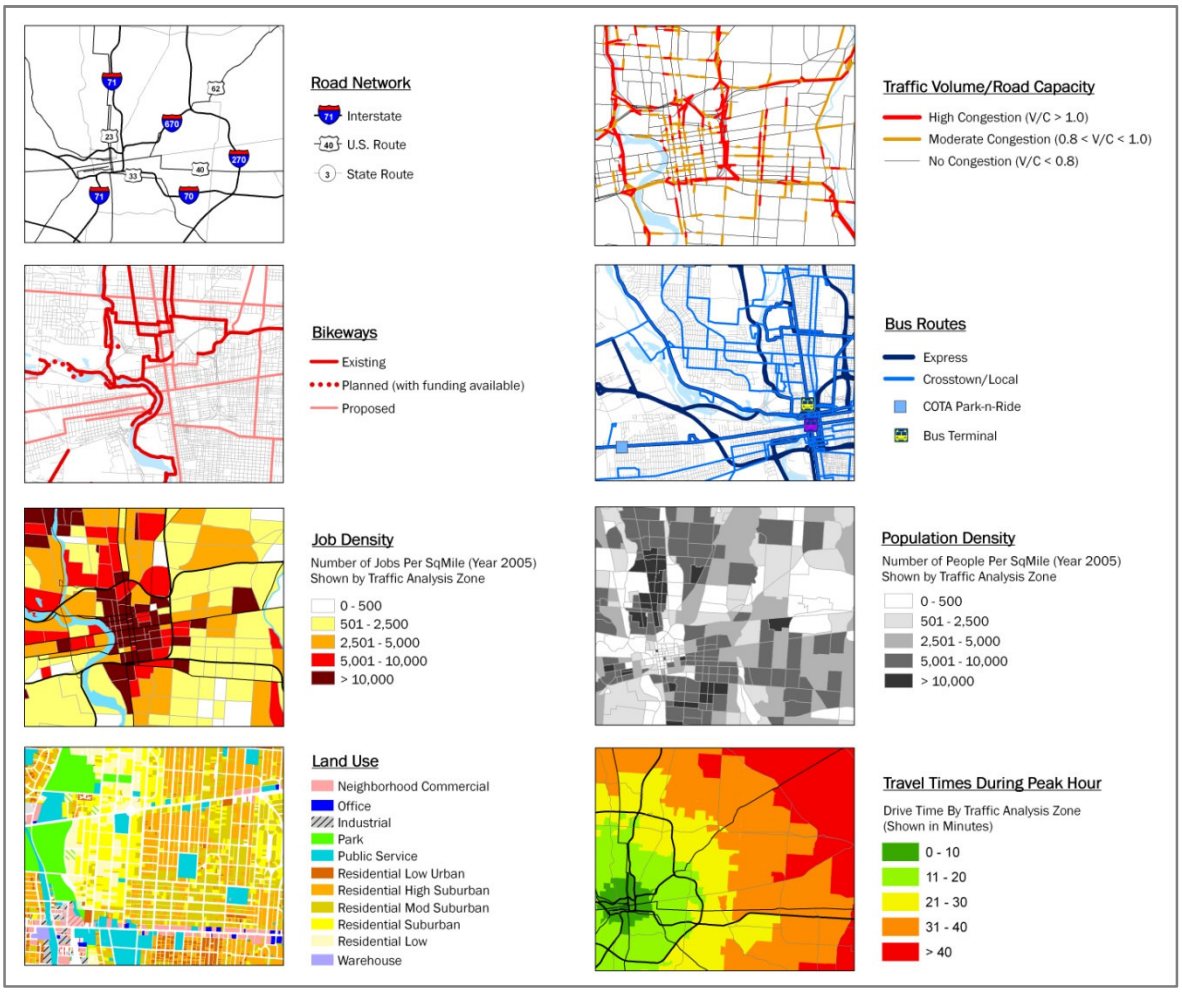
Prior to the development of any large survey, a pre-survey should be conducted using a small sample of the population to whom the research is targeted. Such efforts are necessary to better assess which type of questions have the greatest potential in detecting answers to the research objectives. While interviews, which involve face-to-face or telephone interaction where the researcher orally solicits responses, can provide great insight into someone's thinking and allow the researcher to interact directly with the subjects, they are also very time-consuming (Mefford and Horner 2004:5). Focus groups, on the other hand, refer to eight to twelve individuals from the target population who are gathered in one room for a conversation under the leadership of a trained moderator. The discussion focuses on a consumer problem, product, or potential solution to a problem. Often, the small sample size serves well for an in-depth exploration of the selected issues but does not permit for statistical testing or projections to the general market (Clifton and Handy 2003:288).

In regard to the study's objective, a focus group will help to gain further insight into work-related commuting behavior and to aid in establishing the attributes and questions that need to be addressed in a behavioral survey (Pratt 2003:148). Such a behavioral survey should then include a variety of topic-related questions that are designed only for a specific group of participants, for example commuters that drive alone to work. The questions used in such a survey could be asked within a wide spectrum of methodologies, depending on the type of answer needed.

3.2 Assessing the Spatial and Situational Context

Census statistics and spatial data that describe the transportation infrastructure and the environment around a specific site are important indicators for travel demand. Within so-called status quo analyses, information about population size, number of (reversed) commuters, public transit access, availability of carpooling and vanpooling services, urban development patterns, route information, or the parking situation are obtained. This type of information is most commonly retrieved through the census, the city's statistical bureau, personal interviews with employers, available GIS data, and through simple observation and traffic or parking counts. Spatial information in particular allows the researcher to better understand the physical opportunities or restrictions that travelers face due to the current transportation infrastructure and policies. Mapping the gathered spatial facts via GIS can then largely aid to the understanding of current travel behavior. Utilizing spatial software that allows the visualization of travel routes, times, or the number of employees within certain transportation corridors provides necessary information for developing TDM concepts that have the potential in achieving a modal split (see Figure 3-2).

Figure 3-2: Spatial and site-specific data examples for TDM analysis



Source: Own design.

However, in order to address all situational constraints, such as working hours, employee residential locations, or current modal split, all employees of a company should be surveyed as well. Such a survey should be short and precise, easy to complete, and easy to access. To obtain a high survey response rate, the company's Intranet can be a very effective channel for surveying employees. Advantages of online questionnaires include the potential to collect a large amount of data in a relatively short period of time and the elimination of data entry into a database. Hundreds of respondents can fill out the survey within a matter of days, and all of the responses can be automatically exported into a database. Such aggregate analysis along with spatial data is conducted for the presented research. Details on the methodology and the results for the specific research project are described in chapter 6.

3.3 Assessing the Personal and Cognitive Constraints

While many urban planners believe that land use design has the greatest impact on mode choice, social scientist would argue differently. Social scientists have long been interested in understanding travel behavior from the individual's perspective. However, to this end they have predominately employed quantitative research methods (Clifton and Handy 2003:284ff,

Golledge and Stimson 1997:4ff, among others). Although qualitative techniques do not yield statistically significant results, they are ideally suited for exploratory research such as identifying the influential factors of travel behavior (Golledge and Stimson 1997:14). Qualitative survey methods, including attitudinal surveys, focus groups, personal interviews, or participant observation methods, are techniques that provide more detailed answers to current questions and issues related to transportation and travel behavior. Even though qualitative methods offer great potential for transportation research, they should not be seen as a replacement for quantitative methods. Qualitative methods should be viewed as an extension to assist in explaining psychological and social influential factors of travel behavior (Mefford and Horner 2004:4, Clifton and Handy 2003:288, Goulias 1995:325, Poulenez-Donovan and Ulberg 1994:5).

Since 'soft' (or qualitative) data can be particularly useful when studying perceptions, attitudes, or attribute valuations (Loo 2002:212), it is the primary focus of the described research. A qualitative approach, complemented by quantitative studies and analysis, is seen as essential in gaining detailed insight into the individual's transportation decision process and to develop possible marketing strategies.

The literature review in chapter 2 confirmed the assumption that cognitive processes play an important role in determining travel behavior to work (Ben-Akiva et al 2002, McFadden 2002, Louviere and Hensher 2001, Axhausen and Sammer 2001, among others). Many of the mentioned scientists have conducted their research utilizing revealed preference, stated preference, discrete choice analysis, and conjoint analysis methods in order to develop predictive choice models. Stated preference experiments are commonly employed for identifying the most important product features or alternatives for travel by providing respondents with different hypothetical scenarios relating to a current behavior such as the work commute (O'Fallon et al 2004, Axhausen 2003, Stopher and Zmund 2001, Beaton et al 1997, Hunt and McMillan 1997, Abdel-Aty et al 1996, among others). Stated choice questions demand choosing one of several alternatives or scenarios, stated preference questions request the evaluation of each alternative by scaling methods, and stated ranking questions ask the respondents to rank several alternatives by preference. If such surveys are designed with 'realistic' scenarios, they can provide fairly accurate information about the decision-making process (Stopher and Zmund 2001:305, Beaton et al 1998:58).

Conjoint analysis is particularly suited to assess the importance of certain product or service attributes so that an optimal transportation service and marketing strategy to increase commuters' interest in other modes of transportation can be designed. Conjoint analysis allows the researcher to estimate the importance a person attaches to different features of a product without direct questioning (Backhaus et al 2000:565). Consequently, conjoint analysis can help determine the transportation mode attributes most relevant to the consumer and how variations of the attributes and its levels will influence consumer behavior (Chakrapani 2004:135ff). Conjoint analysis involves the use of designed hypothetical choice situations to measure individuals' preferences and to predict their choice in new situations. Multiple hypothetical scenarios, called product profiles, are generated and presented to respondents who are requested to either express their degree of preference for these profiles or to choose between these profiles (Backhaus et al 2000:571ff).

For the presented study, an in-depth survey utilizing a variety of question types is conducted with a selected set of SOV commuters. Conjoint analysis is seen as a key element in identifying the attributes of transportation services that are most important to car drivers and the trade-offs they would be willing to make if certain attribute changes occurred. In order to analyze the results, regression analysis seems well suited.

Regression analysis is a statistical technique that allows the researcher to assess the causal relationship between one dependent variable and one or several independent variables. The analysis assumes a distinct direction of the relationship between the variables, which is not reversible. As such, it examines if-then-relationships (Backhaus et al 2000:2ff, Bryman and Cramer 1999:252ff). The two benefits of regression analysis are 1) to predict values on a dependent variable based on the knowledge of the values on the independent variables, and 2) to assess the relative degree to which each independent variable accounts for variance in the dependent variable (Kachigan 1991:186).

The multiple regression equation ($y = a + b_1x_1 + b_2x_2 + \ldots + b_jx_j$) shows that while y is the predicted value of the dependent variable and x_j are the values of the independent variables, the values of a and the regression coefficients (b_j) must be determined from the sample data (Bernard 2002:629, Backhaus et al 2000:16ff, Kachigan 1991:181, among others). The objective is to determine the parameters a and b_j in such a way that the sum of non-explained variance (standard deviations) is minimal (Bernard 2002:629ff, Backhaus et al 2000:17). The regression coefficients or weights (b_j) explain the influential strength of each independent variable on the dependent variable. b_j indicate "the correlations of the individual predictor variables with the […] [dependent] variable, and […] the correlations that exist among the predictor variables themselves" (Kachigan 1991:149).

Since regression analysis can be applied to help determine the relationship between independent and dependent variables, it also seems an appropriate tool for assessing the importance employees place on transportation attributes and to use the results for further analysis.

Most variables of a survey can be analyzed using frequency analysis and cross tabulations. Cross tabulations or contingence analysis examine the interrelation between variables. They are usually presented as a contingency table in a matrix format. Whereas a frequency distribution provides the distribution of one variable, a contingency table describes the distribution of two or more variables simultaneously. Cross tabulations are frequently used because they are easy to understand and can be applied with any level of data (nominal, ordinal, interval, or ratio). In the case of transportation research, cross tabulations can, for example, show the relationship between mode choice and sociodemographics.

3.4 Assessing Marketing Strategies

Marketing strategies tend to be most effective if they address specific target groups. Cluster analysis, in particular, shows much potential in segmenting customer groups for marketing purposes. As described in chapter 2, the decision-making process is a very complex matter. Commuting is such a repetitive behavior that choosing one particular travel mode has become

a habit among many Americans. In order to increase alternative mode usage among employees, it is necessary to assist commuters in making a new choice and thus, forming a new habit. Convincing the individual about one mode being superior over another is not easy since each transportation mode clearly has its own pros and cons. However, depending on the importance a person places on a certain attribute, the mode that best meets that criteria can be marketed to all those that feel the same way. It is therefore crucial to cluster commuters into somewhat homogeneous groups with very similar characteristics, for example into those that are most cost sensitive.

Cluster analysis is a multivariate statistical classification technique for discovering whether individuals of a selected population fall into different groups by making quantitative comparisons of multiple characteristics. Thus, objects are being placed into more or less homogeneous groups in such a manner that the relationship between groups is revealed. The differences within any group should be less than the differences between groups (Bernard 2002:653, Johnson and Wichern 2002:668f, Backhaus et al 2000:329). However, cluster analysis requires decisions to be made by the user relating to the calculation of clusters. These decisions can have a strong influence on the results of the classification.

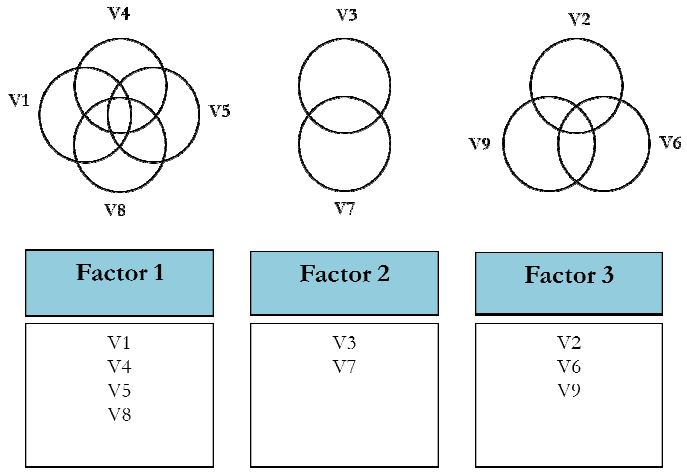
Cluster analysis is typically used for grouping large data sets. However, it can also be performed as a qualitative approach to assist in detecting possible target groups and their typical characteristics. Clustering participants according to their preferences of a specific product or service has shown to be effective for market research (Everitt et al 1993:2). According to Anable (2005:77), "this information allows alternative transport services to be presented in contrasting ways so as to emphasize the individuality of the users, avoid stereotypes and therefore address the widest possible audience without relying on the 'average', hit or miss mass marketing approach. […] Hence, the segmentation approach illustrates that policy interventions need to be responsive to the different motivations and constraints of the sub-groups."

Factor analysis is another statistical instrument that allows for the evaluation of marketing concepts as well as the continuation of surveys with a broader population. A comprehensive in-depth survey can include many questions that all result in the same answer. In order to detect this redundancy in variables and determine the key factors that underlie travel behavior, factor analysis is valuable. It can help to produce shorter surveys that can be distributed in an aggregate manner so that statistically representative results are possible. These surveys can be used to attract new information of other commuters and also to reassess the implemented strategies based on the cluster analysis described above.

Factor analysis differs from cluster analysis in the sense that it is a statistical analysis technique that attempts to reduce a large set of variables to a more meaningful, smaller set of variables, the so-called factors. This data simplification method is often used to identify a small number of factors that explain most of the variance observed in a much larger number of manifest variables (Bernard 2002:642ff, Backhaus et al 2000:253ff, Kline 2000:113ff, Hackett and Foxall 1999:323ff, Kachigan 1991:236ff, among others). Therefore, factor analysis is primarily applied in an effort to describe the covariance relationship between many variables in regards to a few underlying factors (Johnson and Wichern 2002:477).

Many forms of factor analysis exist, but probably the most widely and commonly used form of factor analysis is the principal component analysis (PCA) (Cudeck 2000:274, Backhaus et al 2000:257, Bryman and Cramer 1999:273ff, Kachigan 1991:245, among others). Within the PCA, the number of factors initially extracted is the same as the number of included variables. Each factor is viewed as a weighted combination of the input variables. Typically, the first extracted factor is responsible for the largest share of the data set's total variance. Each subsequent factor is responsible for less and less of the total variance.

Figure 3-3: Reduction of many variables to few factors (Factor analysis)



Source: Own design.

Figure 3-3 gives a visual representation of the nature of factor analysis. In this example, all variables clustered together are meant to highly correlate with each other, and each cluster represents a factor. Here, three factors possess virtually all the information of the nine variables. The factors are relatively independent of one another. As such, factor analysis can sift redundancy from a set of variables (Kachigan 1991:237ff). For example, a factor called 'flexibility' could possess variables such as independence, irregular work schedule, and ability to get home in an emergency.

Factor loadings are the correlations of the variables with the factors and are represented in the cell entries of the factor matrix. They vary in value from –1 to +1 and signify to which degree each variable correlates with each factor (Bernard 2002:643, Kline 2000:116, Hackett and Foxall 1999:243). Variables with high loadings on a factor usually provide for the meaning and interpretation of that factor. The cut-off for the variables to include in the explanation of the factors is commonly in the range of factor loadings of 0.3 and 0.6 (Bernard 2002:644). Any items that correlate less than 0.3 with a factor account for less than nine percent of the variance and are therefore considered unimportant (Bryman and Cramer 1999:280).

In order to determine the number of factors that are sufficient in describing the variables, so-called eigenvalues and scree plots are helpful. Eigenvalues are the sum of squares of all loadings on a factor. They represent the amount of total variance within the dataset and the amount accounted for by the factor. Scree plots or scree curves are created by plotting the number of factors against their respective eigenvalues (Bryman and Cramer 1999:277ff, Hackett and Foxall 1999:324). Only factors above the so-called elbow of the scree plot should be

considered for the analysis since all others represent mostly random error variance (Kachigan 1991:247, Hackett and Foxall 1999:324f, Backhaus et al 2000:289f, Kline 2000:143, among others). The number of factors can therefore be determined by either the total variance explained or by examining different solutions in regard to the meaning of the variables loading on the respective factors (Kachigan 1991:247).

Factor rotation is commonly used to redefine the factors that were selected as meaningful to the analysis. Using this method, the explained variance is redistributed among the newly defined factors and defines sharper distinctions between the meanings (Bryman and Cramer 1999:279f, Hackett and Foxall 1999:334, Kachigan 1991:248ff). Factor rotation neither changes the number of factors nor the total variance explained but rather redefines the factors considering how the variables load on (or correlate with) the factors (Kachigan 1991:250).

In regard to the objective of the described research, factor analysis can be a very helpful tool in determining underlying influential factors on why people choose to drive alone to work. Anable (2005:69ff), for example, has performed a factor analysis in her research on leisure travel behavior in an effort to reduce the set of variables (attitudinal statements). Applying this method allowed the researcher to find 17 factors underlying more than 70 variables. Mokhtarian and Salomon (1997:40ff), as another example, conducted a factor analysis based on a long survey that aimed at predicting the number of people who would switch to telecommuting. Within their research, they had a number of attitude statements about advantages and disadvantages for telecommuting, work, family, personality, travel, technology, and environment. By performing a factor analysis with each segment of questions, the authors were able to reduce the number of variables from 53 to 17 factors which helped to describe the 'drives' and 'constraints' for choosing to telecommute.

The derived factors could therefore also play a significant role in marketing alternative modes of transportation by concentrating efforts on the key factors accounting for the bulk of the variance in the data (Kachigan 1991:239f). In addition, the results of an exploratory factor analysis can serve as suggestions for future research in this area.

3.5 Summary

A variety of methodologies exist to study the topic of travel behavior, both for survey design and for survey analysis. As illustrated in Figure 3-1, different techniques are available to determine spatial and situational characteristics for a certain urban area or work site, to detect potential personal and cognitive constraints that impact mode choice, and last but not least to develop marketing strategies customized to specific population groups. Based on the research's objective to better understand travel behavior and to utilize this understanding to identify TDM strategies and marketing approaches, all of these techniques are helpful. For example, extensive GIS analysis takes the physical environment and urban infrastructure into account to identify transportation options, gaps, and user proximity to services. In addition to dealing with spatial-related questions, more detailed answers about how people think and perceive things can be obtained not only through simple questions but also through state-ranking and conjoint analysis. Advanced statistical analyses, such as regression, cluster, or factor analysis, seem appropriate to identify target groups and appropriate TDM strategies.

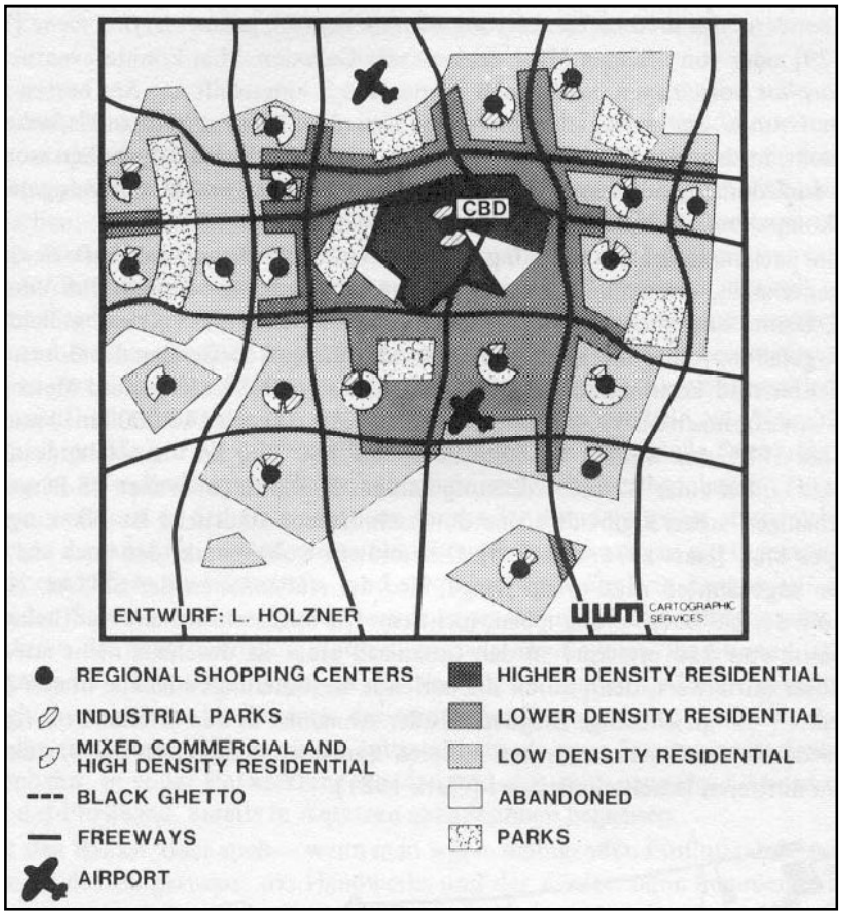
While the next chapters give an overview of the policies and processes of urban transportation planning and statistics on travel behavior for both the United States and the research city and site, chapters 5 and 6 provide detailed information about the conducted research and the results achieved by the different types of methodologies used. The concept of social marketing and recommendations on how to use the results from this research are described in greater detail in chapters 7 and 8.

"Addressing the congestion problem by building more and wider roads is equivalent to a person dealing with her/his weight problem by buying bigger pants." – Author unknown

4 U.S. Land Use and Transportation Planning in Urbanized Areas

The previous chapters clearly illustrated that individual characteristics, attitudes, and perceptions are necessary to understand travel behavior. However, they also indicated that transportation and urban infrastructures are important factors for mode choice as well. In fact, many transportation researchers and practitioners would argue that the high usage of automobiles in the United States is the result of how most American urban areas are structured: small city cores and large residential suburban areas where each has their own industrial center and shopping center, and where all communities are easily accessible by freeways (see Figure 4-1).

Figure 4-1: Simplified illustration of the typical layout of large American cities

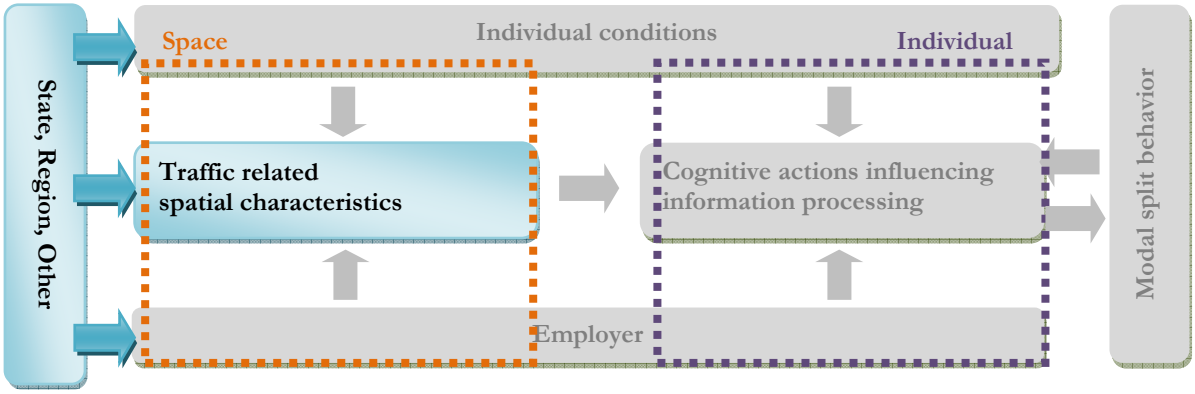


Source: Holzner 1985:195.

The high suburbanization of the various kinds of activity centers since the 1960s has led to the majority of Americans living outside of the CBD. However, the composition of large cities has not always looked like this. Chapter 4 focuses on the kind of influences states, regions, local transportation providers, and businesses have on the spatial development of an urbanized area

(see Figure 4-2). The chapter discusses how the various players directly or indirectly impact the type and location of residential areas, the accessibility to the various modes of transportation based on the traffic infrastructure, as well as where businesses and destinations are located.

Figure 4-2: Research focus on spatial development



Source: Based on Figure 1-2, own design.

4.1 Land Use Development

Traditionally, land use and transportation planning were integrated processes in developing cities and communities. Neighborhoods were created in a compact manner that allowed for pedestrian and transit travel to nearby activity centers, such as work places, shops, restaurants, or banking facilities (Hanson 1995:4f). However, starting in 1945, land use planning became separated from transportation planning as a result of the increased production of automobiles to enhance economic growth (Atash 1996:37, also see section 4.2). While the federal and state governments were strongly involved in transportation planning, their involvement in urban planning was minimal. Land use planning was mostly done on the local levels, and the development of regions was primarily guided by economic growth opportunities. Since transportation planning was highly focused on providing automobile connections from outlying suburbs to the CBD, it encouraged suburban outward expansion. Most cities allowed a wide spread development to quickly accommodate population growth, only few were able to 'plan' for the future (Atash 1996:37). In particular those regions that exhibited physical attractiveness, employment opportunities, and the availability of cultural facilities quickly populated and increased in size, leading to annexations and spillovers to nearby communities and suburbs (Schiller 2004:36). Overall, lower land costs at the edge of cities as well as the connectivity between communities provided by the extensive road and highway network were crucial in the proliferation of urban sprawl. The improved mobility through technological advancement in automobile design, that allowed traveling further distances in shorter amounts of time, additionally enabled the urban sprawl.

The trend towards suburbanization also facilitated the "spatial separation between different types of land uses" within a city, and local neighborhood stores and restaurants were closed down (Hanson 1995:5). Most residential areas were now physically separated from employment, entertainment, and industrial centers. While shopping and employment centers eventually followed the suburban housing developments, they remained separate from

residential areas. Along with the spreading of suburbs came the change from high-density mixed land use in core areas of a city to low-density single use communities at the growing outskirts of the city. In addition, the decline of downtowns was accompanied by people's negative attitudes that associated the dense urban areas with noise, pollution, crime, or disease (Gatti 2008).[3]

It was not until 1991 that, for the first time since 1945, "the connection between transportation, land use and air pollution" was made through the federal transportation bill named ISTEA (Atash 1996:38). The bill placed great emphasis on addressing congestion and air quality issues through multi-modal planning and the involvement of MPOs[4]. In addition, the CAAA of 1990 supported the notion of planning collaboration among different disciplines. The next transportation bills, TEA-21 and SAFETEA-LU, maintained and increased guidance and funding to reduce the negative consequences from low-density development (see section 4.2). Environmentally, these negative consequences include air quality issues, increase in noise levels through the high rate of single use automobile travel, and the destruction of green spaces, among others. However, many states and regions are just now, with the growing awareness for the impact of transportation and development on the environment, embracing such thinking and studying strategies that promote mixed land use and alternative transportation options. Implementing those strategies will take time since most American cities are already fairly spread out with low population densities.

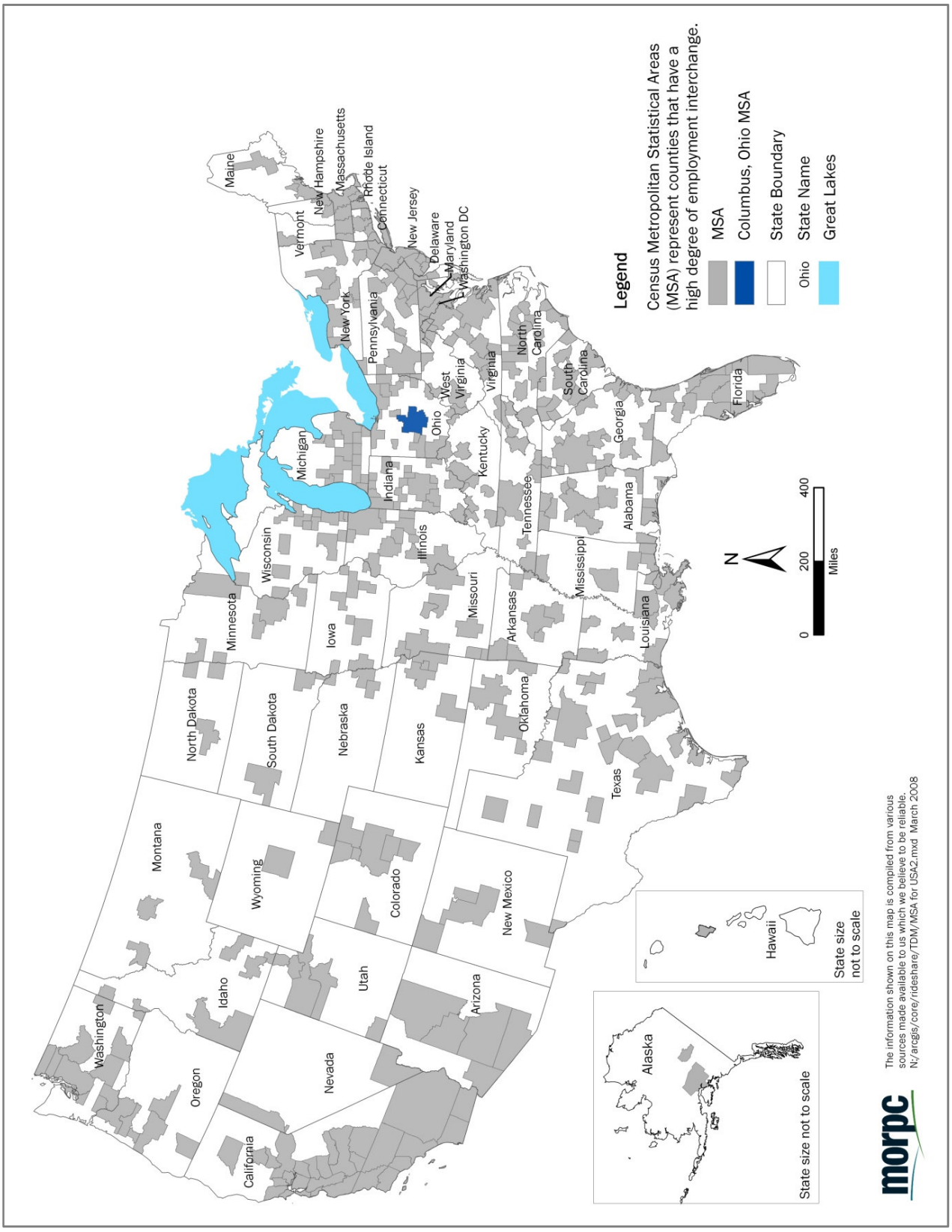
4.1.1 Metropolitan Statistical Areas with Polycentric Structures

More than 80 percent of the U.S. population lives in metropolitan areas today (McGuckin and Srinivasan 2004:1-4ff). A Metropolitan Statistical Area (MSA) is defined as a densely populated geographic area. The definition is based on the concept of "a core area with a large population nucleus, plus adjacent communities having a high degree of economic and social integration with that core" (U.S. Census 2000). To qualify as an MSA, the city must have 50,000 or more inhabitants. The central counties of the MSA are those that contain the largest city (also known as 'principal city') and the surrounding densely settled territory. In general, most of the population growth in MSAs takes place in the suburban counties. An MSA is characterized by a downtown, residential areas, industrial areas including shopping and leisure facilities, and by transportation systems. Today, 362 MSAs exist in the United States (see Map 4-1). With more than 18.3 million residents in 2000, the New York/Northern New Jersey/Long Island MSA is considered the largest in the country, followed by the Los Angeles/Long Beach/Santa Ana MSA with over 12.3 million residents and the Chicago/Naperville/Joliet MSA with nearly 9.1 million residents. With a population of 1.5 million in 2000, the Columbus MSA is considered the 31st most populous region in the nation (U.S. Census 2000, also see chapter 5).

[3] The physical separation between vehicular and non-motorized travel originated in Radburn, New Jersey, which is often referred to as the 'town for motor age.' The urban design was created in a way that "gives its inhabitants security and happiness" (Gatti 2008).

[4] As a reminder, a Metropolitan Planning Organization (MPO) is a regional planning entity responsible for transportation planning and approval of federal transportation funding for the region. An MPO is federally required for urban areas with a population of 50,000 or more.

Map 4-1: Metropolitan Statistical Areas of the United States

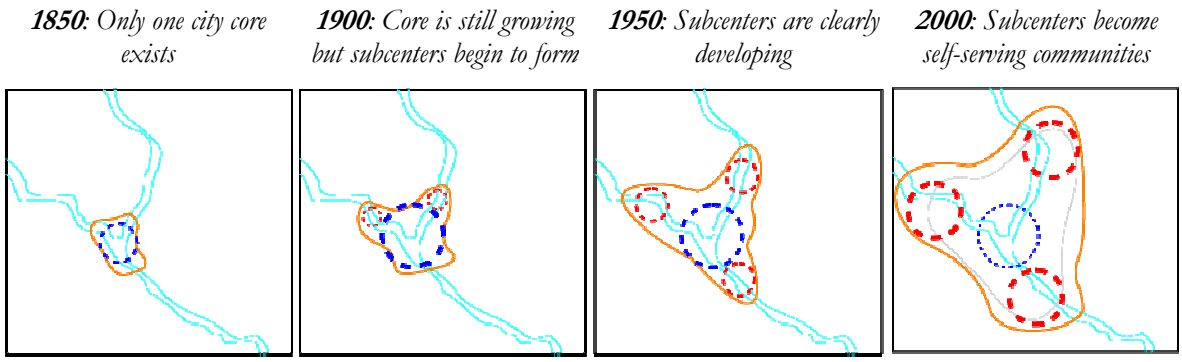


Source: MORPC, own design. Based on Census 2000 data.

The fast growing development of MSAs is demonstrated by the fact that from 1982 to 1997, the American population grew by 17 percent while at the same time urbanized land increased by 47 percent (Schiller 2004:28). Due to the large overspill of residents into suburban areas, smaller communities have grown to become their own cities which are often referred to as 'bedroom communities.' More specifically, between 1960 and 2000, the number of residents working in the suburbs grew by almost 20 percent, leading to an increasing decentralization of employment from the CBD to suburbs in major U.S. cities (McMillen 2004:225).

Research has shown that the monocentric city is being replaced by a new structure that is often referred to as polycentric (Malecki 2002:322, see Figure 4-3). The difference between a monocentric and polycentric urban structure is the number of activity centers versus the number of residential neighborhoods: Within a monocentric city all production activities take place in the CBD, and all workers commute to the CBD from the surrounding area. On the contrary, polycentric cities show a number of different residential and business districts within a defined geographic area so that the commute routes are not clearly evident (Mori 2006:1).

Figure 4-3: Development of suburban communities over time (conceptual design)

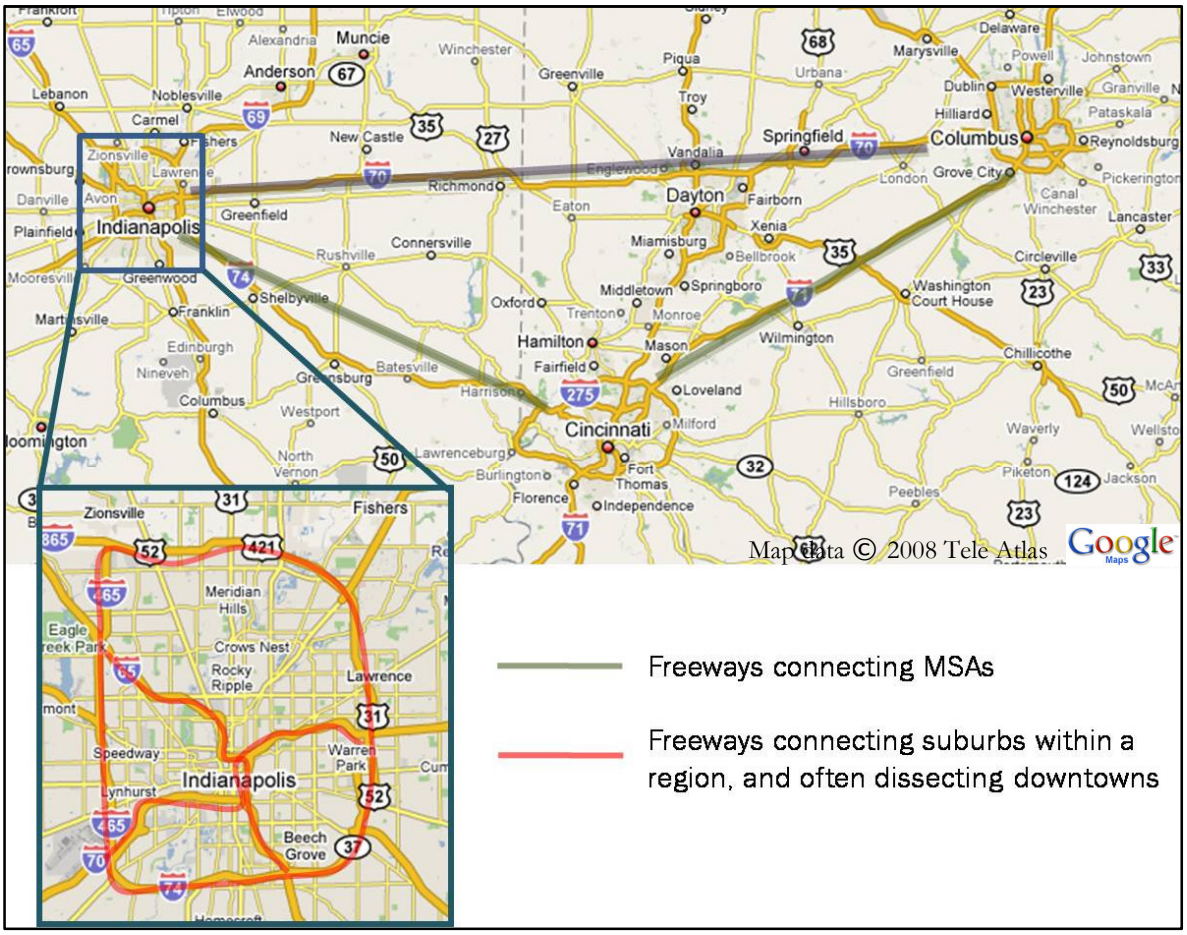


Source: Own design. Drawing: Dilip Karpoor.

While no city is purely monocentric or polycentric, many cities show dominance over one urban structure than the other. In general, the spatial structure of a monocentric city allows for higher densities near the center, shorter average trips, and more efficient public transportation planning. Polycentric cities benefit from cheaper land, making it easier for businesses to locate. From an environmental perspective, pollution in polycentric structures is less concentrated, although more pollutants are emitted due to longer trips (Bertraud 2007). A freeway network that not only connects the large urbanized regions with each other but also the communities within the MSA facilitates such polycentric development (Holzner 1985:192, Levy 2003:196, see Map 4-2).

The trend to 'polycentrification' is mainly believed to be the result of developments in transportation practices and technology that made it possible for people and goods to be transported more quickly and efficiently over larger distances (Schiller 2004:28). The construction of major road networks allowed cities to grow in population and expand in land area while the need for urban concentration decreased.

Map 4-2: Example of the U.S. freeway network between and within city regions



Source: Map data © 2008 Tele Atlas, Google Maps, own design.

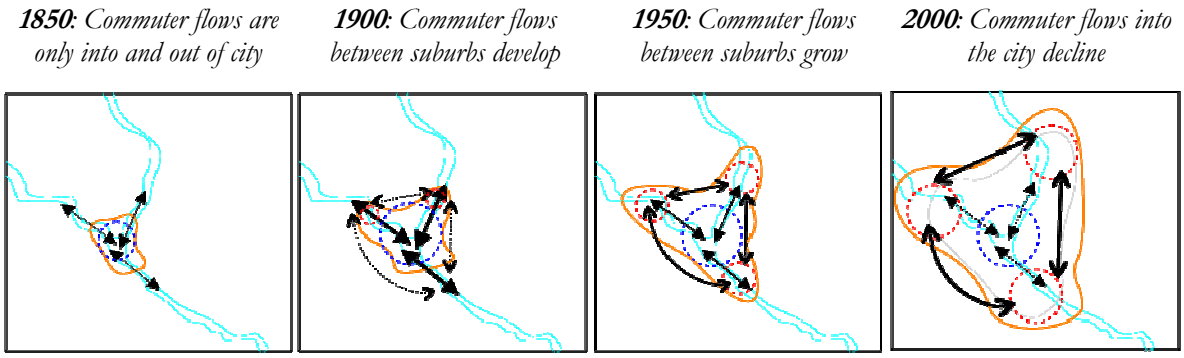
Although it is clear that the construction of freeways and the emerging transportation technologies were influential for the described urban development, the human behavioral side should not be left out of the discussion. Holzner (1985, 1994, 1996), for example, strongly believes that the values Americans carry about what defines an ideal lifestyle are pivotal for today's urban landscape. Ideals such as "love of newness", "desire to be near nature", "freedom to move", or "individualism" have resulted in a somewhat anti-urban mentality that views owning a home and a piece of land as a personal achievement and need for self-development (Holzner 1985:198ff). These societal and cultural trends must have played a great role in the urban landscape as it is today because without people's demand for individual housing units at affordable prices and the willingness to drive longer distances, the new suburban residential developments could not be filled as easily. Therefore, the degree to which people contributed to the development of American cities through their values and needs should not be underestimated.

4.1.2 Activity Subcenters

Regardless of whether urban areas have been planned for or not, the trend towards suburbanization has often resulted in a polycentric structure where several activity centers of similar design coexist. With such spatial dispersal and fragmentation of activity centers arise

new challenges. For example, traffic patterns change from having one gravitation point, the CBD, to now having several attraction points (see Figure 4-4). In order to account for these changes, many polycentric regions have incorporated the traditional elements of a monocentric city with those of a decentralized spatial form. Such assimilation can be achieved if decentralization takes a more concentrated form by developing so-called activity subcenters where a large percentage of jobs or shopping opportunities are offered within a small area (Bogart and Ferry 1999:2099). According to McMillen and Smith (2003:322), such subcenters are defined as areas "with significantly higher employment densities than surrounding areas […and …] should be large enough to have a significant effect on the overall spatial structure of the urban area, leading to local rises in population density, land prices, and perhaps housing prices."

Figure 4-4: Change in commuter flows over time (conceptual design)



Source: Own design. Drawing: Dilip Karpoor.

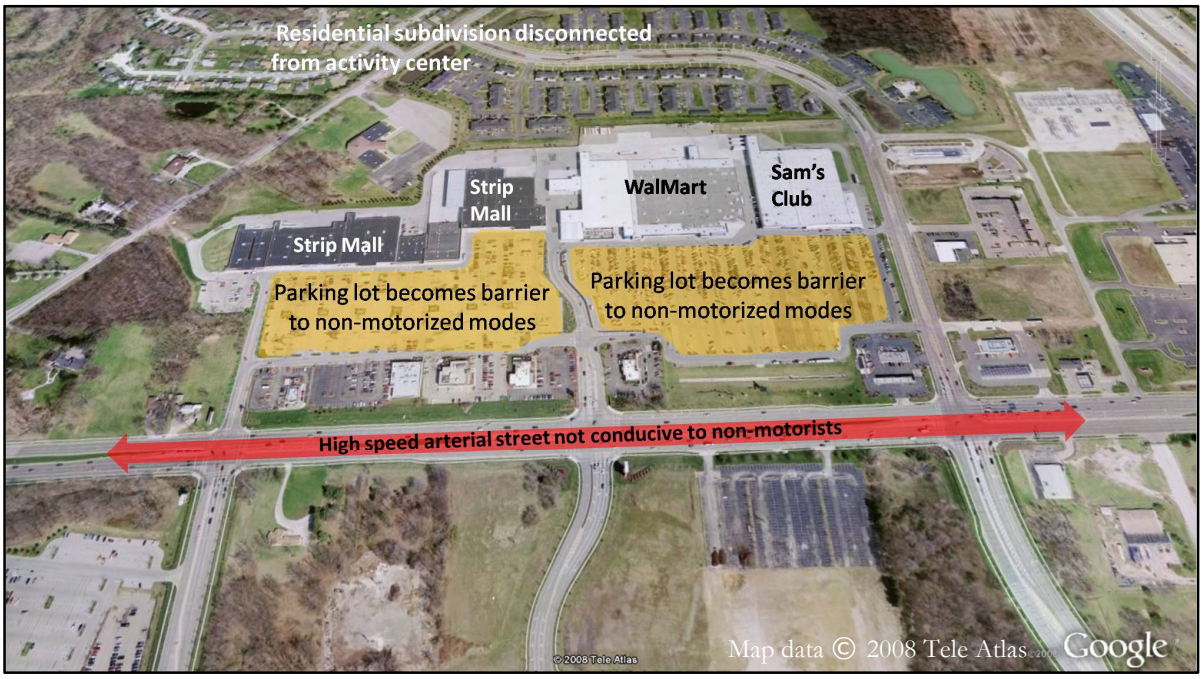
Employment subcenters, in particular, seem to originate from a phenomenon called edge cities, which refers to "major business districts that have developed as low-density agglomerations based on office parks, but include also the more standard higher-density, high-rise office districts" (Golledge and Stimson 1997:124). Edge cities are often seen as an area at the border of a region that combines all utilities necessary for living, such as housing, jobs, shopping, and recreation. Advantages of employment subcenters include the cost benefits of agglomeration economies, face-to-face communications, cheaper land, and efficient automobile transportation (McMillen 2001:17, McMillen and Smith 2003:321, Cervero 2001:1668). Companies in the suburbs are often located close to interstate highways and are subject to less overall congestion.

The dominant commuting pattern in such polycentric structured areas replaces the suburb to CBD pattern of monocentric cities with the suburb to suburb pattern (Golledge and Stimson 1997:133). In fact, in many MSAs the number of residents living in the suburbs and working in the core city has been declining since 1960 (U.S. Census 2000). In general, suburb to suburb commuter flows impede public transportation, unless commuter flows are clear so that bus or rail systems can be established along these routes to help with preventing more congestion and reducing travel costs (McMillen 2001:15ff).

Activity subcenters not only relate to office building agglomerations but also to large shopping malls, civic institutions, and residential neighborhoods (Duany et al 2000:4ff). Although the various subcenters are often built near residential agglomerations and are combined with a

variety of leisure functions, such as movie theatres or restaurants, they are disconnected from another. Its transportation infrastructure therefore greatly accommodates motorized vehicle travel but impedes safe pedestrian access (Duany et al 2000:24ff). Figure 4-5 exemplifies the physical separation of activity centers in an Ohioan suburban community.

Figure 4-5: Typical American store access in the suburbs: convenient only to motorized travelers



Source: Map data © 2008 Tele Atlas, Google Maps, own design.

The development of polycentric regions and activity subcenters with sufficient and free parking and cheaper land can result in a significant desolation of the CBD and a trend towards more crime and segregation in the downtown urban core that is now being neglected. Other negative consequences of dispersed growth patterns and increased travel distances are often described as 'social costs' and refer to the increase in transaction costs and disproportionate increase in air pollution and congestion. Furthermore, the low-density developments greatly support solo driving, and dispersed commuting patterns can hinder non-motorized and transit transportation. While any business is important for the economic growth of a region, actions to preserve and improve accessibility and life quality in core areas of a city need to go hand in hand with the stabilization and design of well-planned activity subcenters. Viewing polycentric cities as a group of smaller monocentric cities can help with the implementation of employer-based TDM concepts. However, from a regional perspective, urban and transportation planning efforts need to look at an MSA holistically so that the various activity centers within communities can easily be interconnected not only by highways but also through pedestrian, bikeway, and transit facilities. This multi-modal approach to transportation planning carries with it the underlying premise of critical densities which presumes the understanding of compact development. In this regard, the accessibility to a multi-modal transportation network plays an important role.

4.2 Transportation Planning Trends

How and where roadways are built and the degree to which transit services are funded often determine if car usage is either encouraged or discouraged. The following brief synopsis of the federal and state transportation planning regulations and efforts helps explain the high existence of solo driving in the United States. A short description of transportation funding decisions and TDM activities follow this overview.

Historically, the transportation planning decisions made in the United States clearly demonstrate the favoring of automobile services after World War II. Before then, transit and especially electric railway systems were well established with more than 1,000 rail companies transporting approximately 11 billion passengers by the end of World War I. After 1923 the motorbus became increasingly popular due to its lower capital costs and flexibility to change routes, causing a significant decrease in ridership of railway systems (Weiner 1997:6f). With the end of World War II, transportation planning became focused on automobile travel due to the growing demand for houses, particularly in suburban areas, and the high demand for personal vehicles. The G.I. Bill[5] of 1944 greatly supported this movement by subsidizing housing for World War II veterans who wanted to live away from the city (U.S. Department of Veterans Affairs 2008). The production of automobiles increased from only 70,000 in 1945 to 2.1 million in 1946 and to 3.5 million in 1947. At the same time, the usage of public transportation systems declined just as fast as it had increased during the war. During the post-war time, federal assistance for planning and construction projects for both rail and bus lines was unavailable, and federal interest in transit dwindled. Moreover, when transit ridership decreased, financial problems for transit providers increased, which prohibited the rehabilitation of facilities and equipment. "In some urban areas, transit authorities were created to take over and operate the transit system" (Weiner 1997:14).

Starting in the 1950s, as a result of the strong focus on automobiles, highway congestion was considered the primary urban transportation issue by elected officials and the public. National and state agencies mainly dealt with the problem by expanding arterial streets and constructing expressways and parkways. Roadways were considered a public good "that should be built and maintained by the government to serve the most "democratic" of transportation choices – the automobile" (Pucher 1998:1). Needless to say that the Automobile Manufacturers Association strongly supported the construction of highways within cities.

The Interstate Highway Act passed by Congress in 1956 allowed the "largest public works project in the history of the country. The act authorized 40,650 mi (later expanded to 42,796 mi) of Interstate and National Defense Highways to be built by 1972 and provided $24.8 billion in funds for the period from 1957 to 1960" (Pucher 1998:1). At the same time, the passing of the Highway Trust Fund authorized that all federal taxes received through gasoline or other vehicle-related purchases would go to the construction and maintenance of highways

[5] The Service members' Readjustment Act of 1944, commonly known as the G.I. Bill of Rights, was signed into law by President Franklin Roosevelt on June 22, 1944. The G.I. Bill provided for an education and training program as well as for home loans available to all World War II veterans (U.S. Department of Veterans Affairs 2008).

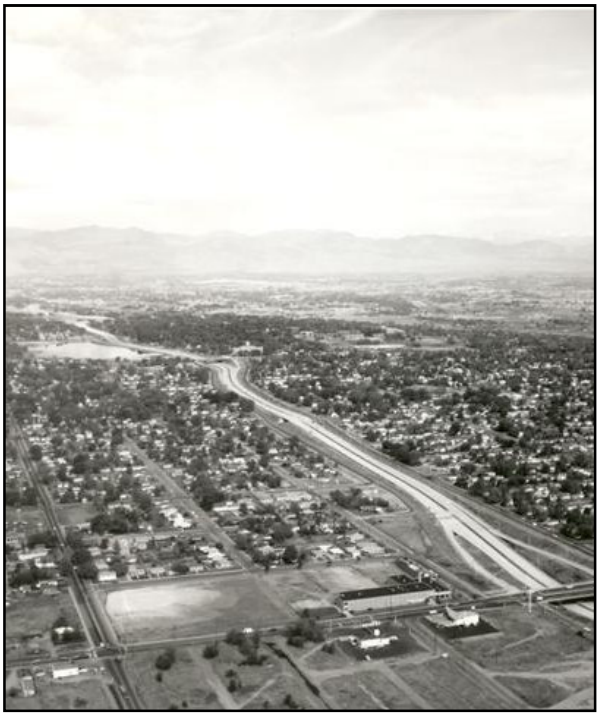
(Pucher 1998:1). In 1962, the Federal-Aid Highway Act was approved and provided 90 percent federal funding for Interstate highway projects (Weiner 1997:1). The interstates were generally laid out as a national plan, but the exact locations were worked out with the states (Lawler 2007). The strong focus on highway expansion resulted in an obvious decline of the public transit network while the new and widened facilities quickly became congested again.

In the 1960s and 1970s congestion remained a problem. However, issues related to the decline of public transportation, the building of freeways through cities, and automobile safety were also noticed. Since the extensive highway construction started to interfere with urban development, activism increased about the social and economic development of the cities and their downtowns (Pucher 1998:2). Figure 4-6 exemplifies how the construction of interstates often dissected cities. This dissection is associated with many negative effects, such as tearing apart neighborhoods, encouraging social segregation, and dislocating the affected populations.

Figure 4-6: The construction of interstates dissecting neighborhoods

Interstate 71 in Columbus, Ohio (1963)

Interstate 70 in Denver, Colorado (1966)



Sources: Photohio 2008 and Colorado DOT 2008.

Starting in the mid 1960s, the public protested against the use of the large amounts of land that were needed to build major roadways. They wanted to protect existing urban communities from destruction. The public outcry effectively led to the revision of the national transportation bill (STPP 2006:4). The rising awareness for the environment, such as growing noise levels, the reduction in green space, and increasing air pollution, was eventually a key factor in changing transportation planning regulations. In 1969, the National Environmental Policy Act passed and made it mandatory for federally funded projects to develop

environmental impact statements. The EPA[6] then established the CAAA of 1970 which required states to write state implementation plans (SIPs) for non-attainment areas. Non-attainment areas are geographies that show pollutant levels higher than the level allowed by federal standards (Pucher 1998:2, Weiner 1997:47f). Unfortunately, planning agencies were often not involved in developing these transportation plans since the preparation, submission, and review of the SIPs took place outside the traditional urban transportation planning process (Weiner 1997:49).

In 1977, the CAAAs required state and local governments to revise their SIPs for all non-attained areas. Sanctions for not submitting an SIP, or the EPA disapproving the SIP, would include discontinued federal-aid for highways. Often, states with revised SIPs had to develop so-called transportation control plans that included strategies to reduce emissions (Weiner 1997:82). The sanctions were expanded in the CAAAs of 1990. As a result, transportation planners were now challenged to act on the requirements of improving air quality while providing urban mobility (Weiner 1997:138f).

Increasing funding opportunities for public transportation projects

While the passing of the Urban Mass Transportation Act (UMTA) in 1964 was considered the "first real effort to provide federal assistance for urban mass transportation", only $150 million per year were approved to go towards public transportation, which was not enough to carry out this legislation (Weiner 1997:30). However, the act helped in making the public ownership of transit systems more popular, which resulted in state and local governments requiring funding to continue and expand service. The mobility of people who did not or could not own cars became more significant within an environment of growing automobile use (Pucher 1998:2).

The Urban Mass Transportation Assistance Act (UMTAA) of 1970 presented the first serious long-term commitment of federal funds. With $3.1 billion, the act enabled the financing of public transportation beginning in 1971. In addition, the Federal-Aid Highway Act of 1973 made it possible to use highway funds for urban transit projects. These projects were authorized to be substituted for interstate highway projects if the interstate highway projects were not considered essential for the system. Furthermore, in 1974, the National Mass Transportation Assistance Act allowed the use of federal money for transit operating assistance for the first time (Weiner 1997:55ff). In 1976, the rules for interstate and highway funding continued to become more flexible and could be used for transit projects as well (Pucher 1998:2).

In 1991, the transportation bill ISTEA was passed which required a stronger involvement of people working at all levels of government as well as the consideration of all transportation modes in urban development (Pucher 1998:3f). The two following bills sustained and extended these fundamental changes: TEA-21 and SAFETEA-LU (STPP 2006:5). ISTEA also realized another block program called the Surface Transportation Program (STP). This program enabled funding for a wide array of highway, transit, safety, and environmental purposes. The STP funds were allocated as follows: ten percent for safety programs, ten percent for the

[6] For more information about the history of the Environmental Protection Agency (EPA), refer to Lewis 1985.

Transportation Enhancement Program (TEP), such as bicycle and pedestrian facilities, and 80 percent for statewide distribution for general purposes. A total of $23.9 billion was authorized over a period of six years (Weiner 1997:142ff, Fielding 1995:300). Unfortunately, most states and MSAs continue to spend the majority of the STP funds on highway projects. More about today's transit funding sources is described in section 4.2.1.

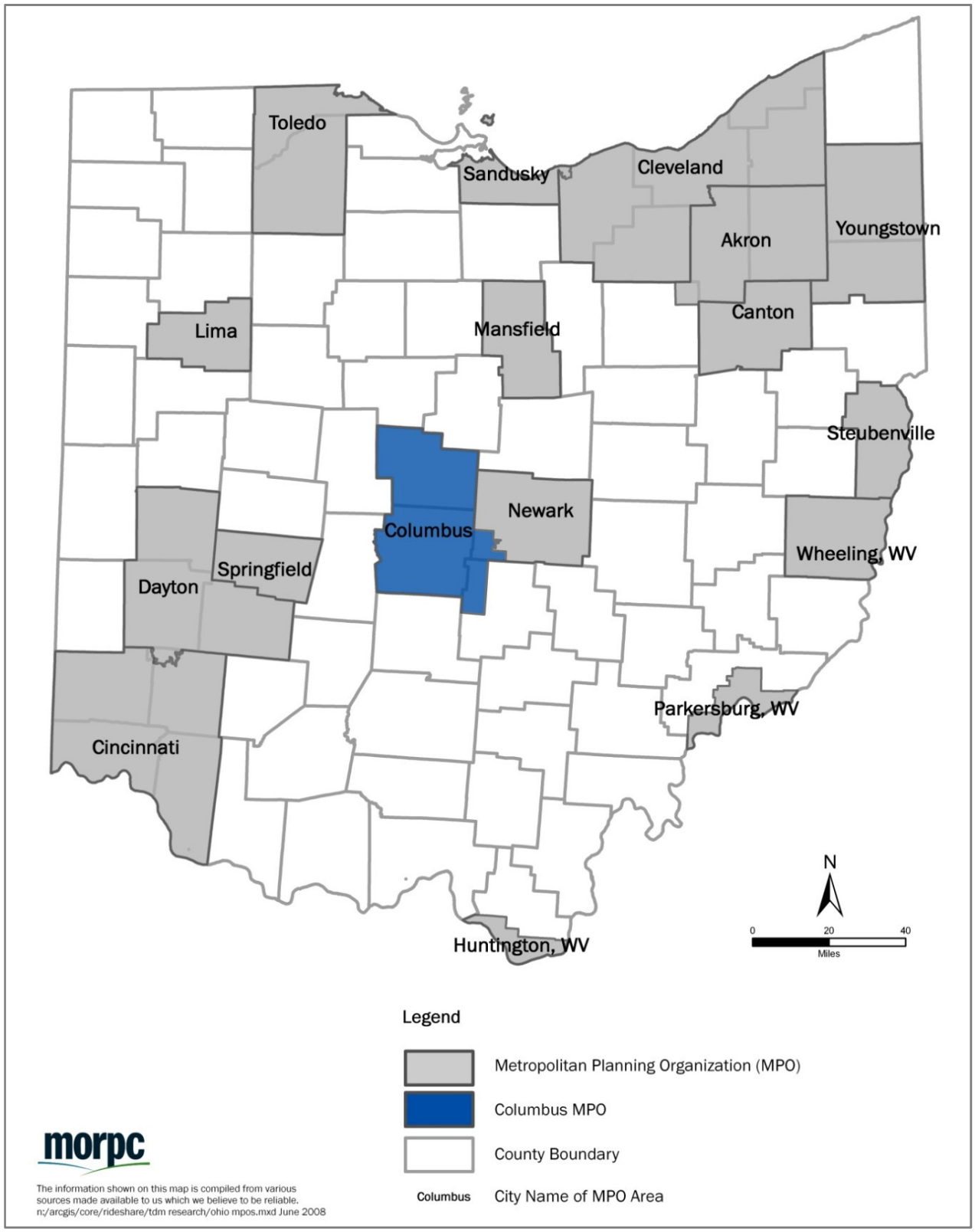
Establishment of state and metropolitan transportation planning organizations

Traditionally, transportation policy decisions were made from the top down, putting federal and state officials in charge of decisions regarding where to build what type of transportation infrastructure. Environmental or other constraints were rarely considered, and much of the focus was placed on the construction of the interstate system. The U.S. Department of Transportation (DOT)[7] was established in 1966 "to coordinate transportation programs and to facilitate development and improvement of coordinated transportation services utilizing private enterprise to the maximum extent feasible. The Department of Transportation Act declared that the country required fast, safe, efficient, and convenient transportation at the lowest cost consistent with other national objectives including the conservation of natural resources" (Weiner 1997:35). Each state was assigned its own DOT responsible for transportation planning and funding within their geographic area. "As the number of federal programs addressing urban issues expanded to include urban interstate highways, transit projects, urban renewal, and model cities, the federal government saw a need for coordination at the metropolitan level to avoid duplication of effort or contradictory programs. The federal government promoted regional cooperative efforts such as establishing a clearinghouse for federal grants and metropolitan planning organizations for transportation planning" (Pucher 1998:3). The state of Ohio, for example, has a total of 17 MPOs (see Map 4-3).

Today, states, and to a lesser degree the MPOs, are authorized to provide funding for planning, programming, and roadway construction, maintenance, and operations projects. In general, state transportation departments, transit agencies, and the MPOs are the key players in transportation planning. Counties and cities in rural areas conduct their transportation planning with the appropriate regional planning organization. The two major planning documents are the long-range transportation plans produced by the MPOs and the multi-year capital programs, the so-called transportation improvement program, produced by both the MPO using four-year projections and the state using 20-year projections. The documents are supported by other studies and planning efforts, such as freight activities, safety research, or corridor studies. These studies play an important role in determining the type of projects being built and the amount of investment in each. Since many of the transportation projects are funded through tax dollars, it is important to get the residents' support, making public involvement a critical component of this planning process (STPP 2006:9ff). Therefore, public participation is now part of the entire planning process.

[7] Agencies under the U.S. DOT today are as follows: Office of the Secretary of Transportation, Federal Aviation Administration, Federal Highway Administration, Federal Motor Carrier Safety Administration, Federal Railroad Administration, Federal Transit Administration, Maritime Administration, National Highway Traffic Safety Administration, Office of the Inspector General, Pipeline and Hazardous Materials Safety Administration, Research and Innovative Technology Administration, Saint Lawrence Seaway Development Corporation, and Surface Transportation Board (U.S. DOT 2007).

Map 4-3: Metropolitan Planning Organizations in Ohio by geographical boundaries



The boundaries of MPOs are partly statutory and partly political and can extend over state boundaries. Essentially, it is the urban area as defined by the last census plus the area expected to urbanize in the 20-year horizon. MPOs can be as large as the entire MSA, if all surrounding jurisdictions were interested in becoming a member (Lawler 2007).

Source: MORPC, own design. Based on Census 2000, ODOT, and MORPC data.

4.2.1 Transportation Funding Today

The amount of funding allocated per transportation project greatly determines today's transportation infrastructure. In the United States, about one fourth of all governmental spending is reserved to go towards highway and transit projects. The formulas for federal funding depend upon the type of funding. The criteria used to distribute federal dollars can be based on population, on the number of road miles of a particular functional classification, on population in air quality non-attainment areas, or on transit availability (Lawler 2007). In fiscal year 2006, $29 billion were given to the states as so-called core highway dollars. The core federal highway programs include the following: Bridge, CMAQ, Equity Bonus, Highway Safety Improvement Program, Interstate Maintenance, National Highway System, and STP (STPP 2006:34). Federal law allows the states to spend the funds flexibly, where "at least 60 percent of each core highway dollar can be used for any project eligible under the law. In some cases, more than three of four highway dollars could be shifted to transit investment" but most likely they are not (STPP 2006:32). Independent of who owns the roads, all federal money is delivered to the states who then determine the amount given to regional and local stakeholders. Typically, each state gets a minimum of 0.5 percent and the remaining share is dependent on the mentioned criteria, existing earmarks, or competitive programs. Additional formulas are in place to ensure that states do not get below a certain minimum of their share. Congress requires that a certain amount of STP funds is sub-allocated to MPOs with an urban population over 200,000. Any money over and above the required amount is at the discretion of the state DOT. Many of the formulas are historical and not formalized in written policy. The MPOs as well as the county engineers decide how much funding is given to each of their members (Lawler 2007).

There are a variety of additional funding sources which are used to finance transportation projects. These sources include the federal gas tax (18.4 cents per gallon), the state gas tax (in Ohio: 28 cents per gallon), vehicle registration and license fees, and state bond sales. Local governments also collect property and income taxes in addition to license fees. Income from these taxes is generally used for operations and capital improvements. In 2006, the state gas tax in Ohio, for example, was distributed as follows: 70 percent of the tax dollars went to the state, 13 percent to municipalities, 11 percent to counties, and six percent to townships (ODOT 2007).

In respect to regional transportation funding, the local MPOs in Ohio have three funding sources available to support transportation projects: STP, TEP, and CMAQ. The STP federal funds attributable to the central Ohio MPO, for example, are based on the population in the Columbus and Delaware urbanized areas. No funds are attributable to the MPO based on the population in the planning area that is outside the U.S. Census Bureau defined urbanized areas. Consequently, as long as there are unmet needs inside the urbanized areas, the local MPO will allocate funds for projects only within the adjusted urbanized area boundaries. Exceptions include studies that are regionally significant and projects, such as ridesharing, which reduce travel in the urban area and utilize CMAQ dollars (Lawler 2007).

In regard to transit funding, approximately $5 billion were given to transit agencies in fiscal year 2006 as formula grant funds. Formula grant programs are non-competitive awards based

on a predetermined formula. The amount of formula grants per agency is based on service, including ridership and fleet size (STPP 2006:35f). The majority of capital funding comes from a combination of federal and state grants, often through the Federal Transit Administration (FTA) (McCann 2008). "For urbanized areas with 200,000 population and over, funds are apportioned and flow directly to a designated recipient selected locally to apply for and receive Federal funds" (FTA 2008). Neither in Ohio nor in Franklin County are state gas tax dollars utilized to fund transit operation (MORPC 2004:4ff). The local Columbus transit authority's operation expenses are primarily financed through current ticket sales, bond interest, and selling advertisement space. With the exception of the Job Access and Reverse Commute program and the New Freedom grants, federal grants are not used for operational purposes (McCann 2008).

At times, the local transit authority will ask the public to vote for a small income tax increase (e.g. 0.25 percent) that would go towards a specific project, such as increasing service or implementing a light rail. Such dependency on ticket sales and public willingness to pay more taxes illustrates the transit agency's reliance on customer demand. Unfortunately, this financial constraint often results in a vicious cycle: If only limited funding is available to operate the system, the service is low and therefore its ridership. With insufficient service, transit is now not seen as a viable transportation alternative and citizens will be less likely to vote for a tax increase.

Alternatively to the complex public funding mechanisms, private funding sources are virtually non-existent in the United States. While private businesses and developers are often asked to pay for certain aspects of the transportation infrastructure which are directly related to their developments, such as traffic lights or turn lanes, they are not made financially responsible for any roadway construction project related to the anticipated growth of the area. Instead of making developers and employers responsible for paying private dollars to municipal transportation projects, they could, at a minimum, be encouraged through TDM to provide incentives to reduce automobile usage and increase the use of alternative modes of transportation.

4.2.2 Transportation Demand Management as a Planning Factor?

TDM strategies have a long history in the United States, but mainly as a reactionary solution to transportation-related problems. For example, the embargo of oil shipments to the United States by the Organization of Petroleum Exporting Countries in 1973 had a great impact on transportation planning. Since oil was so important to the economy and particularly the transportation sector, the shortages of oil and the increase in price steadily resulted in a major problem for transportation planning because much of the construction costs were dependent on gas prices (Weiner 1997:67). In order to reduce gasoline consumption, the Emergency Highway Energy Conservation Act in 1974 implemented a national 55 miles per hour speed limit which was prolonged in 1975. The act also allowed federal-aid highway funds to be used for carpooling demonstration programs. But it was not until the fuel shortage and rising gas prices of the second crisis in 1979 that urban transportation planners integrated energy issues into their projects (Weiner 1997:67f,88f). Also in 1979, the U.S. DOT established a national

ridesharing demonstration program with the goal to increase ridesharing by five percent. Projects at 17 sites totaling $3.5 billion were funded by this program. Projects included P&R facilities, vanpooling, regional and employer-based marketing, and flexible working schedules (Weiner 1997:94). Many employers started to become more involved in commuting issues after the two energy crises and because of the increasing traffic congestion. In the early 1980s, Transportation Management Associations (TMAs) were formed by businesses, developers, and local employers to collectively deal with transportation issues. TMAs are non-profit organizations that provide transportation services in a particular area. They are generally public-private partnerships and consist primarily of area businesses with local government support. Among the functions of such TMAs are the management of carpooling programs, administration of parking management strategies, contracting for bus service subscriptions, organization of flexible work hour programs, administration of local traffic flow improvements, and technical assistance and education (Weiner 1997:111).

In 1987, the American Association of State Highway and Transportation Officials established a task force to focus on the Transportation 2020 Census. Its objectives were to evaluate the U.S. surface transportation requirements until 2020 to find possibilities on meeting these requirements at all government levels and to reach an agreement on how to meet these requirements (Weiner 1997:126f). In response to the severe traffic conditions in the 1980s and 1990s, more strategies to reduce congestion were created under the category of TDM. Such strategies included carpooling, vanpooling, telecommuting (working from home), or compressed work weeks (working four ten-hour days). Its goal was to reduce peak travel by changing travel routes, travel modes, or travel times. Most often, TDM was "focused on a suburban activity center but was also used for CBDs and radial corridors" (Weiner 1997:114).

As mentioned in section 1.2.1, a few states, such as California, Washington, and Oregon, have passed CTR laws that are active today. These laws require all state agencies as well as businesses with 100 or more employees in very populated areas to develop commuter programs with the goal to reduce the number of vehicle trips traveled (Winters and Zhou 2007:3f).

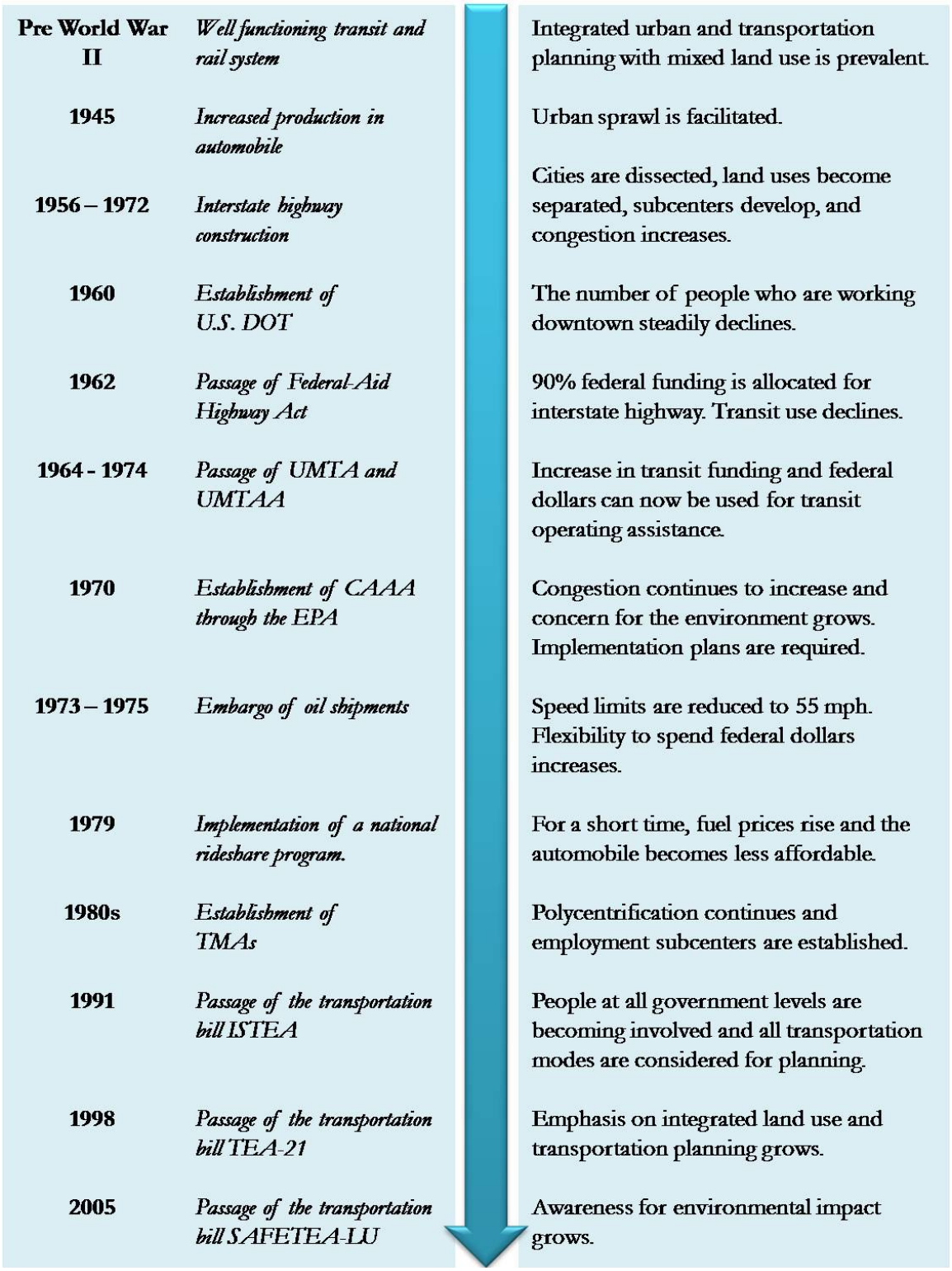
Due to the need for environmental consideration in the planning process, integrated intermodal transportation planning is now slowly becoming an important element of most long-range transportation plans (see SAFETEA-LU). With CMAQ funding available to finance programs that reduce the amount of emissions in the air, TDM will be a logical strategy and component of transportation planning. On a regional level, many MPOs already have programs in place that assist local governments and businesses in implementing TDM strategies.

4.3 The Impact of Land Use and Transportation Planning on Journey to Work Trends

The previous sections demonstrated that, in contrary to the urban planning process, transportation planning was and still is strongly guided by the federal and state governments, especially via the allocation of funding and through the requirement of regional state

transportation plans. It is clear that transportation planning has often been conducted in an isolated manner and not in cooperation with land use planning. It was not until the 1970s that regional organizations were established who made the link between land use and transportation planning.

Figure 4-7: Milestones in the U.S. land use and transportation planning history in urbanized areas



Source: Own summary and design.

Factors such as rapid (urban) population growth, a significant increase in car ownership (partly due to a high boost in real income), increased population movement to suburban areas, and a growing federal involvement in requiring comprehensive urban planning contributed to the development of urban and transportation planning (Pas 1995:54). Figure 4-7 highlights the milestones of the land and transportation development processes.

While the construction of interstates was the primary focus of transportation planning in the United States until the 1970s, other countries, such as Germany or Canada, made more complex decisions regarding transportation investments and land use. Even though car use has also increased in those particular countries and public transportation usage has declined since the mid 1960s, public transportation has remained competitive due to different societal perceptions and attitudes. The governments of these countries view public transportation as a social service and therefore a necessary component of the transportation system. In addition, federal assistance is higher than in the United States (Fielding 1995:298).

Part of Germany's success, for example, are public policies which have put great restrictions on automobile use and made the owning and usage of a car far less convenient and significantly more expensive than in the United States. These policies include traffic calming measures, car-free pedestrian zones, strict parking restrictions in areas within close proximity to the city, right-of-way priorities for public transportation and non-motorized vehicles, strictly enforced laws to regulate travel behavior (such as vehicle inspections, license requirements, or urban speed limits), taxes on automobile ownership and use (such as fuel taxes), and the construction and support of bicycle and pedestrian paths. Policies also support the financing of a more balanced transportation system where approximately 60 percent of federal funding for urban transportation goes to public transit and 40 percent to roadways (Pucher 1998:46ff). In addition, interstate highways were rarely built through a city, therefore keeping the core of a town intact. Motor vehicle taxes and commuter tax relief programs incentivizing transit usage resulted in much lower car use for the more than 30 million Germans who regularly commute to work compared to American commuters (Breiholz et al 2004:57).

Table 4-1: Percentage of workers by modes of transportation, Germany

Mode of transportation to work	1996	2002	2004
Driving the car	60%	66%	64%
Riding in a car	4%	5%	3%
Public transportation	14%	11%	13%
Biking / Walking	19%	17%	18%
Other means	3%	1%	2%
Total	**100%**	**100%**	**100%**

Source: Based on Breiholz et al 2004:57 and Statistisches Bundesamt Deutschland 2007, own design.

Even though car usage has increased slightly since 1996 and suburbanization trends are present, both public transportation and non-motorized transportation usage have only declined about one percent each (see Table 4-1). In general, the car becomes more attractive the further an employee lives from work. In Germany, for travel distances of more than ten kilometers, 80

percent of employees use their car to drive to work. One third of workers who live within ten kilometers to work choose their bike to commute (Statistisches Bundesamt Deutschland 2007).

These statistics differ from American commute statistics. In the United States, smaller households, a growing female workforce, and increased suburbanization with high accessibility to high-speed arterials, among other factors, have led to an increase in vehicle ownership per person as well as to a growing use of private vehicles as the primary mode of transportation to work. The U.S. Census shows that three-quarters of all American workers today drive alone to work. With the exception of telecommuting, all other means of travel have experienced a decline since 1980 (Table 4-2).

Table 4-2: Percentage of workers by modes of transportation, United States

Mode of transportation to work	1980	1990	2000
Driving alone	64.4%	73.2%	75.7%
Carpooling /Sharing a Ride	19.7%	13.4%	12.2%
Public transportation	6.4%	5.3%	4.7%
Walking	5.6%	3.9%	2.9%
Other means	1.6%	1.3%	1.2%
Telecommuting/Working from home	2.3%	3.0%	3.3%
Total	**100%**	**100%**	**100%**

Source: Based on McGuckin and Srinivasan 2004:1-18, own design.

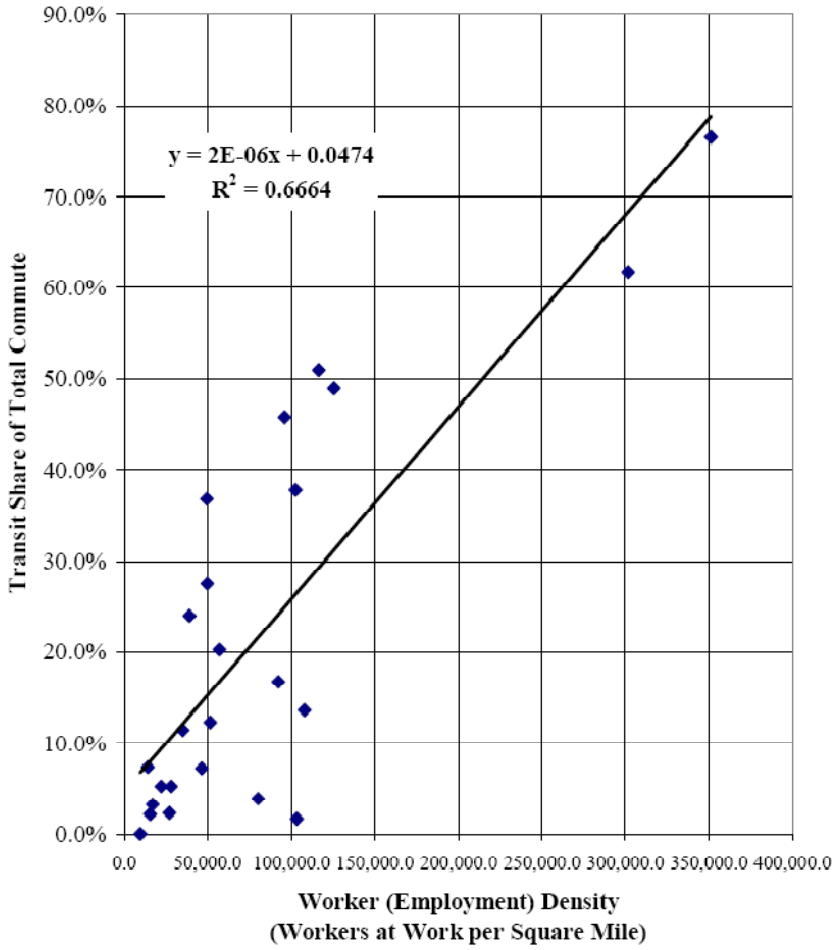
As public transportation continues to fight the difficult task of competing for public resources in an automobile dominated environment and society, transit use will remain low (Wachs 1995:272). Today, transit use is concentrated in the largest U.S. cities. Although all metropolitan areas, most small cities, and many rural areas have some form of public transit, 90 percent of all transit use occurs in urbanized areas that have more than one million residents. The eastern seaboard from Boston to Washington, D.C. accounts for 54 percent of transit use in the United States and has therefore the largest concentration. Chicago is the next largest with 9.6 percent (Fielding 1995:288). In general, transit as well as non-motorized travel is facilitated in areas with high population densities and a mix of residential and entertainment locations. Figure 4-8 illustrates how transit usage increases with employment density.

Along with the spatial development of cities and accessibility to certain modes of transportation, the characteristics of workers and the location of jobs influence the pattern of commutes. Due to the integration of the CTPP[8] into the decennial census, the United States has access to fairly accurate commute statistics. Questions in the CTPP include means of transportation, departure times to work or school, overall commute travel times, and availability of vehicles per household. This data and other local information sources, including

[8] The decennial census in the United States has a long history on demographic data collection and was first taken in 1790. But it was not until the late 1950s that travel information questions were integrated into the survey. The Federal Highway Administration (FHWA) showed increased interest in urban transportation planning data and funded the Bureau of Census to develop tabulations that would assist in transportation studies (FHWA 2007, Weiner 1997:52).

traffic counts, transit ridership, crash data, or availability of sidewalk and bikeway facilities, assist researchers and urban and transportation planners in better decision-making.

Figure 4-8: Transit commute share versus work density in the United States



Source: TRB Subcommittee ABJ30(1) 2005.

4.4 Conclusions

Referring back to Figure 4-2 at the beginning of this chapter, the previous sections provided a brief overview of how the national and state governments, through urban and transportation policies, impacted the spatial landscape of the United States as it looks today. The chapter also demonstrated how those policies influenced the decision of where businesses would locate.

As illustrated, most American cities were developed along a transportation network that was highly focused on automobile travel; highway systems encouraged car travel by offering wide roadway lanes and high-speed arterials. Little to no restrictions on automobile usage make this mode of transportation very affordable. Limited federal and state regulations on land use planning facilitated the suburbanization process and, along with it, the separation between different types of land uses. The separation then led to so-called activity subcenters. These subcenters provide vast areas of free parking and storefronts that are often not connected to sidewalks. Residential areas are built as separate entities, nearly impeding non-motorized travel to worksites or grocery stores. Under the common phrase 'convenience', most errands can be

completed without ever leaving the car: Drive-in restaurants, banks, pharmacies, and even small grocery markets allow customers to remain in the car and order the product via a street side window.

All these factors have greatly impacted today's modal split in favor of the automobile and led to a number of negative consequences. Besides the previously mentioned increase in traffic congestion and reduced air quality levels, the high accessibility and affordability of cars also impacts the health of many Americans. Over the last 20 years, obesity levels have increased dramatically. According to the Centers for Disease Control and Prevention (CDC), 22 U.S. states had a prevalence of obesity of at least 25 percent, while only four states showed a prevalence of obesity less than 20 percent (CDC 2008). The term obesity is defined as having a Body Mass Index of 30 or higher. While this paper does not elaborate on the health issue related to low physical activity, it certainly should be a strong concern at the national level.

In addition to the negative effects of excessive car travel on the transportation system, the environment, and personal well-being, urban sprawl has also changed the predominant commute pattern from suburb to CBD to suburb to suburb. Many employers have left the CBDs and moved to the outskirts of the cities where land prices are cheaper and congestion is less. As a result, many cities are struggling to keep the downtown area an attractive business environment, and transit agencies that traditionally serviced towards the core of the city are losing ridership. Establishing public-private partnerships for transportation services is now more important than ever in order to revitalize downtown districts. Studying commute behavior to either a remote or a CBD worksite is essential in better understanding mode choice and determining the type of strategies needed to reduce motorized car travel to work.

The state and regional planning organizations are probably best equipped to coordinate planning efforts towards sustainable transportation and TDM policies. Table 4-3 summarizes the different funding sources available to the various players to implement transportation services that reduce SOV travel.

Table 4-3: Transportation services by implementing agency and funding source

Agencies	Transportation Services	Possible Funding Sources
State government	HOV lanes	CMAQ, STP, tolls
Local government	Bikeways Sidewalks	STP, TEP, CMAQ
Transportation provider	Bus service Rideshare program Rail service	CMAQ, STP, Gas tax, Sales tax increase
Coordinated efforts	Traveler Information System	STP, CMAQ, Private sector, Local government funds

Source: Own summary and design.

With ISTEA and now SAFETEA-LU, the United States is trying to implement a policy similar to Germany and Canada where a "National Intermodal Transportation System [is developed] that is economically efficient and environmentally sound, provides the foundation for the

Nation to compete in the global economy, and will move people and goods in an energy-efficient manner" (Hanson 1995:22). In general, plans should provide for the development and integrated management and operation of transportation systems and facilities so that they can function as an intermodal transportation system for the metropolitan planning area or state. Unfortunately, many cities still have not yet made the shift from a primarily highway-oriented planning focus to a fully mode-integrated infrastructure long-range plan. This imbalance of available transportation facilities for motorists compared to non-motorists emphasizes the need to implement short- or mid-term measures to provide alternative solutions for residents who cannot or do not want to be solely reliant on the automobile. One way to address this issue is through employer-oriented TDM which is the focus of the presented paper.

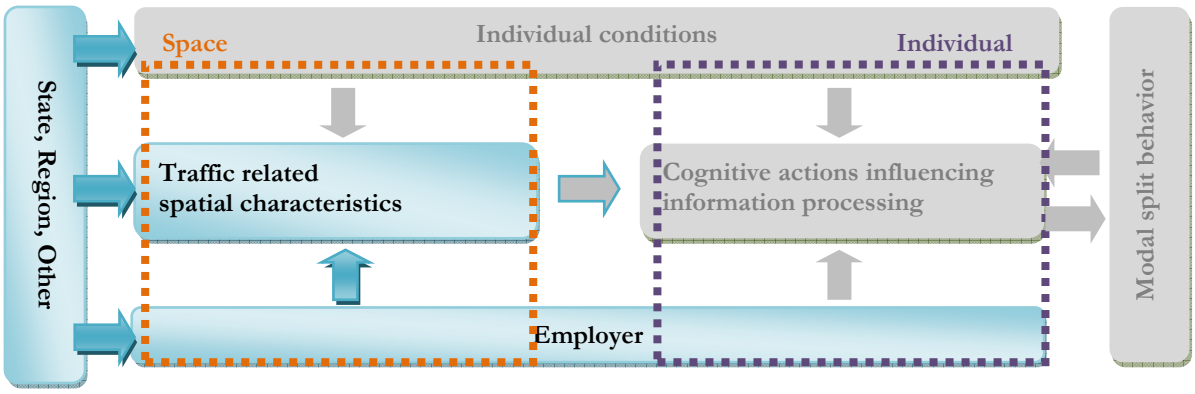
"A certain level of transportation should be considered as a basic right, because in our society transportation is almost always essential for access to those services and activities that are required for human fulfillment." - Waller 1997:7

5 Study Site and Research Object

While chapters 1 through 4 laid the foundation and basic framework for the conducted research and placed it in the context of the United States, the following chapters detail the study area, elucidate the survey process, and provide the research results. Chapter 4 in particular alluded to how many American cities developed and how transportation planning was, and often still is, focused on highway construction. The city of Columbus, Ohio, was selected as the research site because it exemplifies this development. A pattern of strong suburbanization, a degrading CBD, and the development of a polycentric region also holds true for the Columbus MSA. The city's layout greatly assimilates the urban structure of many American cities, as illustrated in Figure 4-1. In addition to the spatial structure, Columbus has long been considered to be a 'typical' American city due to its demographics, which include a mix of races and a wide range of incomes, and its urban, suburban, and nearby rural areas. It is therefore often used as a test market for new products (Zing Real Estate 2008).

According to the 2000 Census, Columbus is ranked as the 31st most populated MSA in the United States with more than 80 percent of the population commuting alone to work. Although an established bus system exists for the city of Columbus, most every bus line leads towards downtown, not addressing the recent development of suburban employment centers. An abundant roadway network is responsible for the city not yet suffering the high congestion levels of other cities of its size, although the number of 'bad' air quality days is growing.

Figure 5-1: Research focus on spatial and employer characteristics of research site



Source: Based on Figure 1-2, own design.

As Figure 1-1 shows, the spatial components of a region are influenced primarily through four players: 1) the federal, state, and local agencies that determine the urban infrastructure and transportation network, 2) the organizations that provide transportation services, 3) the private businesses that generate most of the traffic, and 4) the individuals who travel the system and choose their residence, work location, and travel modes. Chapter 5 describes the urban landscape and transportation system for the study site and relates it to the different players and their impact on mode choice. It focuses on the researched employer and the external characteristics that need to be incorporated in any TDM effort (see Figure 5-1).

5.1 Urban Development of Columbus, Ohio

The city of Columbus was founded in 1812 and has been the state capitol of Ohio since 1816. With a population of 711,470 in 2000, the city holds more than six percent of all 11.5 million residents in Ohio. Columbus is centrally located in Ohio and primarily encompassed by Franklin County. The six surrounding counties are (from North clockwise) Delaware, Licking, Fairfield, Pickaway, Madison, and Union (see Map 5-1). Together, they are referred to as the Columbus MSA.

In general, Columbus shows strong signs of suburbanization as the six surrounding counties are growing at a faster pace than Franklin County (U.S. Census 2000). Low-density housing districts at the border of existing urbanized areas are most attractive to the growing population (MORPC et al 2004:2.1). In fact, "the counties outside of Franklin County have been urbanizing at a rate 1.5 times faster than expected from the amount of urban population growth. Forty percent of new houses are being built outside of Franklin County. Central Ohio has one of the highest per capita land consumption rates in the state. […] Employment opportunities in the suburban communities are competing against downtown. There has been a shift of jobs and commerce away from the downtown. […] Office costs in downtown Columbus are 30 percent higher on average than in an upscale suburban development" (MORPC et al 2004:1.5f).

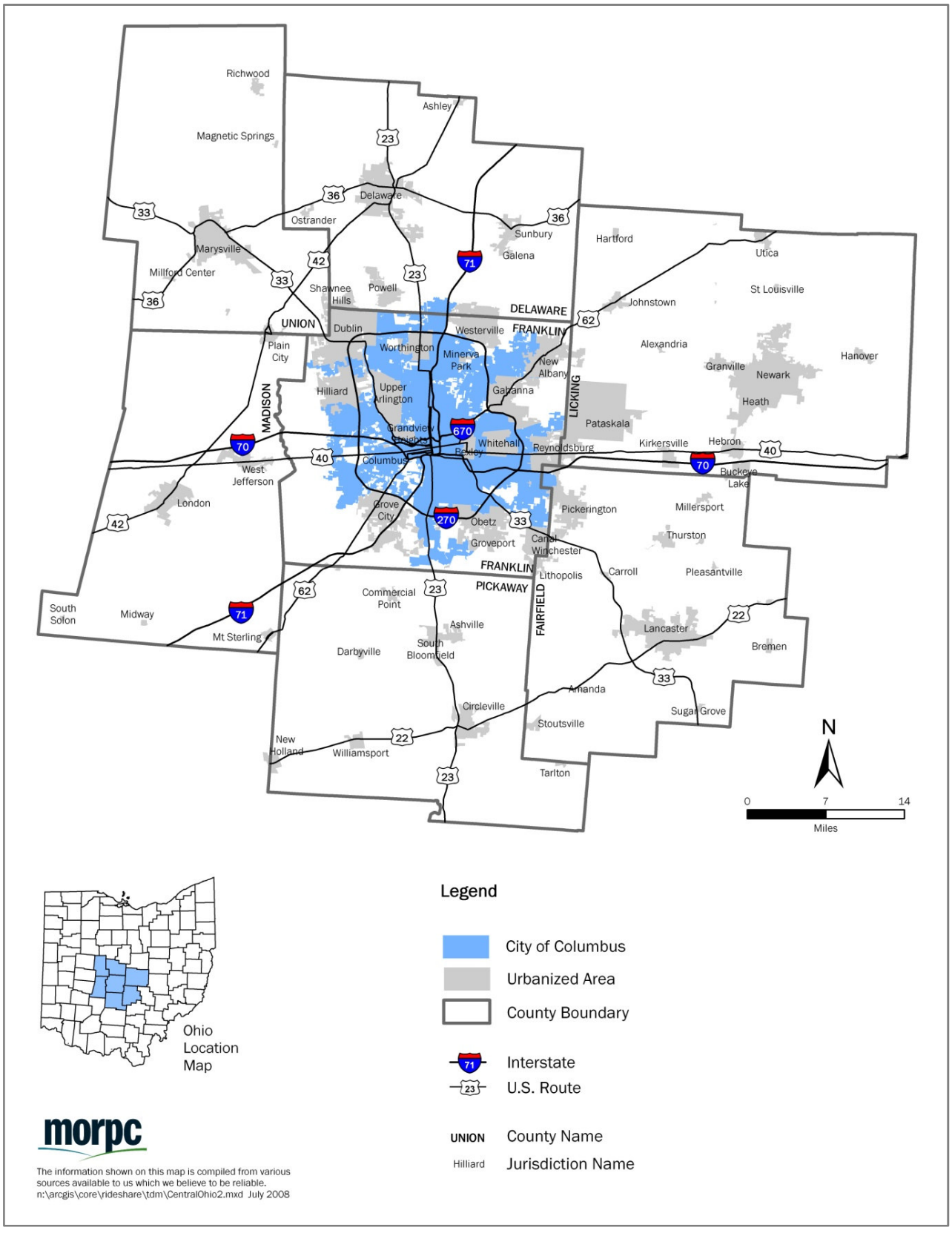
Table 5-1: Population numbers for central Ohio's counties, 2000

County Name	Population Size	Percentage	Land size (in square miles)	Population density per square mile
Franklin	1,068,978	67.7%	543.90	1,965.00
Licking	145,491	9.3%	688.05	211.45
Fairfield	122,759	7.7%	505.00	243.10
Delaware	109,989	6.9%	459.00	239.60
Pickaway	51,727	3.3%	507.00	102.00
Union	40,909	2.6%	436.94	93.63
Madison	40,213	2.5%	467.00	86.10
All Counties	**1,580,066**	**100.0%**	**3,606.89**	**2,940.88**

Source: Based on U.S. Census 2000, own summary and design.

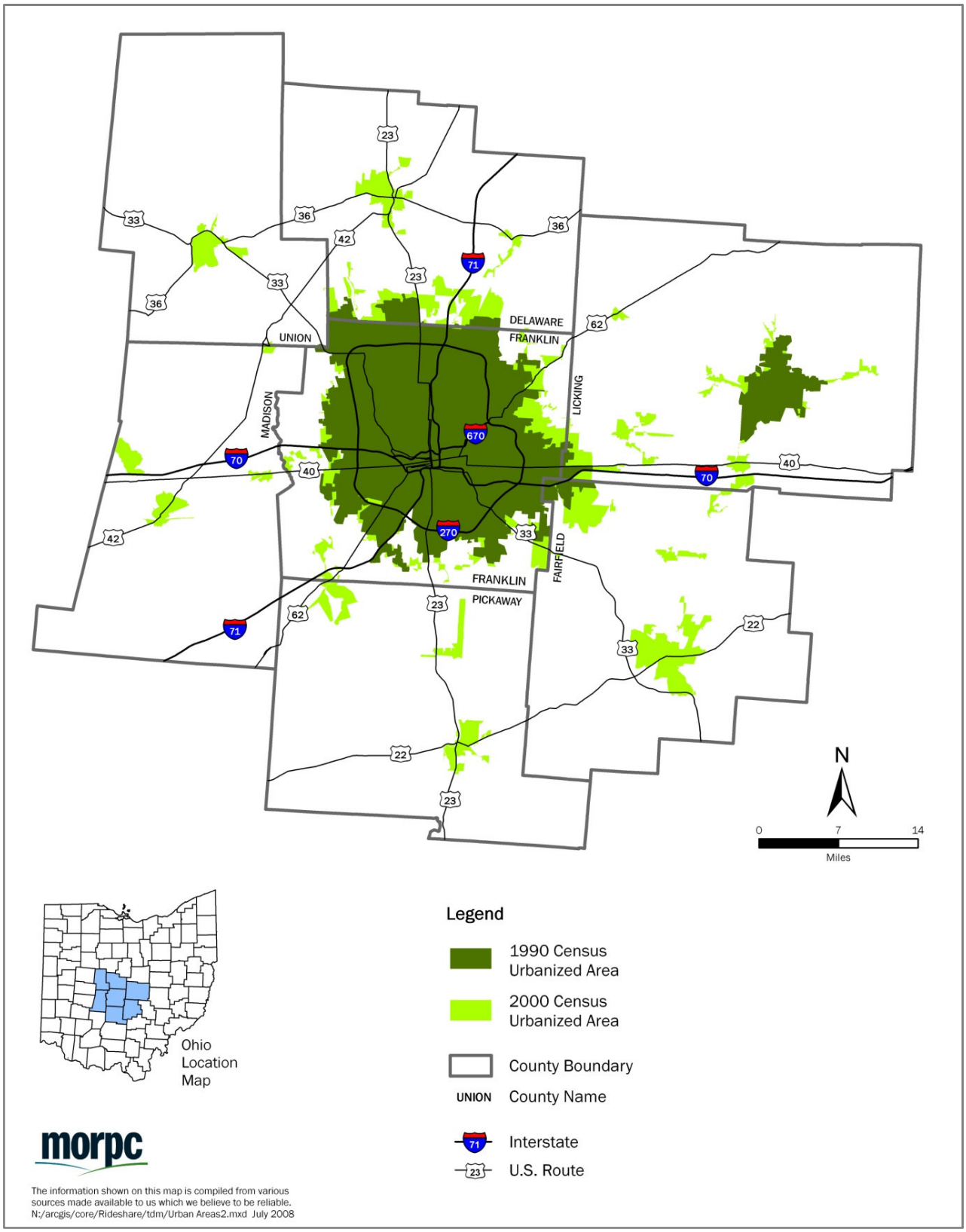
As with many Midwestern cities, the vitality of Columbus' downtown has declined in recent decades. This change is marked by the loss of large shopping centers and private employers to the surrounding suburbs. A good example of suburbanization effects is the establishment of entertainment districts outside the core city, such as the Easton Town Center, the Polaris Fashion Mall, or the Tuttle Crossing Mall. These entertainment districts often combine shopping activities with restaurants, bars, and theatres.

Map 5-1: Central Ohio Counties



Source: MORPC, own design. Based on Census 2000, ODOT, and MORPC data.

Map 5-2: Urban areas in central Ohio from 1990 to 2000



Please note that the appearance of rapid urbanization around the county seats is exaggerated due to a change in the census definition of 'urban' between 1990 and 2000.

Source: MORPC, own design. Based on Census 2000, ODOT, and MORPC data.

Between 1990 and 2000, the central Ohio region experienced an 18 percent growth rate in employment, adding over 120,000 jobs to the region. Many of these businesses were built in the suburbs along with shopping malls that replaced the once monocentric downtown City Center with polycentric activity areas near residential developments. (MORPC et al 2004:3.1ff). Besides relatively low building costs and few requirements for site developments, tax break incentives given by local governments attracted many employers to settle their businesses in areas most accessible by car. Employment subcenters are therefore clearly established in the Columbus MSA (see Map 5-3).

With the increase in population also came an increase in travel. While the population grew by 15 percent between 1990 and 2000, VMT rose by 31 percent, which is comparatively higher than the national average of 26 percent (BTS 2005). Partly responsible for this trend is the rising interest in lower density housing developments in the suburban communities (MORPC et al 2004:1.5). Like anywhere in the United States, the travel between destinations is most frequently done by the automobile while the use of public transportation is declining (see section 5.2).

In terms of population characteristics, more than three quarters of the residents are at least 18 years old, with a median age of 30.6, reflecting a fairly young population. The number of housing units represented a 17.7 percent increase within the last decade, affirming the strong and dynamic growth of the city (U.S. Census 2000). The average household income in 2003 was $47,233, while family households made up 54.8 percent of all households. On average, 2.39 people were living per household. These numbers differ from the overall national statistics. In 2000, the U.S. median age was 35.5, the average household size was 2.59, and the median household income was $41,994 (U.S. Census 2000). These comparisons illustrate that the Columbus population is overall younger and lives in households with fewer people and higher incomes.

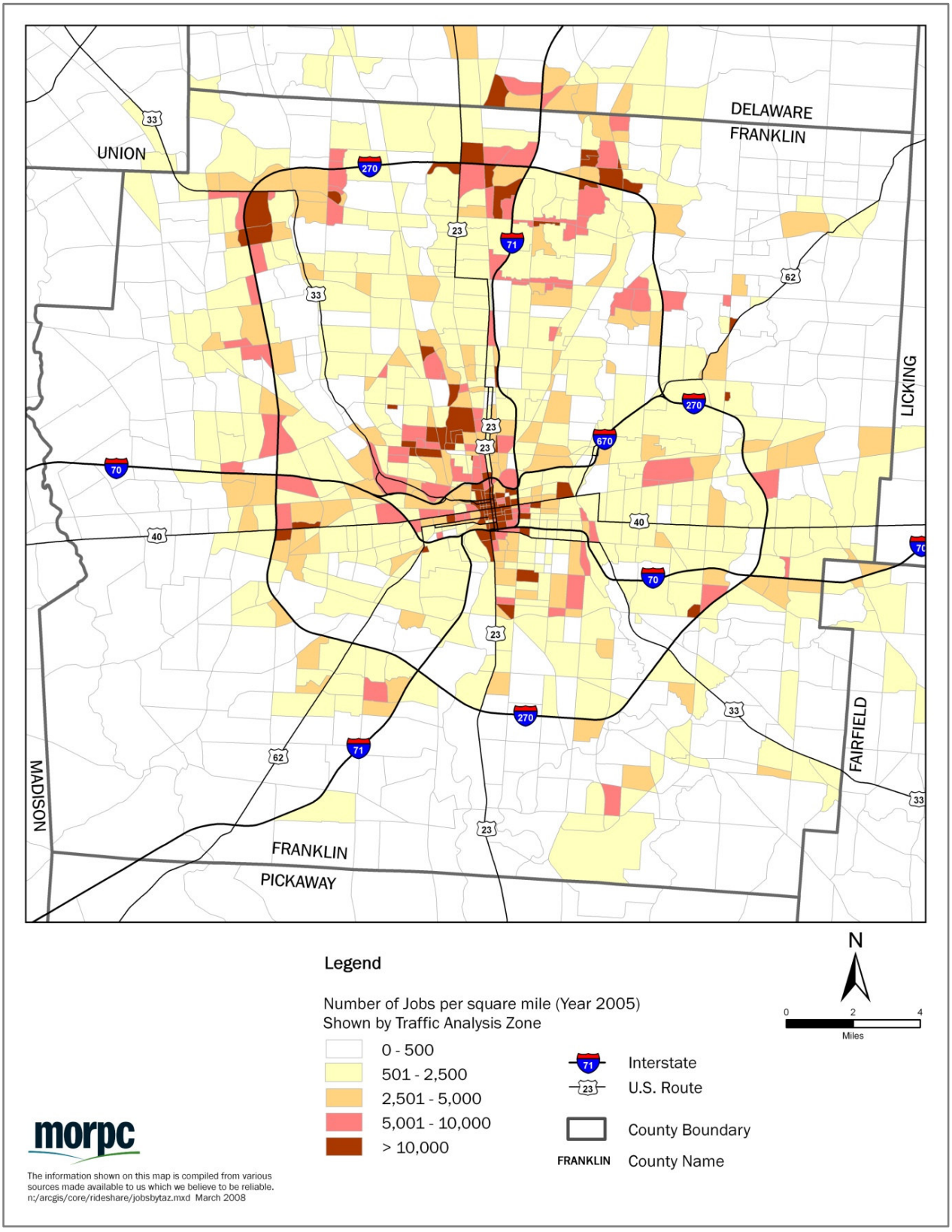
The Mid-Ohio Regional Planning Commission (MORPC)[9], which represents the local MPO, projects that the current growth rate will persist through 2010. By that time, 43 percent of the metropolitan Columbus population will live beyond the interstate I-270 outerbelt and therefore in the suburbs. The population is expected to grow 36 percent by 2030, which would result in 573,800 new residents for a total population of approximately 2,155,000. These forecasts developed by MORPC were substantiated by subsequent forecasts prepared by the Ohio Department of Development (MORPC et al 2004:2.2). Appendices 2 and 3 illustrate the expected outward development for both residences and jobs.

The coupling of a low unemployment rate and affordable cost of living made the Columbus MSA an attractive location for employers and employees. While the suburban trend clearly includes businesses, many companies still have headquarters in Columbus' downtown, and major efforts are being made to preserve and improve the existing CBD. Government officials see the benefits from having a well-functioning CBD where firms can take advantage of a

[9] The commission receives financial support from several sources including the federal government, the state of Ohio, public utility companies, local governments, and membership dues (MORPC 2008a).

highly developed transportation infrastructure and agglomeration of similar firms and support services (Columbus 2008a).

Map 5-3: Employment subcenters in and around Columbus, Ohio



Source: MORPC, own design. Based on Census 2000, ODOT, and MORPC data.

5.2 Transportation Infrastructure of Columbus, Ohio

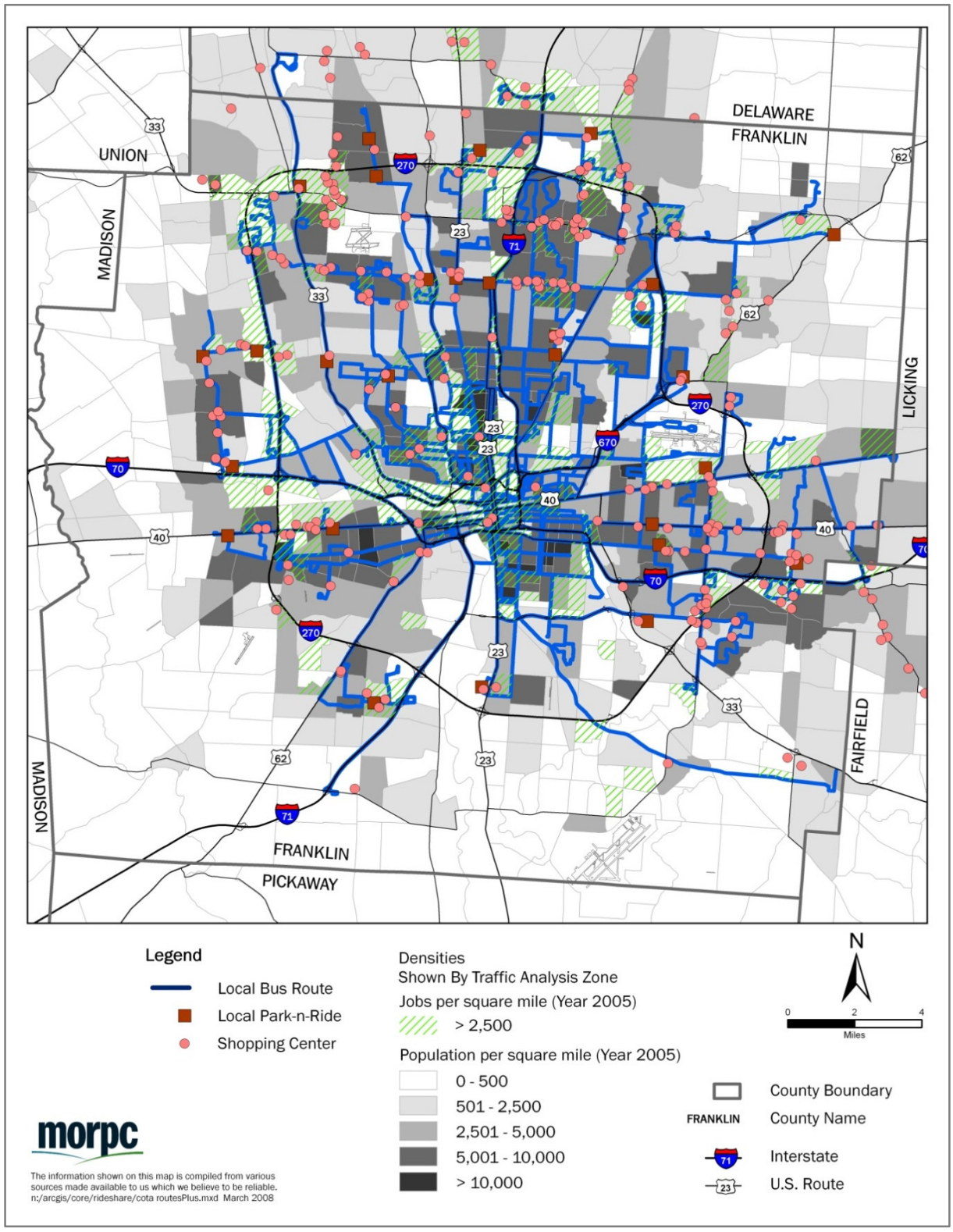
As mentioned in chapter 4, the transportation infrastructure in the United States was, and to a large degree still is, highly focused on car travel. Since highway funding became the highest priority in urban transportation planning after World War II, most local engineers and officials in Columbus took advantage of the 90 percent federal funding for highways and focused on providing a well-connected highway network with little consideration for transit (Weiner 1997:1). Today, two major interstate highways lead into and through the city. The first one is named I-71 and runs North-South through Columbus, connecting Cleveland (Ohio) with Louisville (Kentucky). The second one is named I-70 and runs East-West from Pittsburgh (Pennsylvania) to St. Louis (Missouri). In addition, a 56-mile outer beltway named I-270 surrounds the city of Columbus with a distance of four to ten miles from the downtown district (see Map 5-1). "The plans for the freeways were developed in a 1953 study prepared under the direction of the Franklin County Regional Planning Commission […]. The City of Columbus supported the building of the beltway far in advance of need because it, along with sewer and water expansion, supported the city's goals of economic and territorial growth. Because the area had already developed freeway plans when the Interstate Highway Act passed in 1956, it was one of the first areas to begin building interstates" (Pucher 1998:25). Today, the Columbus urbanized area consists of 112 miles of interstate highways and offers 29 miles of other freeways (Pucher 1998:25). However, these freeway numbers only account for 2.8 percent of the 5,114 roadway miles in Franklin County.

As anywhere in the United States, the high focus on automobiles led to environmental movements in the 1960s. These movements requested an increase of federal funding for public transportation projects which had been neglected since World War II and whose ridership had dropped significantly as a consequence. However, finances for transit projects remained much lower than for road investments, and it was up to the local governments to enhance public transportation systems for their cities. Even though Columbus had a growing bus and rail system until the 1960s, the increase of suburban developments due to cheaper land prices and the growing availability of cars worked against it. It seems that the urban planners at that time had not considered the effect it would have on public transportation if no regulations towards housing developments were enforced. Thus, it became more and more difficult for public transportation to serve the residents efficiently (Pucher 1998:24ff).

In 1971, a publicly owned transit provider, named the Central Ohio Transit Authority (COTA), was formed. COTA was authorized by the Franklin County Commissioners and the city councils of the eleven cities in the county. However, transit financing now also depended on taxes, which had to be passed by the Ohio voters. Therefore, if additional funds through various tax sources were not approved, the transit authority was not able to expand their service and, thus, would become increasingly unattractive for the majority of residents (Pucher 1998:26f). Due to such underfunding, COTA experienced a deficit of $1.9 million in 2004. Over the last 20 years, up until 2007, ridership has decreased by about eleven million. In return, the cost per rider for the agency has increased from one to five dollars (Lhota 2005).

While the local public transportation agency can offer an alternative for those that reside in the service area, it is not economically feasible to provide frequent service to all areas. As of today, 59 lines are operating to serve the Franklin County area (see Map 5-4). Most remote areas have no access to fixed-route buses, especially in a time-efficient manner.

Map 5-4: Local bus routes in comparison to high population and employment areas in Columbus, Ohio



Source: MORPC, own design. Based on Census 2000, ODOT, COTA, and MORPC data.

Despite operating under a tight budget, COTA offers various programs encouraging the use of transit. A number of these programs target employers and are touted as an affordable, convenient, and environmentally friendly way of getting employees to and from work while reducing parking problems, congestion, and pollution. COTA offers tax breaks to employers who actively provide their employees with bus passes (COTA 2007). Beyond programs for employers, COTA offers 27 P&R locations where parking is free for bus riders. Additionally, there are two transit centers that provide a centralized location to catch the bus while offering amenities such as daycare, banking, and healthcare.

Despite these efforts, COTA ridership has been consistently decreasing up until 2007[10]. Reasons for this decrease include not only the unavailability of frequent and expanded service but also the overall negative perception of public transit and bus riders and the lack of effective and targeted marketing or advertising. This negative attitude was also the primary reason for the lack of funding support in 2006 when voters defeated the implementation of a light rail system that was planned to go into service in 2008 (McCann 2008).

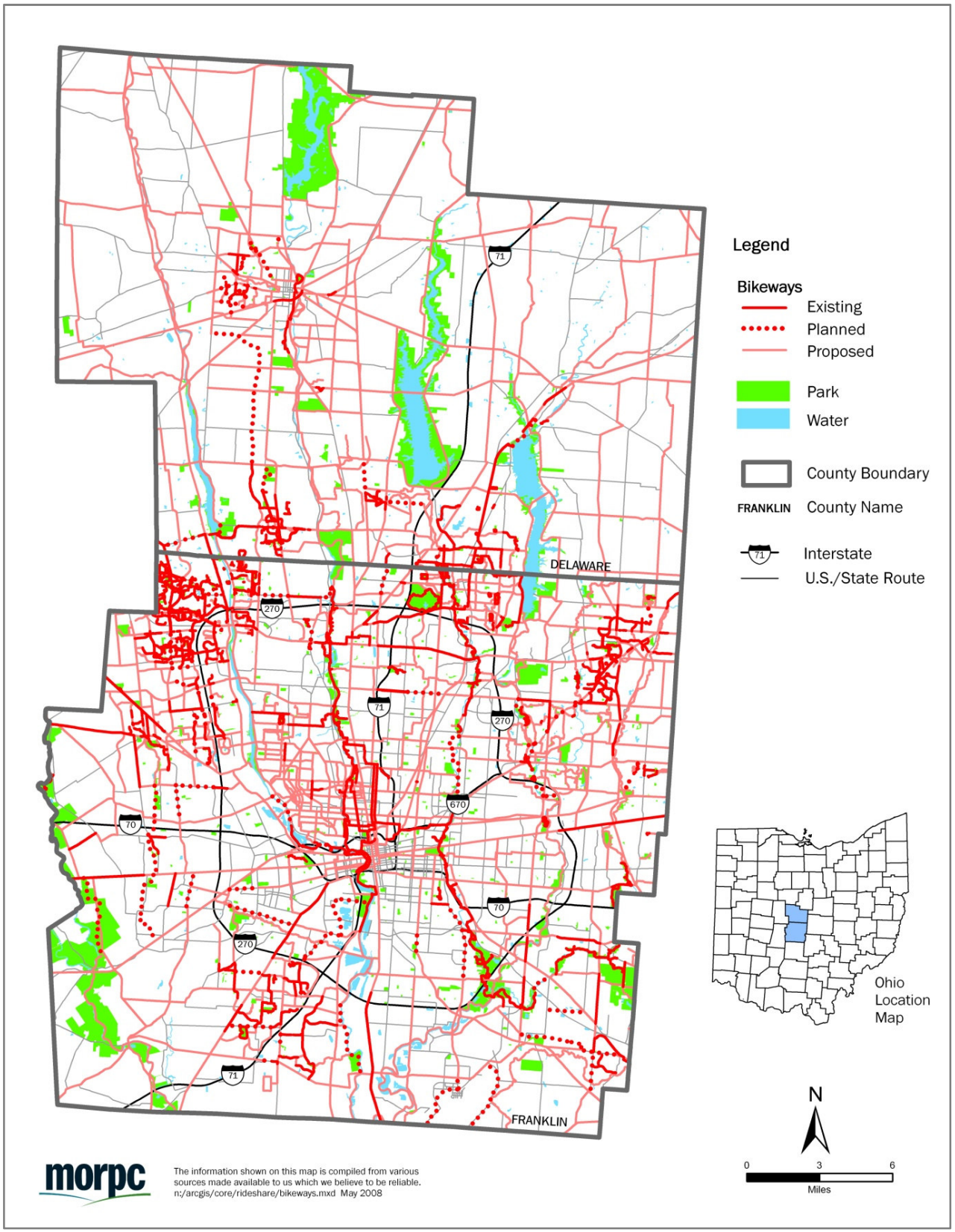
Pedestrian and bicycle infrastructure is needed to provide modal interconnectivity between transit stops and home or work locations. Unfortunately, Columbus is rather deficient in non-motorized transportation facilities, and it was not until recently that the need for more and safer sidewalks was realized by the city through an initiative called 'Operation Safewalks' (Columbus 2008b). Although sidewalks are part of the downtown infrastructure, they are not available in every neighborhood or they are disconnected. Bicycle paths throughout Columbus are scarce which could be attributed to the low percentage of workers biking to work. However, a regional bikeway plan has been developed by MORPC in cooperation with local governments (MORPC 2008b, Columbus 2008c). The plan identifies the existing, planned, and proposed routes as shown in Map 5-5.

In order to offer alternatives to solo driving, MORPC employs a ridesharing program called 'RideSolutions' that provides free information and assistance in carpooling, vanpooling, and public transit in a twelve county service area. The program is committed to the national objectives of reducing traffic congestion, lowering commuter costs, energy conservation, and improved air quality (MORPC 2008c). Some of the tasks include the planning of transportation programs for employers, offering vanpool and GRH programs to employees, holding vanpool information and formation meetings, staffing transportation events to attract additional commuter interest in ridesharing, and providing match lists to interested employees for carpooling, vanpooling, and finding biking partners.

RideSolutions plays an important role in increasing awareness of the need to reduce SOV usage and promote alternative modes. As part of their program, MORPC staff actively approach local communities and businesses to gain support in attaining the goal of increased employer-based TDM programs and community marketing. Therefore, the cooperation with MORPC for this research project was crucial for its success.

[10] Due to the all-time high gas prices in 2007 and 2008, transit ridership, for the first time in 20 years, increased. Many transit agencies, including COTA, were able to sustain higher ridership levels afterwards.

Map 5-5: Existing and proposed bikeways in Franklin and Delaware counties, 2008



Bikeways legend: *Existing* refers to bikeways that are already built. *Planned* refers to bikeways that will be built in the near future. *Proposed* refers to bikeways that are recommended to be built sometime in the future.

Source: MORPC, own design. Based on ODOT and MORPC data.

5.2.1 Local Commuting Trends

The trend towards suburbanization and the expansion of the road network have led to a strong dependency on motor vehicles within the Columbus MSA. Yet, despite the strong auto-oriented infrastructure and dependency, Columbus is still one of the least congested metropolitan areas in the United States (The Public Purpose 2005). The unbroken focus on highway widening and maintenance seems to have the greatest impact on this trend. Still, the demand for transportation alternatives, particularly during rush hour when people travel to and from work, exists. It exists not only because of the increased congestion and air pollution levels but also because of employer-related problems like high parking costs downtown or recruitment problems in remote areas.

The journey-to-work statistics for the Columbus MSA confirm the trend of increased SOV usage for commuting. The U.S. Census states that compared to 1990 driving alone increased from 79.5 percent to 82 percent in 2000 while the usage of alternative modes declined (see Table 5-2). In 2000, a total of 1.36 vehicles were available per worker and 1.74 per household. This trend is opposite to what TDM is trying to achieve.

Table 5-2: Percentage of workers by modes of transportation, Central Ohio

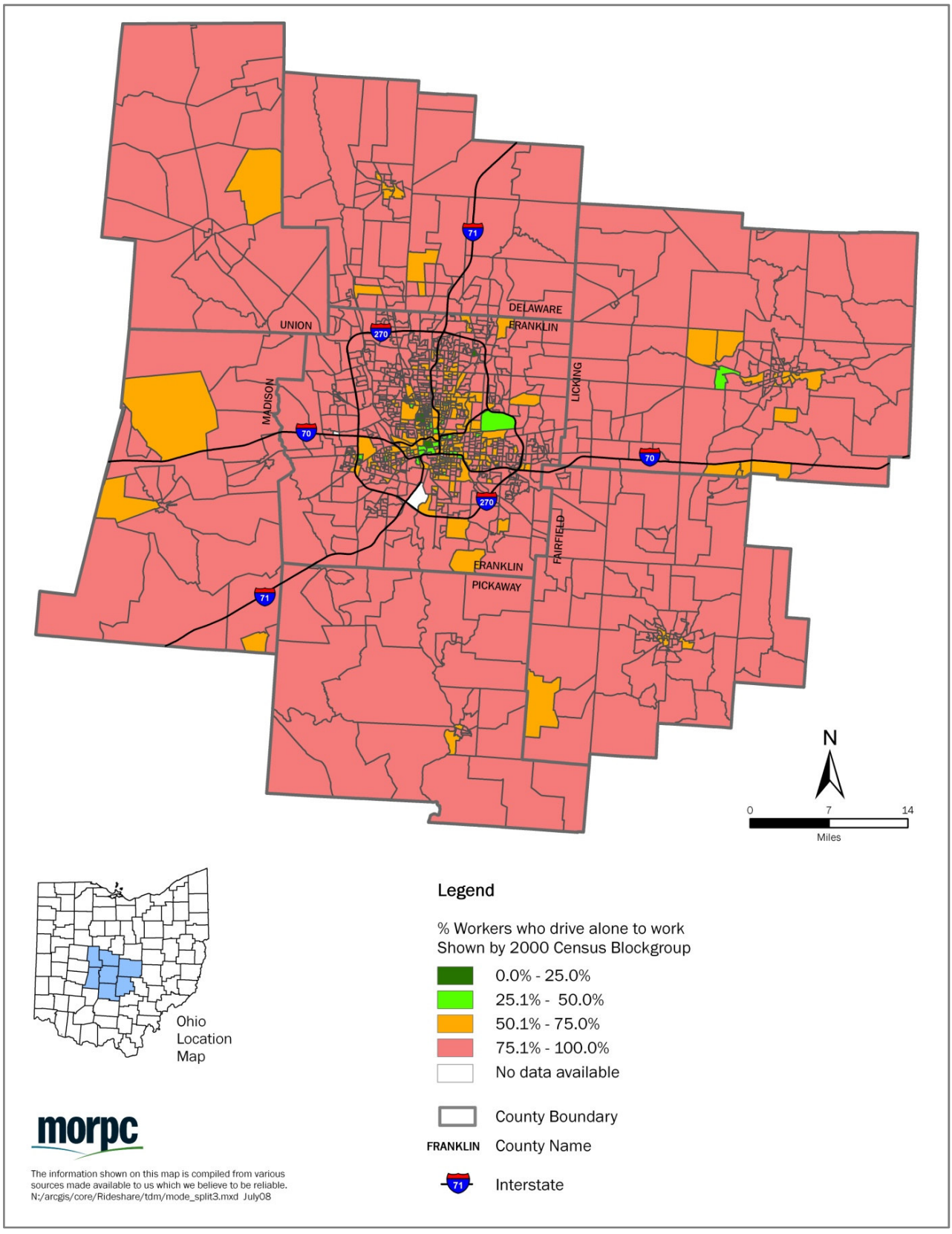
Mode of transportation to work	1990	2000
Driving alone	79.5%	82.0%
Carpooling /Sharing a Ride	11.4%	9.6%
Public transportation	2.7%	2.2%
Walking	3.3%	2.4%
Other means	0.8%	0.8%
Telecommuting/Working from home	2.3%	3.0%
Total	**100.0%**	**100.0%**
Total number of workers	**663,006**	**777,922**

Source: Based on McGuckin and Srinivasan 2004:4-7, own design.

The average travel time to and from work within the Columbus MSA increased only slightly from 20.3 minutes in 1990 to 21.9 minutes in 2000 but is significantly lower than the U.S. average commuting time of 25.5 minutes (Reschovsky 2004:9). The modes of transportation with the shortest to the longest travel times were as follows (in minutes): Bicycle/walked (13.3), drove alone (21.4), carpooled (23.4), public transportation (35.7), and other means (38.8).

While the Columbus MSA clearly shows signs of suburbanization, the number of people who live in the suburbs but work in Franklin County has increased between 1990 and 2000 from 38.8 to 44.2 percent. Meanwhile, the percentage of residents living and working in Franklin County has dropped from 95.2 to 92.7 percent. In general, the percentage of people who work and live in the same county is declining throughout the region.

Map 5-6: Percentage of workers who drive alone per census block group and residence, Central Ohio Counties



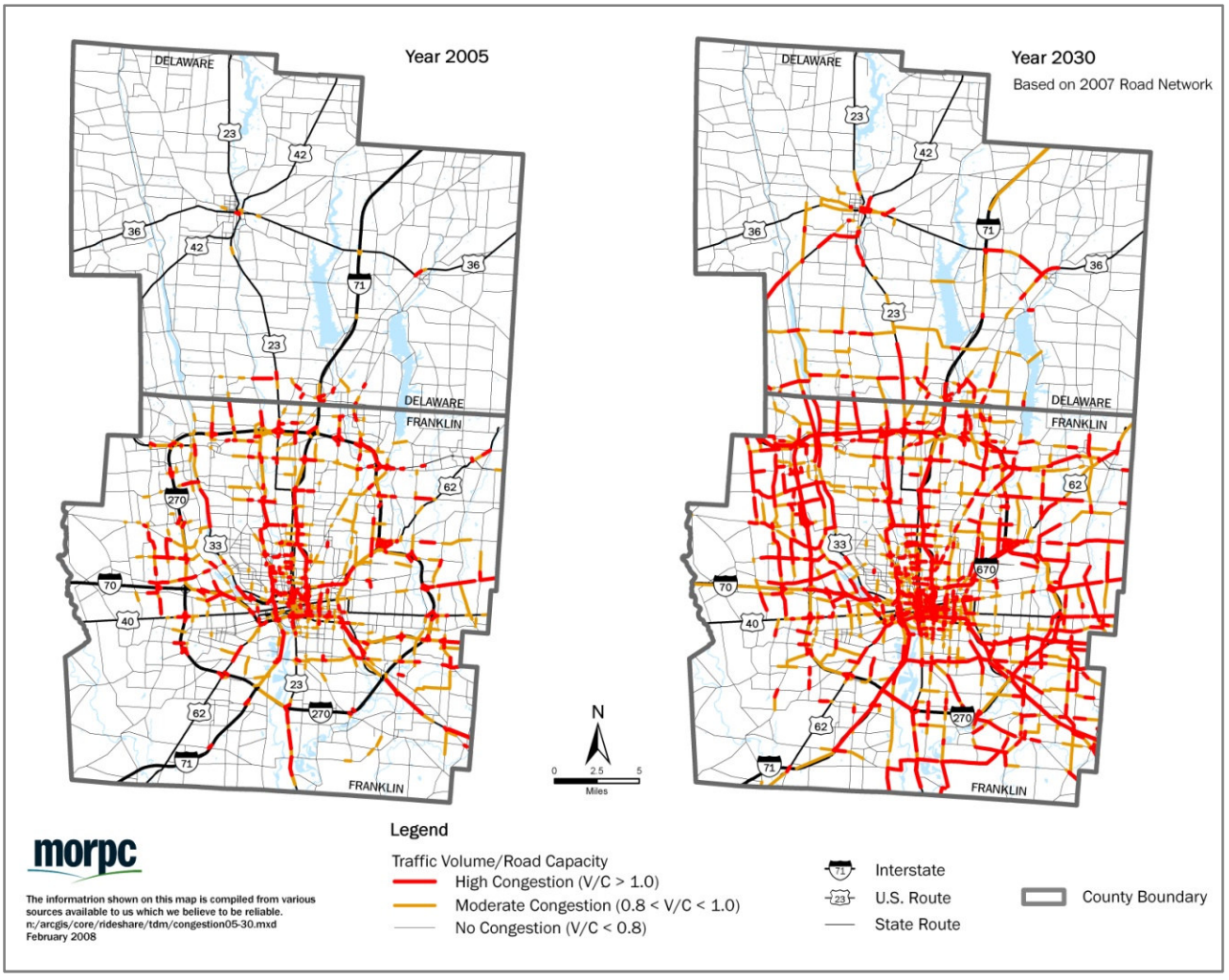
Source: MORPC, own design. Based on Census 2000, ODOT, and MORPC data.

Map 5-6 displays the percentage of workers who drive alone by car to work by census block group. The data is derived from the CTPP 2000. The map supports the statistics that most Americans drive alone to work. Only workers who live near the urban core show a higher usage rate of other modes of transportation than driving their own car to work. The high usage of SOV travel particularly from the suburban counties into Franklin County certainly has a great impact on both the transportation system and the environment in central Ohio. The consequences of increased car travel are described in the next section.

5.2.2 Impacts of Single Occupancy Vehicle Use in Columbus, Ohio

The current automobile traffic in the Greater Columbus area is so high that many roadways are operating at full capacity. Although traffic congestion is not as big a problem in Columbus as it is in cities of comparable size, MORPC et al (2004:5.1ff) project that VMT will increase by 47 percent by 2030. Map 5-7 shows how the number of congested roadways is expected to grow if no changes were made to the transportation network as it stands today.

Map 5-7: Expected increase in congested roadways in Franklin and Delaware counties from 2005 to 2030



Source: MORPC, own design. Based on ODOT and MORPC data, utilizing MORPC transportation modeling data.

Along with traffic congestion come pressing air quality issues. The air quality is greatly impacted by the increase in motorized traffic volume because of engine emissions. In April 2004, the U.S. EPA declared Franklin County and its adjacent counties (except for Pickaway County) of having the 'non-attainment' status for air quality. This designation means that the air does not meet minimum national ambient air quality standards set by the U.S. EPA to protect public health.

Nationally, 39 percent of the U.S. population lives within non-attainment areas. Air quality in Franklin County has declined in recent years. The number of 'good' air quality days has dropped from 80 to 50 percent between 1998 and 2003, and the number of ozone action days has increased by 50 percent from 1996 to 2002 (MORPC 2008a). According to the Ohio EPA, central Ohio was designated as having the unhealthiest air in the nation for two days in June 2004, representing the worst smog case the Ohio EPA had seen in 15 years (MORPC 2008a). Failure to act will not only result in serious health consequences but the economic impacts of non-attainment may also prove significant as enhanced environmental regulation carries greater restrictions on businesses and citizens, and may jeopardize federal funding (Coleman 2005:7). MORPC's Air Quality Committee is currently working with local governments, businesses, health organizations, and the Ohio EPA to develop emissions reduction strategies.

So-called E-Check exhaust tests, referring to vehicle inspection and maintenance programs that ensure that cars meet cleaner exhaust emission standards, are not yet mandatory in Columbus. E-check tests are required every two years and failure to meet the test typically results in additional fees for car owners. As such, the consumer's transportation costs increase significantly and make solo driving less attractive (Hunt 2004).

While measures need to be established to remedy the situation, economic developers fear that restrictions will be detrimental to the development and growth of the area by repelling new businesses (Hunt 2004). Ohio is required to meet EPA air quality standards for ozone by 2009. As for now, central Ohio has never been in danger of exceeding its emission budget. However, the U.S. EPA has proposed to strengthen the national ambient air quality standards for ozone pollution. If the EPA promulgates a more stringent standard, regions such as central Ohio may, for the first time, have to take a more aggressive approach to obtaining mobile emission reductions to comply with the more protective standards (Abel 2007). Given Franklin County's non-attainment air quality status and the current growth rate, it is likely that strict regulations on air emissions for both companies and residents will be imposed through mandatory trip reduction programs (Plaut 1998:197).

In addition to air quality issues, congestion also negatively impacts the individual traveler and employer. Because of the effects congestion has on travel time, employers may be faced with employee retention and recruitment problems, decreased productivity levels, and increase in absenteeism. Employees may experience reduced job satisfaction and increased stress levels. For example, before the widening of the north outerbelt, MORPC found that area employers experienced employee reliability and retention problems as a result of the congestion on that freeway. The problem was largely ameliorated by the widening of I-270, but at a cost of $100 million in public funds (Lawler 2007). It is evident that solving congestion problems through

freeway widening will be far less common in the future than it was in the past, making it necessary to look at alternative ways of transportation.

MORPC and its members in the central Ohio region are already offering services and developing policies to change travel behavior. Such initiatives include technologies related to Intelligent Transportation Systems, the program RideSolutions, increased transit and non-motorized transportation planning, and the development of a growth strategy called 'Regional Connections' (Lawler 2007). Regional Connections creates a vision for how the central Ohio region can grow in a more rational, cost-effective, and equitable way and move in a more sustainable direction. The strategy incorporates both urban and transportation planning by promoting denser neighborhood designs which permit less reliance on cars for local trips (MORPC 2007). While these activities are much needed, they do not study the travel behavior itself which is a necessity in recommending successful countermeasures to SOV travel.

5.3 American Electric Power as the Research Object

As the previous sections illustrated, the current urban and transportation infrastructure in the Columbus MSA greatly impacts the high usage of solo driving. Residents have adapted to, and have often even encouraged, this infrastructure, and greatly contribute to the congestion that is so frequently the result of too many vehicles traveling the same route at the same time. Since much of the congestion occurs during peak hours, it is safe to suggest that most people commute to work by car. In order to reduce congestion, a change in travel behavior is required. Changing a behavior, however, can be difficult, especially if it is as repetitive as commuting to work (see chapter 2). It is therefore necessary to understand why so many people choose to drive alone before suggesting countermeasures and marketing strategies. In this regard, employers play a very important role in supporting certain types of travel behavior based on the incentives or restrictions they provide or do not provide. Studies that show that employer initiatives are most effective in encouraging solo drivers to seek alternatives are therefore not surprising. Important, however, is the fact that private companies and public organizations need to work together in developing successful policies that meet transportation demand (Rye 1999, Meyer 1999).

Studying commute behavior can be a very complex matter that needs to account for the spatial, personal, and informational aspects as shown in Figure 2-3. In order to fully understand the wide range of personalities who travel to the same work site, conducting the research on travel behavior with one particular company seems most promising.

For the Columbus MSA in particular, low traffic congestion and few parking problems make it difficult for researchers to find private businesses willing to participate. Firm owners are often unconvinced of the need to increase the usage of alternative modes and to justify the additional time efforts on their part for the project.[11] In general, employers in downtown districts tend to

[11] Since the presented research was conducted, fuel prices have increased significantly. The dissatisfaction with high travel costs when driving alone has increased awareness among many employers to offer and encourage alternative mode usage or flexible working schedules. The success rate of getting employers involved today might therefore be somewhat higher.

be more aware of the increased car usage and its negative outcome than employers in suburban areas. The dense urban structure and the need for horizontal and thus expensive parking garages are some reasons for this awareness. Many large companies have headquarters in Columbus' CBD where they can take advantage of a highly developed transportation infrastructure and agglomeration of similar firms and support services. Among these companies are Huntington Bank, Nationwide Insurance, and American Electric Power (AEP).

For the research at hand, only large private businesses with at least 500 employees that were either challenged with downtown traffic or were located in the suburbs with little or no transit access were contacted in order to gain employer participation. More specifically, cover letters and response post cards were sent to either the head of the environmental or human resources department of about 40 businesses to gain their interest in improving employee transportation options (see Appendix 4). This mailing was done as a joint effort with MORPC and the previously described EPA program BWC. Using this approach, only 15 percent of the employers responded. Consequently, follow-up calls were made to those who presented either strong environmental involvement or showed problems regarding commuter transportation and therefore demonstrated a higher potential of interest for TDM. In the end, using existing relationships between MORPC and many local businesses was the most effective means in scheduling face-to-face meetings. Five companies (Honda, TS Tech, State Farm Insurance, AEP, and ValueCity) were initially selected as possible research partners. Due to its strong involvement in environmental efforts, its interest in improving the company's image, and its financial co-sponsorship, AEP was finally chosen as the research site.

AEP, also known as the American Gas and Electric Company before 1958, was incorporated in the State of New York in 1906 and acquired its first utility properties in 1907. These original properties provided electric, gas, water, steam, transit, and even ice service to communities. AEP moved its headquarters to a 31-story building in downtown Columbus, Ohio in 1983. In 1997, AEP announced a merge with Central and South West Corporation of Dallas, Texas. The merger was completed in 2000 and resulted in a company with revenue of $12.5 billion (AEP 2006).

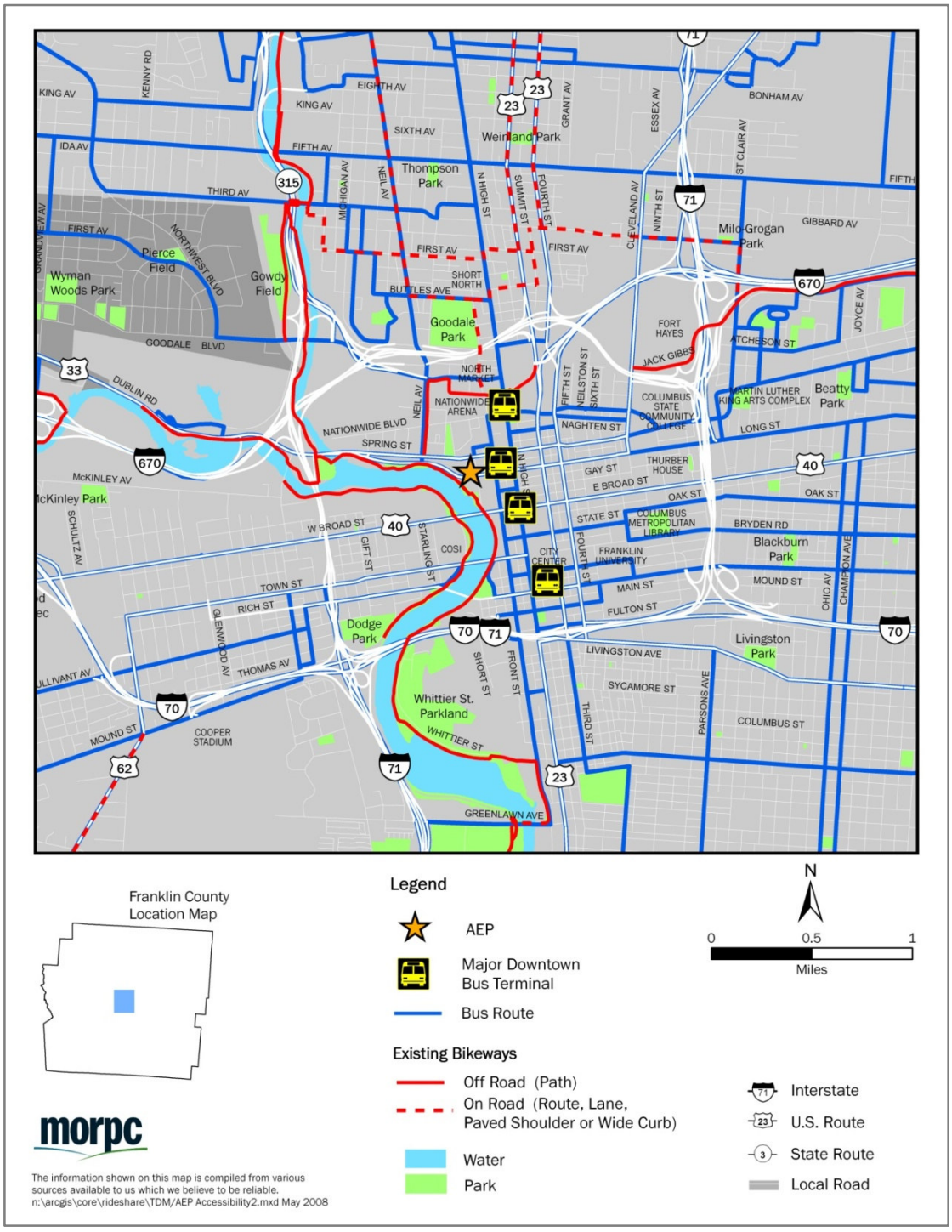
AEP owns and operates more than 36,000 megawatts of generating capacity in the United States (Arkansas, Indiana, Kentucky, Louisiana, Michigan, Ohio, Oklahoma, Tennessee, Texas, Virginia, and West Virginia). The company is also present in selected international markets and is the largest electricity generator in the United States (AEP 2006). AEP employs a total of 3,900 individuals in the central Ohio region. Of these, more than 2,800 work in the downtown Columbus headquarters offices and can be broadly described as white collar workers.

5.3.1 Transportation Infrastructure to and from the Work Site

The immediate spatial environment, including the company's setting in the urban area and the availability of transportation facilities, can have a great impact on the overall travel behavior of the workforce. While AEP has several plants throughout the city, its headquarters is centrally located in downtown Columbus. The company is easily accessible via car by three major interstates, I-70, I-71, and I-670, as well as by State Route 315. AEP's location also offers reasonable access to public transportation. It is within seven blocks of the transit terminals for

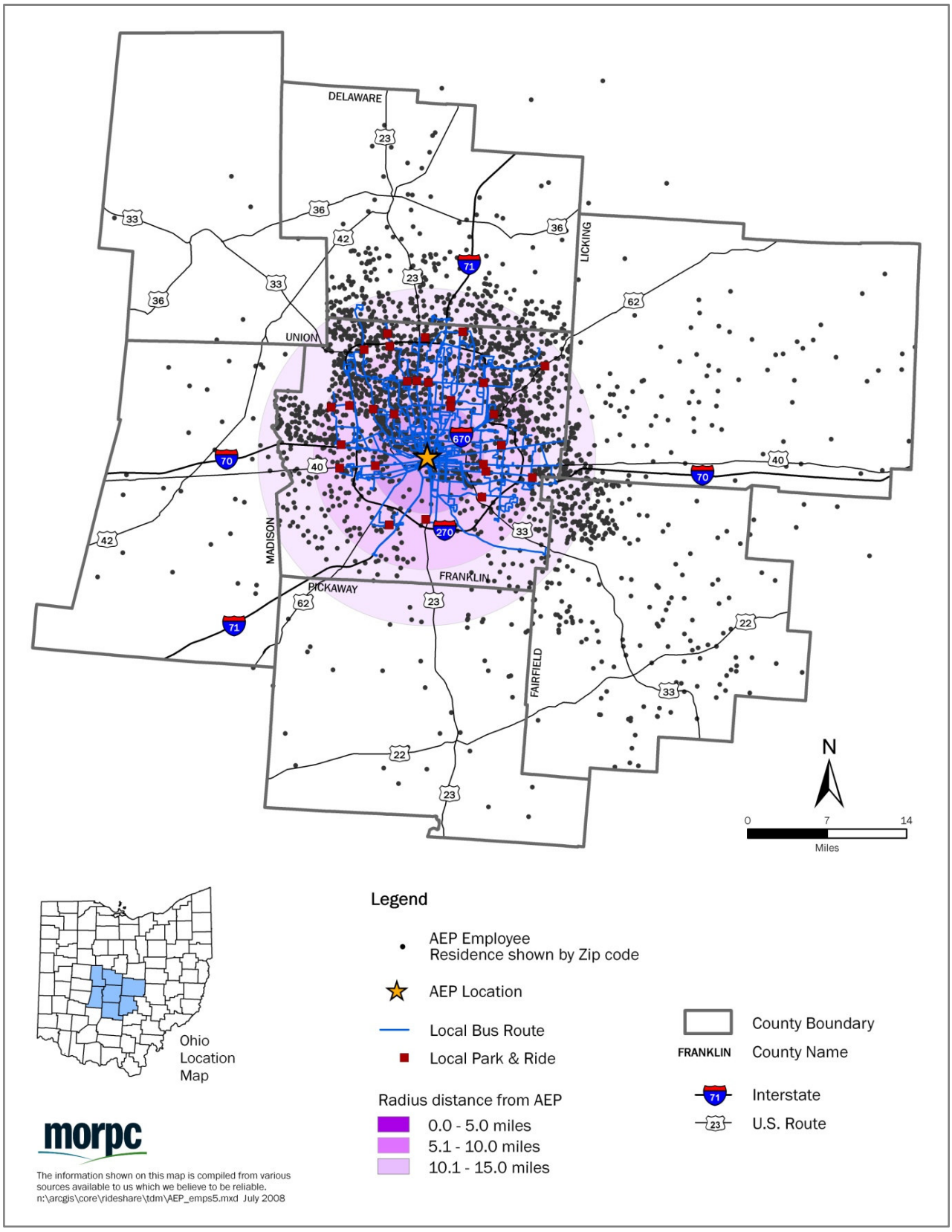
most local transit lines servicing Franklin County (see Map 5-8). Based solely on the transit service area, public transportation could be a possible alternative to automobile use. Unfortunately, the service frequency of many bus lines is rather low, making local transit a somewhat inflexible transportation mode. An overall lack of well-maintained and connected pedestrian and bicycle paths limit the usability of these modes. While sidewalks exist in the downtown area, they are not present in every neighborhood leading to AEP.

Map 5-8: Location of AEP and its accessibility by all modes of transportation



Source: MORPC, own design. Based on ODOT, COTA, and MORPC data.

Map 5-9: AEP employee residence distribution by zip code



Source: MORPC, own design. Based on ODOT, COTA, MORPC, and AEP 2005 employee data. N=2,811

An efficient highway network and abundant parking deter many employees from choosing alternative modes. AEP currently owns two parking garages with 2,010 spaces and rents

another 532 spaces, offering a total of 2,542 parking spaces to their employees. The firm leases the 532 parking spaces for $100 per month, where employees pay $40 per month and AEP pays $60 per month for a total $383,040 per year. This example alone illustrates the cost savings potential for the company itself. By reducing the demand for driving alone and increasing the usage of alternative modes, less parking would be necessary, which would in turn cut company costs.

Residence information by zip code was provided by the Human Resource Department for all 2,811 AEP employees. More than 1,500 employees (approximately 60 percent) live within Franklin County, while all others reside in the surrounding areas, such as the cities of Pickerington, Pataskala, or Powell. The main catchment area is therefore 15 miles (see Map 5-9). The current employee housing and driving time characteristics, along with the research results, are discussed in chapter 6.

5.3.2 Employer-specific Benefits

As mentioned previously, not only can the spatial surroundings of a destination determine mode choice, such as accessibility to freeways, transit, or bikeways, but also if and how the employer encourages certain means of travel. For example, the number of available parking spaces or the provision of discounted bus passes can impact SOV commuting.

In regards to AEP, a variety of benefits are offered to their employees that could be seen as advantageous for promoting alternative modes of transportation. Commuters often argue that they need their own car at work because it allows them to eat out for lunch or run personal errands during working hours. AEP addresses this issue by offering a variety of services related to the employee's personal needs. Located adjacent to a large cafeteria with a wide variety of dining options, AEP facilitates a small coffee shop that offers so-called dock3 services. Dock3 is a program that assists in managing personal and household errands, including shipping, receiving personal deliveries, handling dry cleaning, photo processing, video rentals, shoe repairs, and other local errands. In addition, AEP houses a gym within the work building for only $7 per month. The company has also recently installed a credit union on site. These services give employees the convenience of getting most errands done while being at work. AEP does not offer childcare services on-site, but does support working parents by assisting in finding and financing day care arrangements (Hollback 2005).

The company further supports MORPC's commuter choice program RideSolutions by providing information through its Human Resources Department about carpooling, vanpooling, and the GRH program. The company also works closely with the local transit authority to provide information about bus services and to offer a 32 to 41 percent discount on monthly bus passes to its employees. In addition, the employer regularly supports on-site transportation fairs organized jointly by MORPC, the local transit agency, and a regional program called Paving the Way which collects and disseminates road construction information. AEP also provides safe and roofed bicycle lockers in front of its downtown building. Furthermore, AEP offers its employees flexible working hours as well as the option to telecommute at least once a month.

5.4 Summary

This chapter demonstrated on a local level how urban land policies are closely linked to the transportation infrastructure and therefore influence travel patterns and location decisions of business owners (see Figure 5-1). The sections described the study area in greater detail and explained the importance of employer involvement for TDM. Focus was also placed on the selected company and why it was chosen for the research.

The increasing concern for our environment, the rising state-level interest for multi-modal transportation planning, and the city's plans to revitalize the CBD demonstrate the central Ohio region's willingness to make changes. While changing the urban design and transportation system will take much time, TDM measures can assist in reducing the number of vehicles on the roadway in the short term.

Although the selected company has engaged in efforts to support transportation alternatives for its employees, they are not sufficient. The lack of marketing for these modes is one of the main reasons for the minimal success of the TDM programs offered at the company. In order to recommend new strategies and to improve marketing, information about site-specific commuter needs and behavior is important. The presented research was conducted in an effort to identify such factors. The following chapters describe, illustrate, and explain the results from studies conducted with AEP employees. Using these results, the difficulty in getting people to switch from car use to other modes is demonstrated. Finally, possible strategies on how to increase alternative mode usage are discussed. Implementing some of these strategies provides AEP not only with the potential of cost savings, but it can also increase the image within the company itself and with the community and region at large.

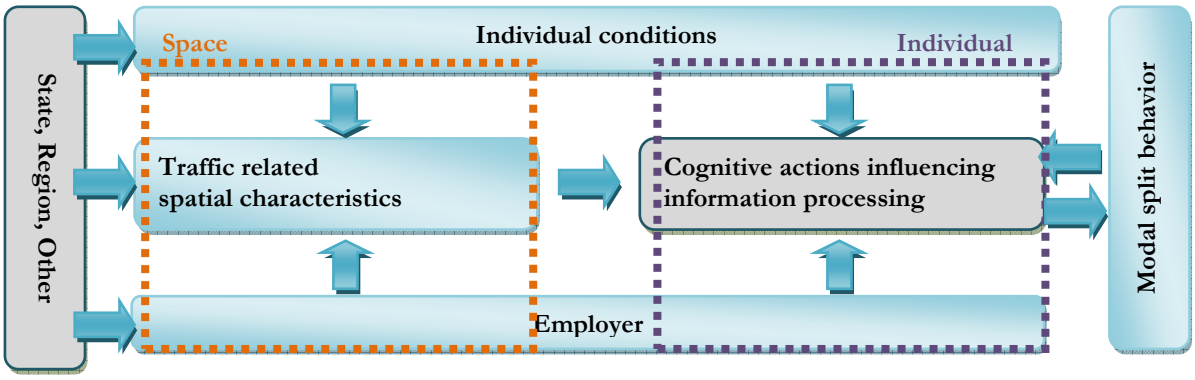
"I wanted my daughter to experience riding on a bus, just so she can see, and I told her: That is why you want to get a good job, so you can get a car." – Focus group participant

6 Research Type and Empirical Results

As previously stated, the primary goal of this thesis is to detect factors that influence mode choice so that effective TDM measures can be developed. While chapters 1 and 2 introduced the topic and gave an overview of existing discoveries related to travel behavior research, chapter 3 discussed various statistical methodologies that seem most appropriate for the research objective. Chapters 4 and 5 then focused on the role of spatial attributes, including land use and transportation planning. The discussion in those chapters made mention of players other than the individual who can have a significant impact on mode choice. Such players include the federal governments, the state, local jurisdictions, regional planning organizations, transit providers, and private companies. The review concluded that many policies in the United States promote car travel, leading to governments that are now faced with people who view abundant parking and an extensive road network as an amenity rather than a luxury. Chapter 5 illustrated by means of the city of Columbus that SOV travel is by far the most prevalent mode of transportation.

Even though city officials in central Ohio are more and more inclined to plan for sustainable transportation, concrete policies and actions are still missing. The issues of increasing pollutant levels, rising fuel prices, and growing traffic volumes need to be dealt with today. This need for action is where private companies, such as AEP, come into play. As illustrated in Figure 1-3, there are many advantages for businesses to get involved in TDM. By understanding current travel behavior and the factors that drive decisions, TDM measures can be especially effective.

Figure 6-1: Research focus on individual conditions both in the spatial and personal context



Source: Based on Figure 1-2, own design.

The objective to detect influential factors can best be attained by conducting in-depth surveys that address the spatial, personal, and informational aspects of their employees as described in Figure 2-3. The following chapter describes the surveys, its results, and the statistical methodologies applied. Much emphasis is placed on the individual component of the modal split model as illustrated in Figure 6-1.

6.1 Conducting a Pre-study

As mentioned in chapter 3, a focus group is often conducted prior to surveying the actual study subjects. Such a focus group was therefore also conducted for the research at hand. The objective of the focus group in regard to the presented research was to gain a deeper understanding for SOV commuting in Columbus. Knowing about some of the reasons that inhibit employees from using alternative modes of transportation is helpful when generating the content of surveys that follow.

The discussion session for the focus group was led by a moderator who was unattached to the researcher. The session was held during lunch hours (11:30 a.m. to 12:30 p.m.), and free food was provided as an incentive. Employees of various local companies were recruited via email through MORPC's contact database. The email advertised the session and asked for people to volunteer their participation. A total of eight SOV commuters who enjoyed driving their car took part. The group was composed of three males and five females of varying ages, although many were between 26 and 35 years of age. In order to warrant cultural accuracy, only U.S. citizens were part of this group.

The discussion was tape recorded with a sound-grabber microphone to ensure that all comments were captured correctly. In addition, a flipchart was used to visualize the answers and help with the analysis of the session. The questions were written as a moderator's guide (see Appendix 5) and were divided into four topic areas. These topic areas were developed with the modal split model of Figure 1-2 and Figure 2-3 in mind. The topic areas were as follows:

- Current travel behavior and trip chaining;
- attitudes about cars and alternative modes, including the importance placed on certain attributes;
- cost perception in comparison; and
- perception of others using alternative modes.

In addition, a short questionnaire was distributed among the participants to capture the sociodemographics of the group (see Appendix 5).

6.1.1 Focus Group Methodology and Results

One of the focus group tasks asked each participant to rank 12 attributes by their preference: convenience, no parking search, flexibility, relaxing/sleeping, comfort, read paper/do work, privacy, less polluting, short travel time, status/image, cost savings, and easy pick up of children. All group members perceived convenience and flexibility as the most important attributes for choosing a mode of transportation. However, rankings varied significantly throughout all other variables which can be explained by the differing importance of personal circumstances. By analyzing the limited set of data, participants could be broadly categorized as 'Long commuter', as 'Mother with young child', or as 'Car lover.' Defining different target groups is an important factor in developing marketing strategies that work and is discussed in chapter 7 in greater detail.

The group consented that alternative modes could not provide them with the flexibility and independence of driving their own car. Schedule limitation, longer travel time, walking to a bus stop in bad weather, and having to depend on others were negative attitudes towards alternative modes. Alternative mode users were often perceived as 'frugal' in the best case and as 'smelly' and 'shady' in the worst. On the bright side, caring for the environment, helping traffic reduction, being cost-effective, and relaxing were positive images provided by the respondents. All participants felt that the image for local transit and its users is often negative and needs to change to attract future customers.

One of the key findings was that most car drivers feel a lot of frustration with other drivers as well as with travel conditions. For them, other roadway users are 'always in their way' when trying to get from point A to point B. Yet, most participants would not give up their car because it offers what they refer to as convenience and flexibility. Only those who experienced an unusually long commute or who perceived traffic as a waste of time would consider using another mode, but only if it was comparably attractive in time and service frequency, and thus, flexible.

Overall, all participants had a sound understanding of their variable car costs. They were able to realize that using alternatives would generally be cheaper. Yet, flexibility and convenience of the car simply outweighed the higher cost.

6.1.2 Lessons Learned Regarding Focus Groups

A large amount of information was obtained by the session. However, a two-hour session, instead of a one-hour session, would have allowed the time necessary to discuss specific aspects in more depth and to gain further clarification of certain mind settings. Unfortunately, two-hour sessions would need to be conducted after work, making it more difficult to find volunteers for participation.

As previously stated, the focus group was conducted as a pre-study to help define variables that should be included and tested with the primary study method. The discussion reiterated the need for questions that explore the attitudes and perceptions of alternative modes and its users. In addition, the focus group results emphasized the need to study the importance of attributes for transportation modes through simple ranking and stated-ranking questions to detect possible trade-offs between variables. Finally, the likelihood to switch if certain measures were available needs to be examined further because the session did not leave time to discuss the type of TDM strategies that would enable a mode switch in greater detail.

6.2 Primary Research

Chapter 3 discussed the importance of qualitative versus quantitative research. While qualitative research does not provide statistically representative results, it does offer the opportunity to study certain factors related to the research's objective in greater detail. Both a qualitatively oriented survey and a quantitatively conducted survey are described below as the key elements to the research project. Much of the surveys' content is based on the pre-study and on secondary research results discussed in previous chapters.

6.2.1 Work Commute Satisfaction Survey

The first survey, called the 'Work Commute Satisfaction Survey' (subsequently referred to as WCSS), was designed to only study current SOV users. Its main objective was to identify the presence and importance of latent factors that determine travel decisions. The questions were based on the assumptions of a modal split model as described in Figure 1-2 and Figure 2-3. Such factors include the attitudes and perceptions about alternative modes, the work commute characteristics, and travel costs, among others.

The in-depth survey was conducted with a small sample of AEP employees and serves as a qualitative research approach. An email was sent out to all employees at the company's downtown headquarters to ask for their participation. The email asked specifically for commuters who drove alone daily to work and who fit either one of the following criteria:

- They lived in one of the listed zip codes that are served by local bus line Nr. 2:

43235	43085	43214	43202	43210	43232	43201	
43068	43213	43215	43209	43205	43227	43227	or:

- They experienced a daily commute to work of more than 30 minutes.

If they fulfilled either one of these criteria, they were asked to submit their interest of participation along with their contact information via an online form. Although the criteria are not distinct, meaning that someone within a bus line zip code can also have a commute of 30 minutes or vice versa, it was an attempt to capture as many employees who have transit access versus employees whose commute is long. Participants could choose between two survey sessions. To facilitate participation, the employer provided free lunch on the company's executive floor upon completion of each survey.

A total of 85 employees responded. Based on the participants' residential location and gender, 60 of these employees were selected. This selection resulted in two relatively equally sized groups. One group contained participants who lived within a zip code serviced by the local bus route Nr. 2, and the other group contained individuals who lived in areas that required a commute of 30 minutes or more one-way. The company headquarters' gender ratio of roughly 20 percent women and 80 percent men was also considered when selecting the participants. A total of 52 employees took the survey, representing a final response rate of 89 percent.

The 11-page survey contained 53 questions and took between 30 and 40 minutes to complete (see Appendix 6). Questions were structured into five different substantive components, and question structures included multiple-choice, ranking, Likert scaling, and stated-ranking questions. The questions were all utilized to gain detailed knowledge about factors that lead SOV commuters to not choose alternative modes. The survey can be summarized into the following five subject areas:

- *Work & Home*, including multiple-choice questions about housing location and choice, employer choice, working hours, or routes to work.
- *Commute Travel*, including multiple choice, scaling, and ranking questions regarding the commute to work, the reasons for choosing the car, satisfaction with work commute, trip-

chaining, possible improvements for route to work, ranking of attributes for transportation services, and personality traits.

- *Opinions*, including a series of attitudinal questions towards all modes of transportation regarding his/her (dis-)agreement with given statements, ranking of transportation modes by preference, as well as the likelihood to switch to alternative modes if certain measures were implemented.
- *Suppose …,* including a scenario of transportation characteristics on plan cards for the respondents to rank by preference.
- *About You*, including multiple-choice questions regarding sociodemographic and socioeconomic aspects of each individual.

As part of the survey, a stated-ranking question was conducted by providing respondents with plan cards that offered nine out of 27 randomly chosen scenarios of commute travel (see Table 6-1). These scenarios were chosen using the statistical software SPSS and conjoint analysis. Each scenario contained one out of three possible choices per attribute, while the attributes were flexibility, cost, and time.[12]

Table 6-1: Description of attribute cards (WCSS, Question Nr. 41)

A You can leave home or work whenever you want. You pay 30 percent more versus your current commute. Your travel time stays the same.	**B** There are only a limited number of departure times you can choose from. Your travel costs stay the same. Your travel time stays the same.	**C** There are many departure times you can choose from. You save 30 percent versus your current commute. Your travel time stays the same.
D There are only a limited number of departure times you can choose from. You pay 30 percent more versus your current commute. Your travel time takes 15 minutes less than now.	**E** You can leave home or work whenever you want. You save 30 percent versus your current commute. Your travel time takes 15 minutes less than now.	**F** There are many departure times you can choose from. Your travel costs stay the same. Your travel time takes 15 minutes less than now.
G There are many departure times you can choose from. You pay 30 percent more versus your current commute. Your travel time takes 15 minutes more than now.	**H** You can leave home or work whenever you want. Your travel costs stay the same. Your travel time takes 15 minutes more than now.	**I** There are only a limited number of departure times you can choose from. You save 30 percent versus your current commute. Your travel time takes 15 minutes more than now.

Source: WCSS 2004.

[12] In transportation research in general, and supported by the mentioned focus group results, these attributes are often seen as the primary factors for choosing a particular mode (Schreffler 2004).

The cost variations (30 percent) were chosen based on average cost savings for carpooling, vanpooling, or using transit according to MORPC's RideSolutions program. The time variations (15 minutes) were conservative and were based on average travel time increases during rush hours compared to regular travel times in the Columbus MSA. It should be noted that card E, as shown in Table 6-1, provides the optimal output for each attribute and thus should have been chosen by all participants as rank 1.

By asking respondents to trade off between scenarios, conjoint analysis is used to determine the optimal features of a transportation service, in the opinion of the respondent, by estimating the weight people place on various factors that underlie their decisions. As mentioned in chapter 3, this particular method has not been utilized before for TDM research in the manner described here. The method, however, was important to the goal of identifying how the attributes flexibility, cost, and time weigh against each other per individual.

All results were analyzed using the statistical program SPSS as well as the GIS software ArcMap 9.2. GIS was particularly useful in visualizing the respondents' home locations and in estimating the carpool and transit potential by residency.

6.2.2 Intranet Survey

In addition to the qualitative survey, an Intranet survey was conducted with all 2,811 employees at the company's downtown headquarters a few months later (see Appendix 7). The objective of this survey was to determine the current modal split at the company as well as to collect further information about the type of TDM measures that would increase employees' likelihood to switch to alternative modes. The survey consisted of questions related to residency, primary commute mode, working hours, ranking of three transportation attributes (flexibility, cost, and time), sociodemographics, and an open-ended question about why employees choose a certain mode. A number of questions were aimed only at SOV commuters. These questions asked about the occasional use of alternative modes, the likelihood to switch if certain TDM measures were implemented, the estimation of vehicle costs per mile, and the maximum gasoline prices employees would be willing to pay before considering altering their travel behavior.

In order to achieve a high response rate, an email was sent to all downtown AEP employees by the head of the environmental department. This email explained that the participation in the study will add to the existing commitment of AEP to environmental stewardship. The email further stated that the survey results will provide information on how to improve all transportation options for AEP employees (see Appendix 7). The email included a link to the Intranet survey, asking employees to fill out the survey within a two-week time frame. A reminder e-mail was sent out one week later in an effort to further increase participation. More than 50 percent (1,433) of the company's employees participated in the survey, providing an overall good response rate.

6.3 Empirical Results to Detect Modal Split Behavior

The survey results are displayed in a way that shows the current travel behavior of AEP employees, their reasons for choosing a particular mode, their housing location in relation to the workplace, and their satisfaction with the current commute. The analysis also discusses attitudes and perceptions towards the various modes of transportation and their likelihood to switch if certain measures were implemented.

The description of the results is based on both the WCSS and the Intranet survey in order to provide a holistic view of the topic based on the individual components of the modal split model. The primary analysis methods are frequency calculations, cross tabulations, and GIS analysis at first to provide a general overview of the results. Advanced statistical analysis, such as regression analysis, cluster analysis, and factor analysis, are then performed and discussed in chapter 7 to detect target groups and key determinants for travel demand.

6.3.1 Characteristics of the Participants

Nearly 60 percent of employees who participated in the WCSS were 46 years or older. The majority (86 percent) of participants were either married or lived in a domestic relationship. Of the 52 respondents, 22 had one or two children under the age of 18 living with them. More than 78 percent held a Bachelor's or higher degree, and half of the surveyed commuters showed a household income of at least $100,000 (before taxes). About 30 percent of the participants reported that they make a household income between $60,000 and $100,000 per year. Almost every participant (46) owned a house. Table 6-2 illustrates these results. While three interviewees were not born in the USA, they did not differ from the group in any obvious way.

The gender distribution of the participants of the Intranet survey (68 percent male versus 32 percent female) is similar to the WCSS results (74 percent male versus 26 percent female). Compared to the overall gender distribution at AEP, women were somewhat overrepresented during the survey. No other personal characteristics were surveyed during the Intranet survey.

Table 6-2: Characteristics of surveyed SOV participants (WCSS)

	Number	Percentage[a]	Missing
Gender			
Male	38	73.1	0
Female	14	26.9	
Age group			
18 to 25 years	2	3.8	1
26 to 35 years	9	17.3	
36 to 45 years	10	19.2	
46 to 55 years	21	40.4	
56 or older	9	17.3	

Table 6-2: Characteristics of surveyed SOV participants (WCSS) - continued

	Number	Percentage[a]	Missing
Marital Status			
Married	43	82.7	
Domestic Partner	2	3.8	
Single	6	11.5	0
Divorced	0	0	
Widowed	1	1.9	
Highest Level of Education			
High school	5	9.6	
Professional/Vocational/Associate's	9	17.3	
Bachelor's	25	48.1	0
Master's	12	23.1	
PhD	1	1.9	
	Mean	**Median**	
Length of commute (in minutes)	34.08	32.50	0
Distance of commute (in miles)	24.56	17.00	

[a] Rounding errors may be responsible for a sum less or greater than 100 percent.

Source: WCSS 2004 analysis. N=52

6.3.2 Modal Split and Reasons for Choosing a Particular Mode

The high usage of automobiles in Columbus can be confirmed by the survey results. Overall, 89 percent of the 1,433 surveyed employees drove alone to work, six percent carpooled, and three percent used the bus (see Figure 6-2). Of the 156 individuals who used alternative modes to work on a regular basis, 57 percent carpooled, 30 percent rode the bus, and five percent biked to work. A total of ten percent of all SOV users and seven percent of all alternative mode users telecommuted at least once a month.

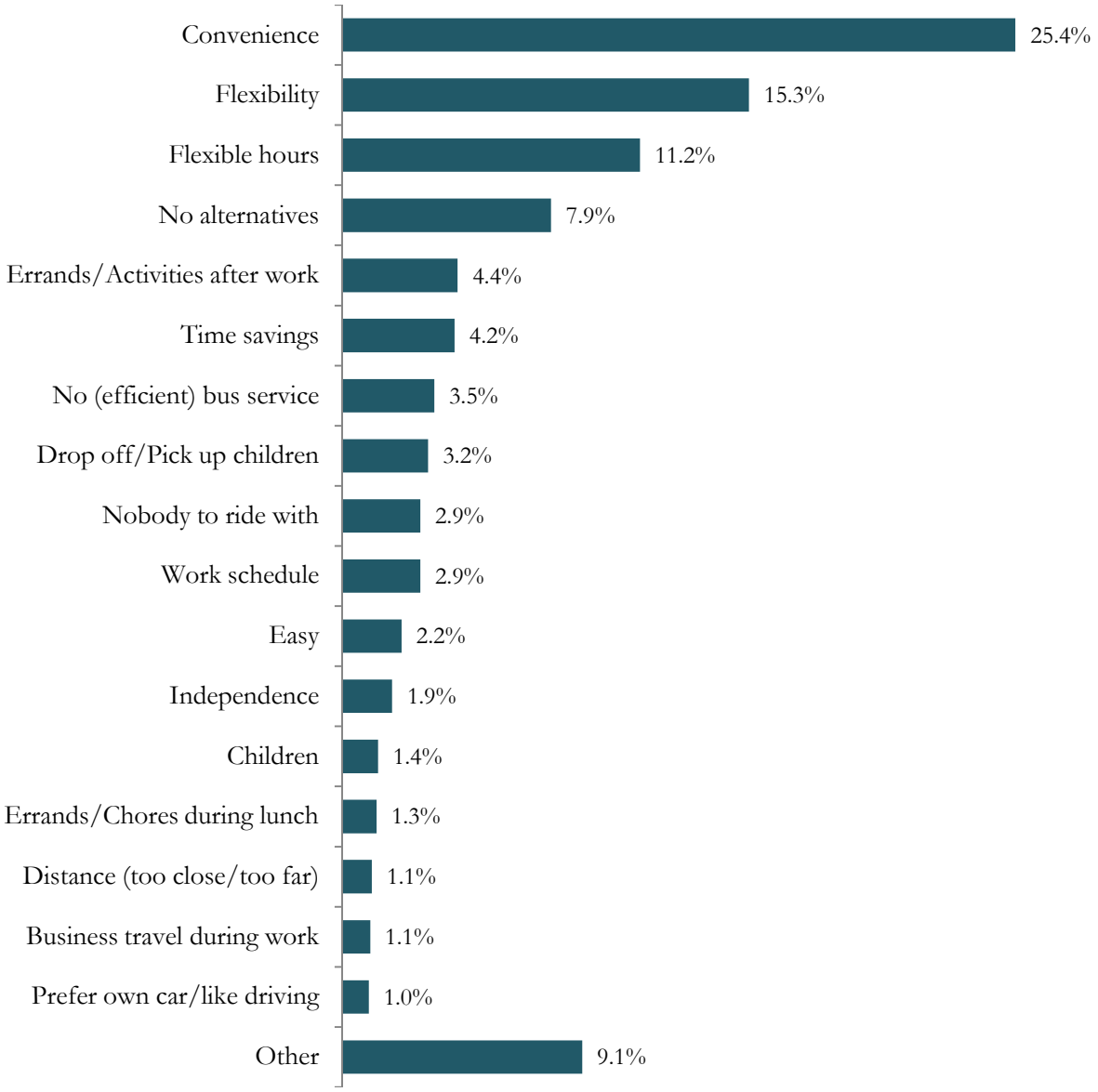
Figure 6-2: Modal Split at the downtown AEP facility (Intranet survey)

Source: Intranet survey 2005 analysis. N=1,433

Employees of the Intranet survey revealed in an open-ended question that their primary reasons for commuting alone via personal vehicle were *convenience* (25 percent) and *flexibility* (15 percent) (see Figure 6-3). These results initially confirm the assumption that flexibility plays a major part in choosing a mode. At least 11 percent of all SOV users stated that *flexible working hours, unexpected overtime,* or *different work schedule* made it difficult for them to schedule a carpool or depend on buses which often end service prior to their departure from the workplace.

Another eight percent of the participants claimed that they have *no alternatives* or *have nobody to ride with* as their reason for driving alone. This lack of alternatives might be due to their work schedule, lack of bus service to their residential area, or missing information and lack of assistance on finding alternative modes. These results also indicate that employees may be lacking information to make other choices (see third box in Figure 2-3).

Figure 6-3: Reasons for driving alone (Intranet survey)



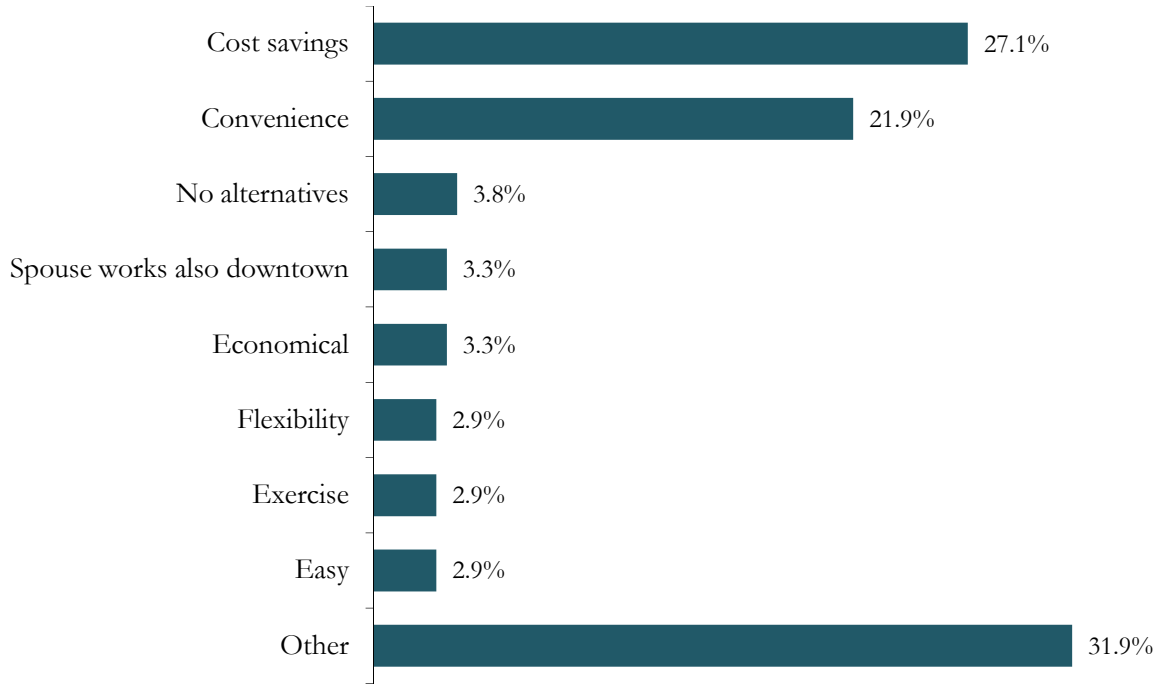
Source: Intranet survey 2005 analysis. N=1,278 (Open-ended question, multiple answers possible)

Fourteen percent (180) of the Intranet survey respondents who regularly drove alone to work stated that they occasionally use alternative modes. Such modes included carpooling (46 percent), riding the bus (37 percent), biking (six percent), walking (four percent), or others (seven percent). Their reasons for normally driving alone were the same as for all SOV users.

In regard to all 156 alternative mode users who participated in the Intranet survey, *cost savings/economical* (30 percent) and *convenience* (22 percent) were chosen as the primary reasons for not driving alone (see Figure 6-4). These results suggest that convenience is a rather

subjective word and can have a variety of meanings, such as flexible, fast, or easy to access. The subjectivity of the meaning could explain why almost the same percentage of SOV drivers compared to alternative mode users stated convenience as their main reason to choose the mode. This assumption further suggests that TDM marketing strategies should focus on changing SOV drivers' perception of convenience so that car travel becomes more inconvenient, e.g. through congestion, high fuel prices, or expensive parking (see restrictive measures as described in section 2.4).

Figure 6-4: Reasons for not driving alone (Intranet survey)

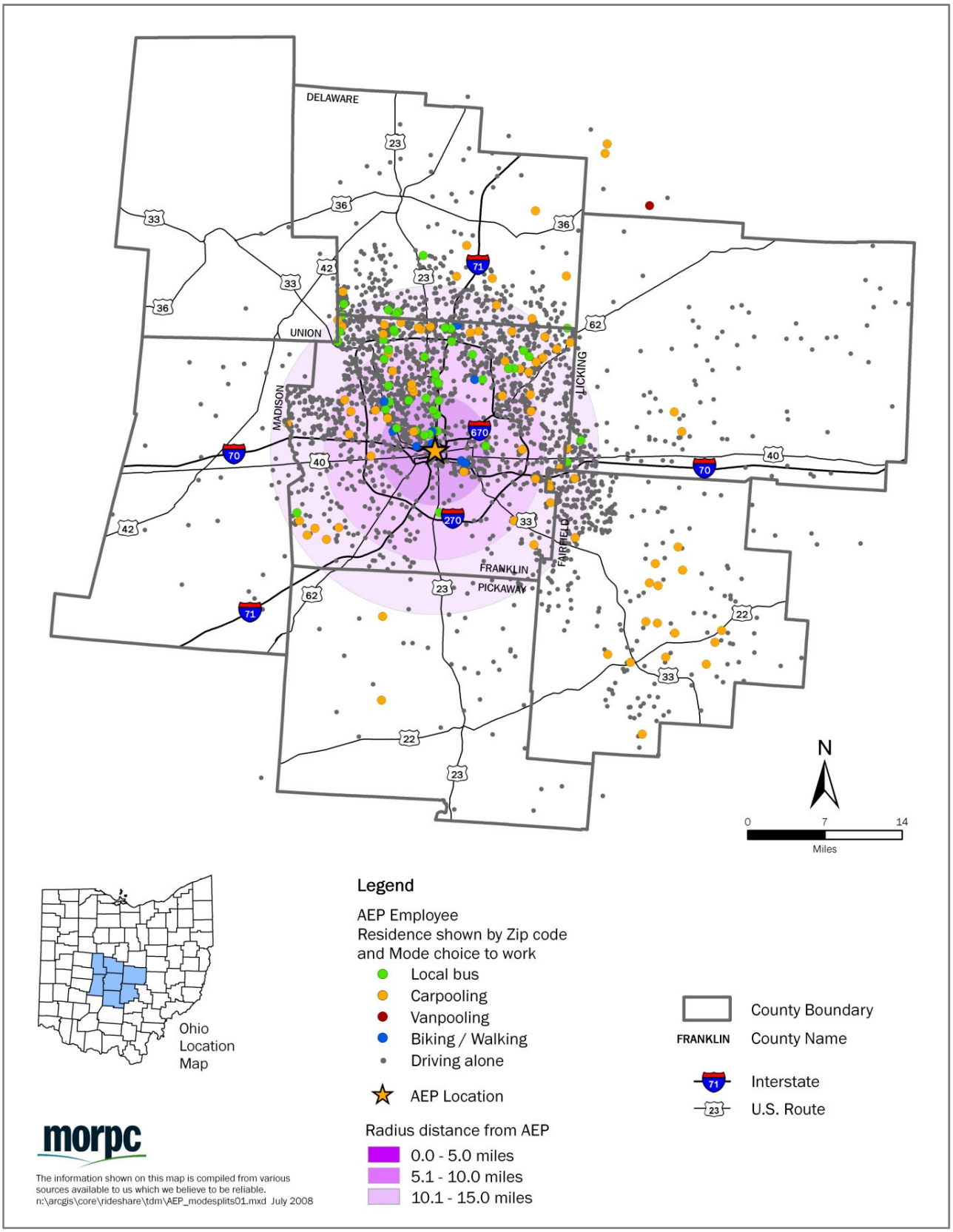


Source: Intranet survey 2005 analysis. N=156 (Open-ended question)

Only four percent of those who did not drive alone to work had no transportation alternatives due to the lack of a car, driver's license, or for some other reason. A total of 12 percent indicated high gas prices or a less stressful commute compared to driving alone as their reasons for using alternative modes. Again, these answers relate back to cost savings, convenience, and flexibility as the primary reasons for choosing a mode.

As Map 6-1 illustrates, the commuting patterns of AEP employees seem to correlate with the availability of services to their homes. As such, most AEP employees who reported that they currently bike or walk to work live within a five mile radius to the firm's downtown headquarters. Employees who regularly take the bus are primarily commuting from the North corridor within Franklin County which offers the most frequent bus service. On the other hand, carpoolers and SOV drivers live scattered around the region since this particular mode does not depend on the proximity to the workplace.

Map 6-1: Modal split of AEP employees by residence zip code (Intranet survey)

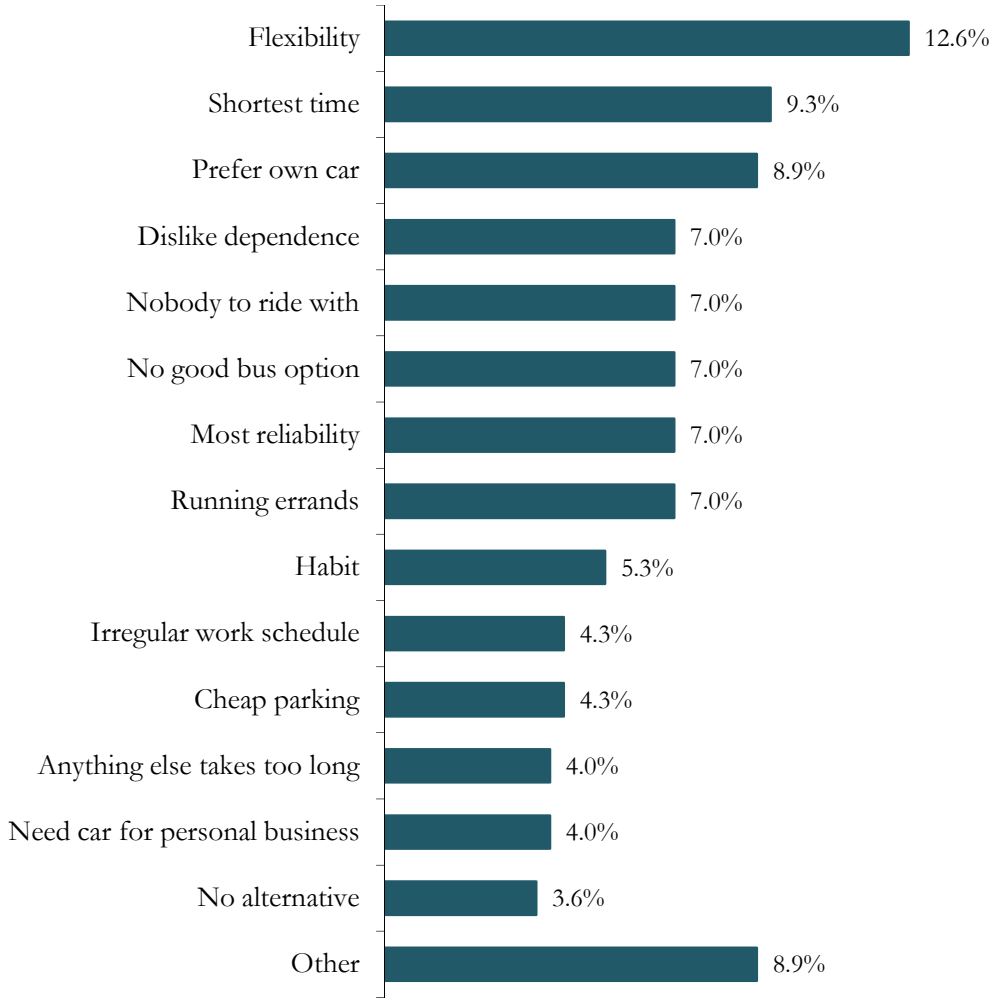


Source: MORPC, own design. Based on ODOT, MORPC, and Intranet Survey data. N=1,433

Participants of the WCSS revealed in a multiple choice question that the primary reasons for driving alone to work were *flexibility*, *shortest time*, and *preference of own car*. *Transporting luggage* or

the *need for business travel* seemed to play no significant role for choosing the car[13]. Figure 6-5 also implies that a negative attitude towards alternative modes of transportation exists. Answers such as *I don't like to be dependent*, *I don't have anyone to ride with*, *there is no good bus option available*, or *using the car is more reliable* show resistance towards other means. These answers further demonstrate the expectancy that alternative modes would not meet their needs in balancing work and private schedule.

Figure 6-5: Reasons for driving alone (WCSS)



Source: WCSS 2004 analysis. N=52 (Multiple answers possible)

Similar to the results of the Intranet survey, 19 percent of the WCSS participants stated that they occasionally use other modes of transportation to work, such as carpooling or riding the bus. These employees did not seem to differ much in sociodemographic or socioeconomic aspects from the overall surveyed group. The participants were equally distributed within gender, age, marital status, and household income.

[13] Please note that it is not possible to compare the Intranet survey results with the results of the WCSS without losing validation and representation due to the different nature of the question (open-ended versus multiple-choice question).

Overall, the survey results revealed that ten percent of AEP's downtown employees currently travel to work by carpool, bus, or bike, and another ten percent of SOV users telecommute at least once a month. These statistics make the AEP location eligible as a BWC. As mentioned in chapter 1, the BWC program recognizes employers who support TDM.

Both surveys also confirmed that the primary reasons for driving alone were convenience and flexibility. In addition, the lack of alternatives and/or lack of information on other means of travel were revealed as contributing factors for SOV travel. Employees who currently used alternative modes indicated that cost savings and convenience were responsible for their choice. However, the way alternative mode users define convenience was not examined in this research. In general, the various reasons for driving or not driving play an important role in implementing and improving alternative modes and in designing marketing strategies.

6.3.3 Housing Distribution and Characteristics

While this paper argues that personal attitudes and constraints are very powerful determinants in choosing a mode, it does not dispute the importance of spatial attributes towards the decision process. The accessibility to different transportation modes is critical in determining if people actually have the option to use another mode but do not choose to use it. The spatial relationship of residences to the AEP workplace is therefore analyzed below.

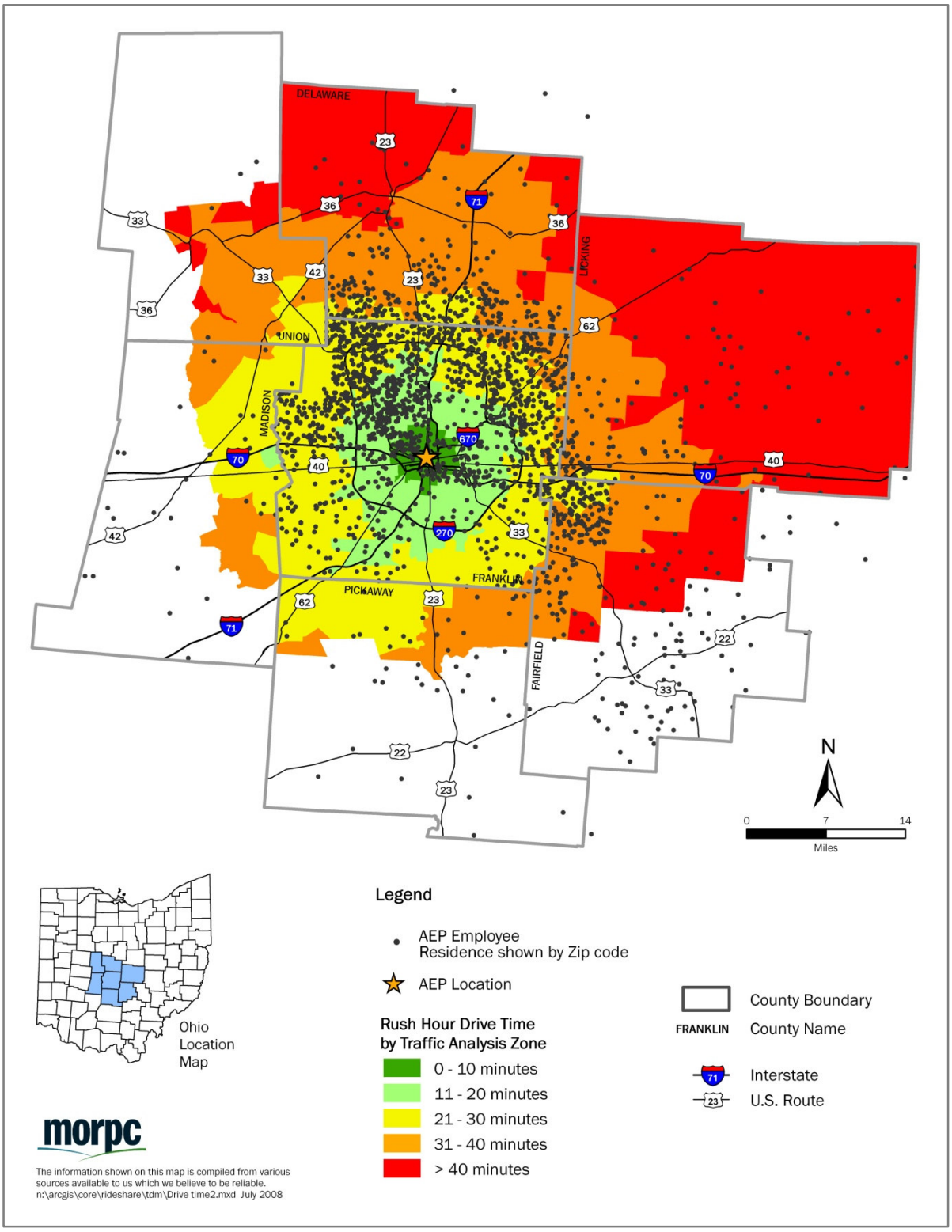
Residence information was provided by the Human Resources Department for all 2,811 AEP employees by zip codes. While actual address information can produce more accurate information about the spatial distribution of employees, the zip codes provide a general idea of the location (Carr and Mitterer 2005:316ff). As illustrated in chapter 5, about 60 percent of all employees live within Franklin County. Using the MORPC transportation model, rush hour driving time estimates were developed using the Traffic Analysis Zones (TAZs). When overlaying these travel time zones with the actual housing information, the map suggests that 20 percent of all employees live within a 20 minute driving distance to work (see Map 6-2)[14]. Another 40 percent live within a travel distance of 21 to 30 minutes, and the remaining reside in areas where the commute takes more than 30 minutes.

The Intranet survey results revealed that about 36 percent of the participants who traveled alone to work experienced a commute of 20 minutes or less. Another 38 percent drove to work within 21 to 30 minutes, and the remaining one-third had a rather long commute of 31 minutes or more. The average driving time was 27 minutes[15]. These statistics are somewhat different to the survey respondents who regularly used alternative modes. Of these commuters, only 55 percent traveled between 11 and 30 minutes while 35 percent commuted between 31 and 60 minutes. The average commuting time for alternative modes users was 32 minutes.

[14] The calculations were made via GIS taking only those zip codes into account that had their centroid within a travel time zone.

[15] The overall commute travel time of all Franklin County residents is 21.9 minutes (see U.S. Census 2000).

Map 6-2: Housing location of AEP employees by zip code and travel time zones



Source: MORPC, own design. Based on Census 2000, ODOT, MORPC, and AEP 2005 employee data. N=2,811

Although the exact address locations are not known, spatial analysis can still help in estimating the potential for alternative modes. For example, in regard to potential transit usage, more than 350 employees live in zip codes serviced by bus line Nr. 2, the line with the highest service frequency. Overall, six bus lines show that they service neighborhoods of more than 400

employees, and an additional ten lines service neighborhoods of 300 to 400 employees (see Table 6-3).

Table 6-3: Number of AEP employees per bus line (intersected zip codes)

Bus Line Nr.	Number of employees	Bus Line Nr.	Number of employees	Bus Line Nr.	Number of employees	Bus Line Nr.	Number of employees
1	406	***18***	465	***45***	183	***69***	18
2	389	***19***	142	***46***	131	***72***	150
3	235	***29***	301	***47***	202	***74***	18
4	133	***30***	412	***49***	140	***81***	132
5	376	***31***	205	***51***	22	***83***	159
6	166	***33***	247	***52***	54	***84***	141
7	79	***34***	71	***53***	135	***87***	106
8	108	***35***	70	***54***	107	***88***	75
9	87	***36***	267	***56***	492	***89***	69
10	372	***37***	302	***57***	313	***92***	99
11	88	***38***	328	***58***	430	***95***	342
12	36	***39***	392	***60***	235	***96***	167
14	43	***41***	186	***61***	392	***97***	43
15	90	***43***	227	***64***	114	***98***	521
16	211	***44***	371	***67***	239		

= Bus line that intersects with zip codes where 300-400 employees live

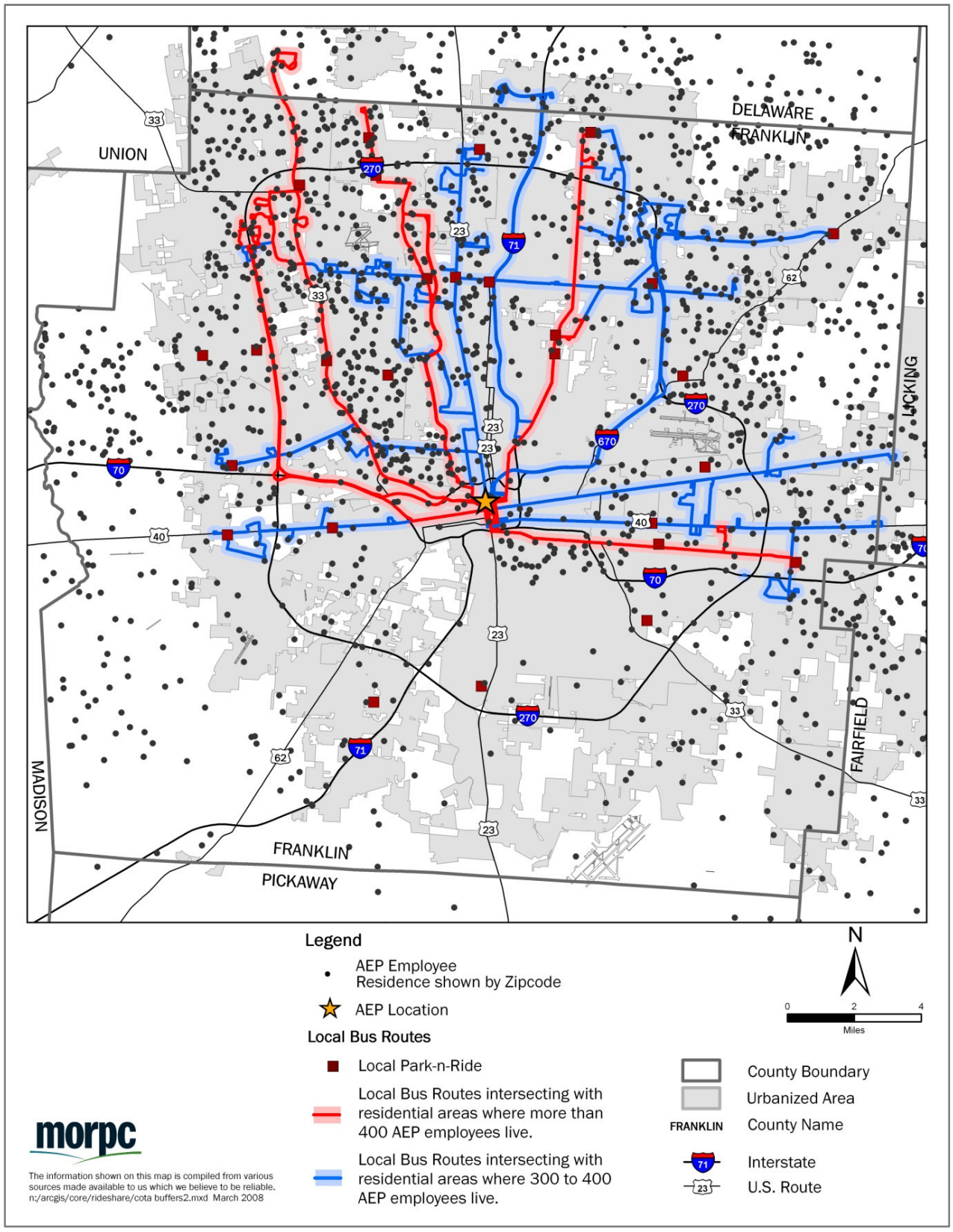
= Bus line that intersects with zip codes where more than 400 employees live

Source: Own GIS analysis using AEP 2005 employee data.

Map 6-3 highlights the major bus lines that service a high number of AEP employees. If the home addresses of every AEP employee were known, it would be possible to determine the exact potential of each bus line by analyzing how many individuals could walk to a bus stop because they live within 1,000 feet (or five minute walking distance) of a bus stop, and how many could utilize a nearby P&R facility (Carr and Mitterer 2005:317ff).

In regard to the 52 WCSS surveyed employees, 24 of the 31 respondents who lived in Franklin County resided in a zip code that is serviced by bus line Nr. 2. The remaining participants lived outside of Franklin County. On average, interviewees experienced a commute of 34 minutes while 50 percent drove less than 32 minutes to work (see Table 6-2). The average distance to work was 18.7 miles, with half of the participants living within 16 miles of the company. Of all interviewed SOV commuters, about 35 percent stated that they knew of a bus stop near home. Only half of the respondents owned a bike. Each household owned on average 2.3 cars, while type and age of cars varied strongly. In 2000, the average number of vehicles in the United States per household was 1.69 and therefore significantly lower than for the survey group (McGuckin and Srinivasan 2004:1-2).

Map 6-3: Selected bus routes that service residential areas with a high number of AEP employees

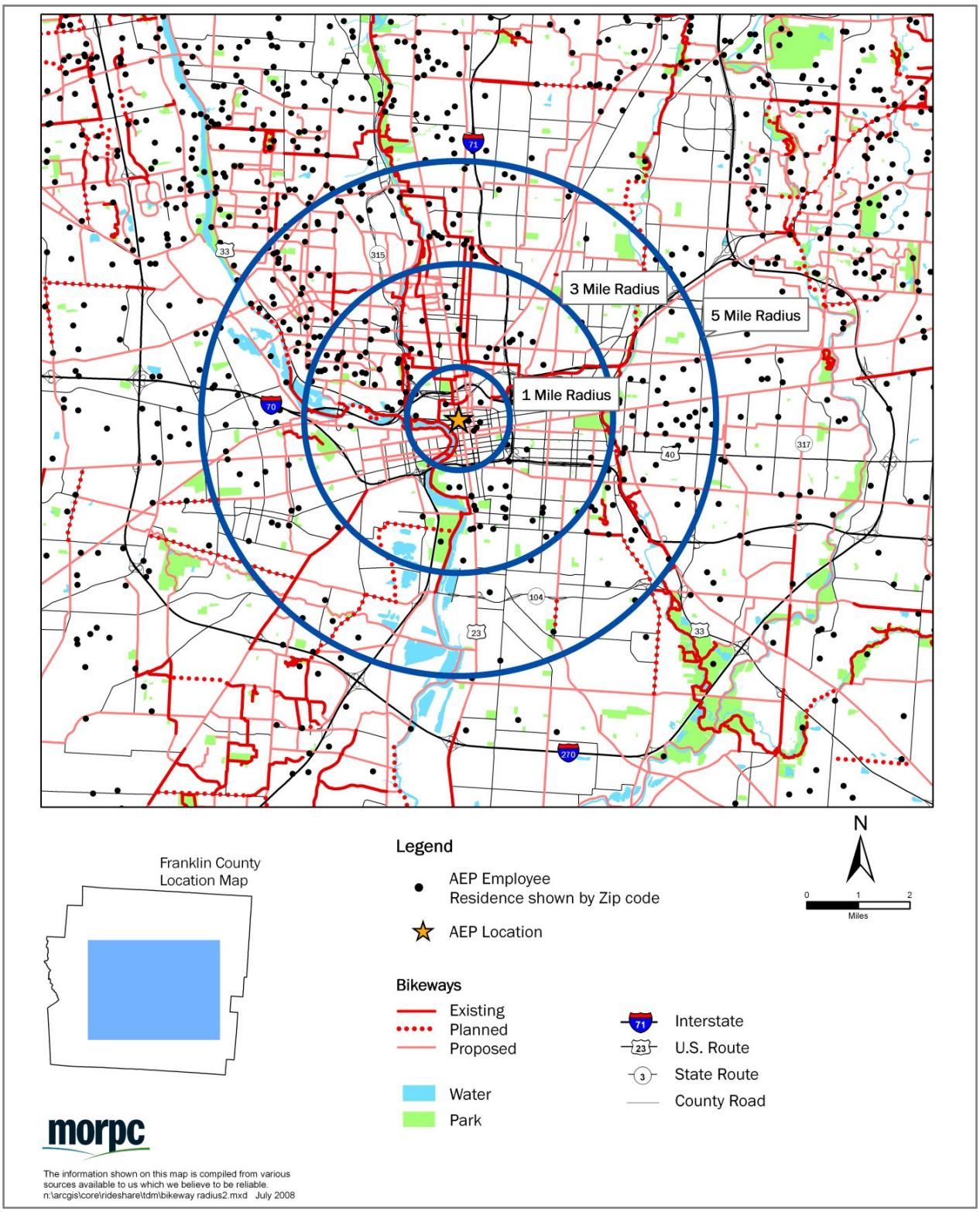


Source: MORPC, own design. Based on Census 2000, ODOT, MORPC, and AEP 2005 employee data. N=2,811

In regard to walking and biking potential, a total of 294 employees live in zip codes that have their centroid within 5 miles of AEP (see Map 6-4). Based on the distance, these employees

could be considered potential bikers or walkers. However, the real potential depends on the availability of safe non-motorist paths.

Map 6-4: AEP employee potential for biking to work

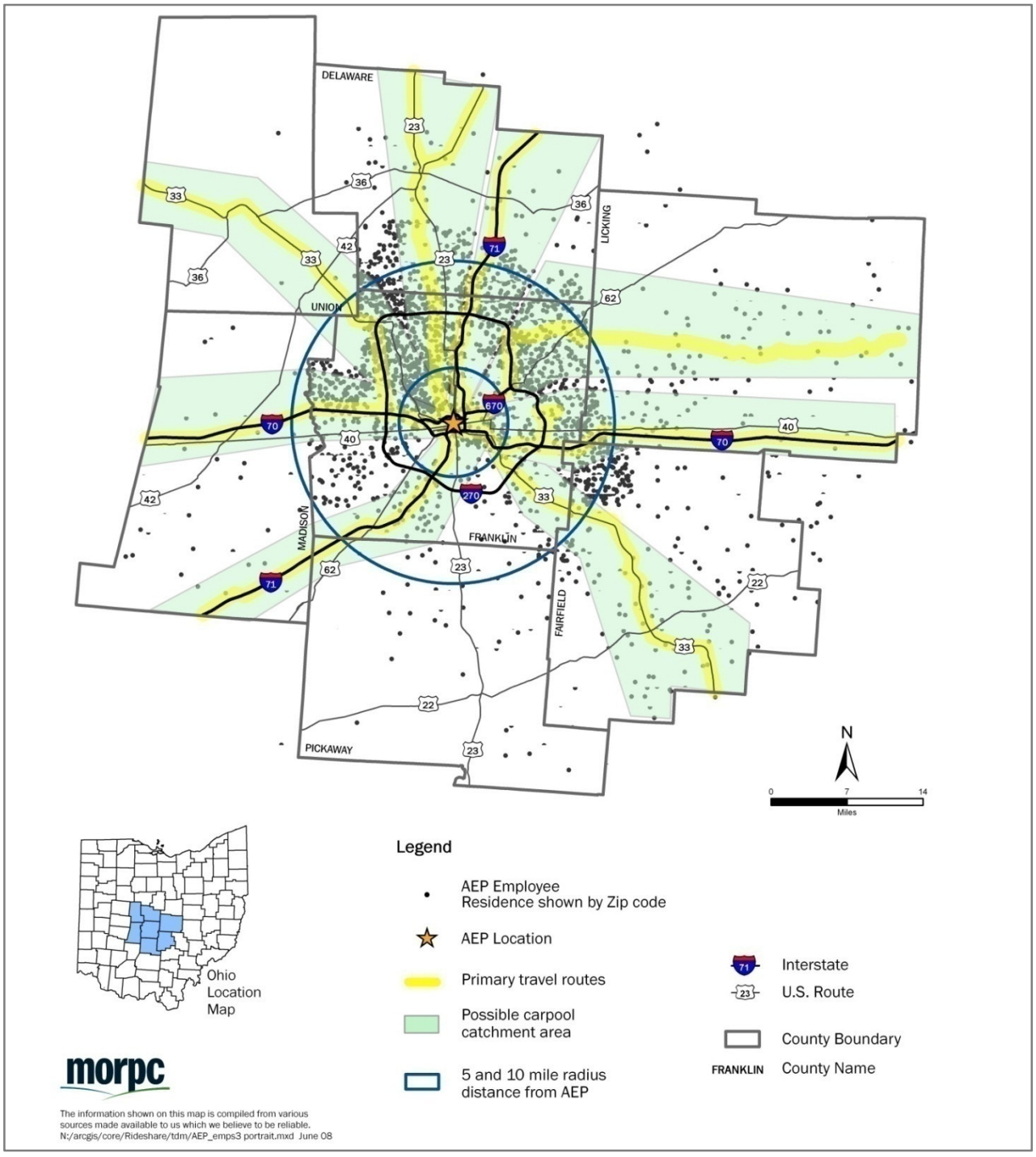


Bikeways legend: *Existing* refers to bikeways that are already built. *Planned* refers to bikeways that will be built in the near future. *Proposed* refers to bikeways that are recommended to be built sometime in the future.

Source: MORPC, own design. Based on Census 2000, ODOT, MORPC, and AEP 2005 employee data. N=2,811

Not only does the housing distribution show potential for public transportation or non-motorist modes but also for carpooling and vanpooling (see Map 6-5). In regard to carpooling, four zip codes in particular contained more than 100 employees. The high-density of employees in one area provides potential for ridesharing. Furthermore, several main corridors could be defined as possible vanpooling routes. To form a vanpool, only seven to 15 workers residing in one corridor need to agree on departure times.

Map 6-5: AEP employee catchment areas for carpooling and vanpooling

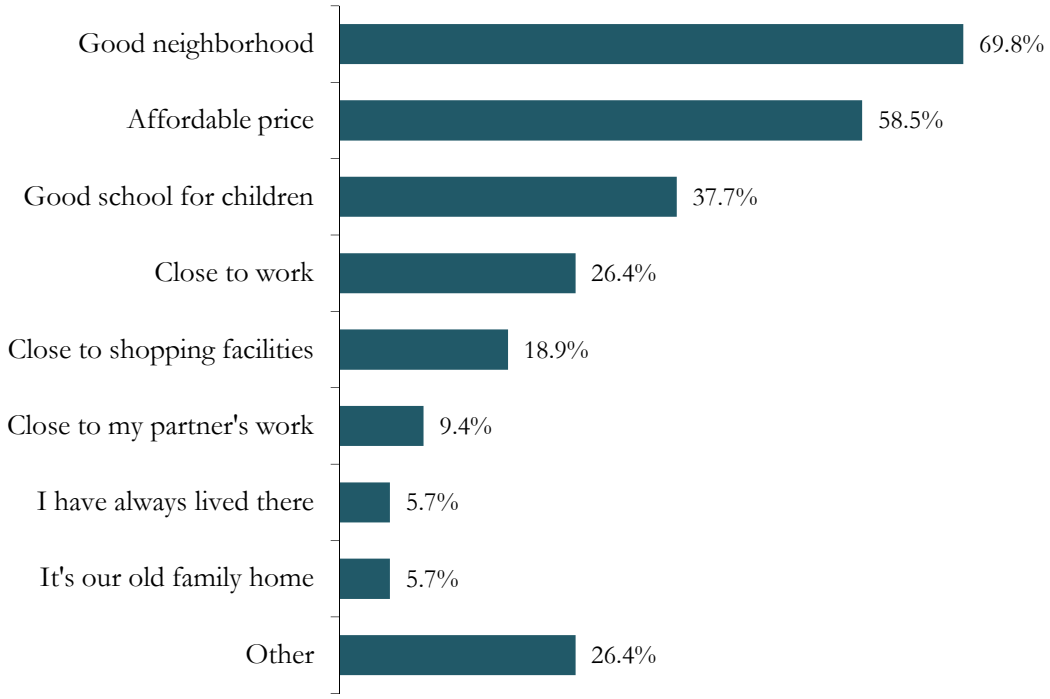


Note: Catchment areas are determined based on proximity of employees to major arterials.

Source: MORPC, own design. Based on ODOT, MORPC, and AEP 2005 employee data. N=2,811

Many WCSS participants responded that their choice of home location was based on criteria such as *good neighborhood*, *house affordability*, and *high-quality school districts* (see Figure 6-6). However, 26 percent of the respondents stated that they wanted to live close to work. Of these participants, only 58 percent lived within a ten mile radius to work, while the remaining resided between 11 and 17 miles away, experiencing a drive of 20 to 30 minutes. Therefore, 'proximity to work' as defined by American commuters does not always correspond with the way TDM professionals define it.

Figure 6-6: Reasons for choosing housing location (SOV commuters, WCSS)



Source: WCSS 2004 analysis. N=52 (Multiple choice)

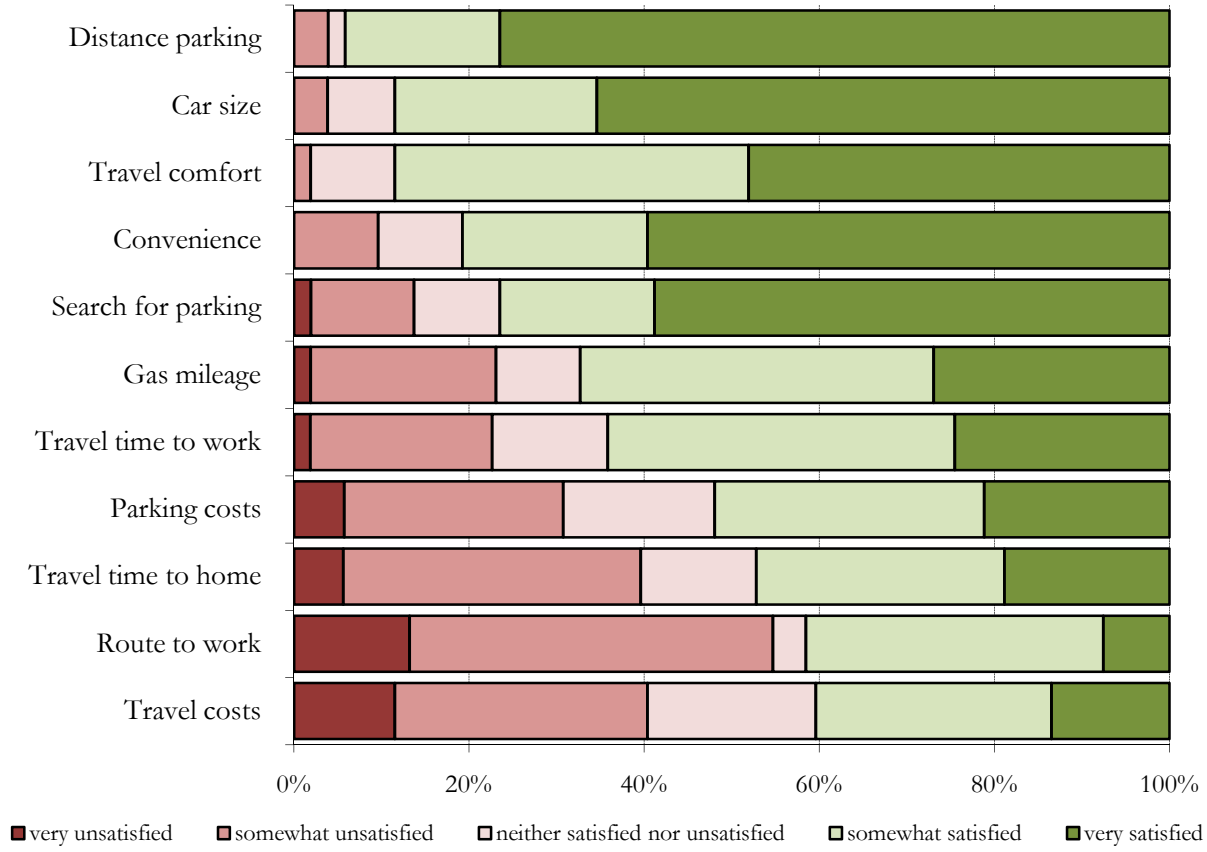
In general, residential proximity to the workplace offers possibilities for biking and walking and for improving public transportation. Simultaneously, employee housing densities along certain corridors allow the formation of carpools and vanpools. TDM strategies based on residential information are discussed in chapter 8.

6.3.4 Satisfaction with Commute

Even though people choose their own home and preferred transportation mode, it does not mean that they are satisfied with their commute. Therefore, the satisfaction with the individual's commute was surveyed in the WCSS. Respondents rated their satisfaction with the current commute an average of 3.6 on a scale from 1 to 5, with '1' being very unsatisfied and '5' being very satisfied.[16] Figure 6-7 demonstrates that the surveyed commuters were least satisfied with their route to work and travel costs.

[16] This calculation does not take the variables *distance from parking to work* and *car size* into account. If all variables were included, the average score would rise to 3.8.

Figure 6-7: Satisfaction with current commute (SOV commuters, WCSS)



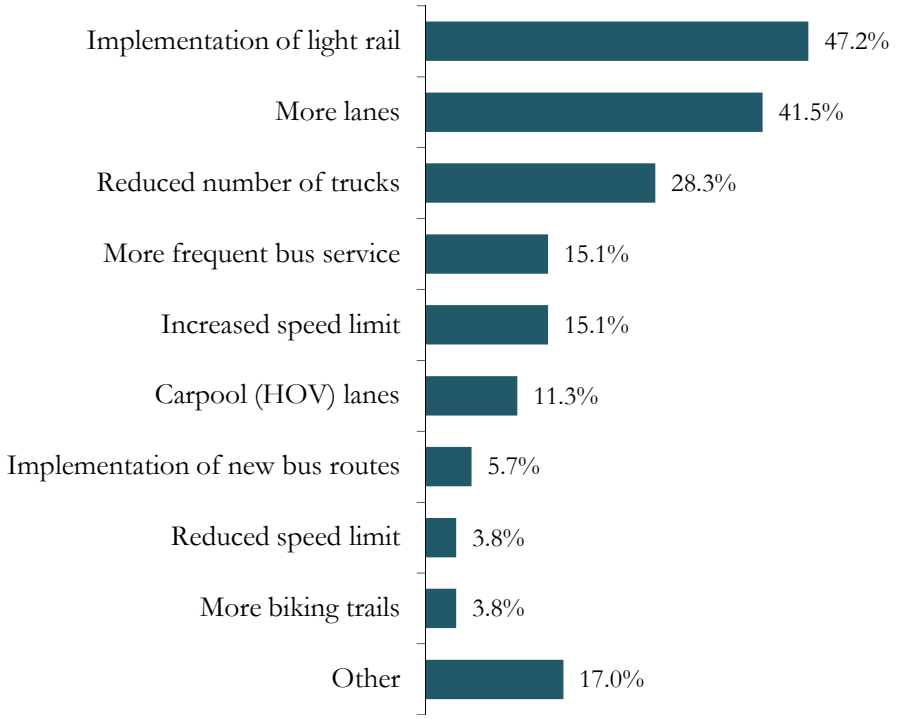
Source: WCSS 2004 analysis. N=52

Nearly half of the WCSS participants felt that the implementation of a light rail system could improve their commute (see Figure 6-8). More than 40 percent of the respondents believed that the construction of additional roadway lanes would also make their overall commute more satisfactory. Approximately 30 percent of the participants would like to see the number of trucks (semis) reduced. Specific suggestions included *better transition for exit or entry ramps*, *better construction management, better timing of lights,* and *improved bus service* or *Park and Ride*. While the implementation of a light rail system relates to another mode of transportation, the next three preferred route improvements are associated with making car travel more convenient. The remaining suggestions for route improvements demand incentivizing alternative modes. These results clearly relate back to section 2.4 where incentives and restrictive measures are described as factors that can help realize a modal shift.

As Figure 6-3 illustrated, SOV users did not see *cost savings* as one of their reasons for traveling by car. This statement indicates that they at least acknowledge that driving alone is relatively expensive. In fact, one third of the Intranet survey participants who drove alone to work revealed that they would seriously consider switching to alternative modes if fuel prices rose between $2.50 and $3.00 per gallon. Another 43 percent of the respondents indicated that gas prices would have to reach $3.50 to $4.00 per gallon for them to consider a mode change. Regardless of gas prices, 22 percent of the participants would not, or felt that they could not, use an alternative mode despite growing vehicle costs. The Intranet survey results also showed that only 28 percent correctly estimated or over-estimated their SOV costs. More than 70

percent believed that their automobile costs per mile were lower than the average of 56.1 cents per mile calculated by the American Automobile Association in 2005 (AAA 2005).

Figure 6-8: Desired route improvements (SOV commuters, WCSS)



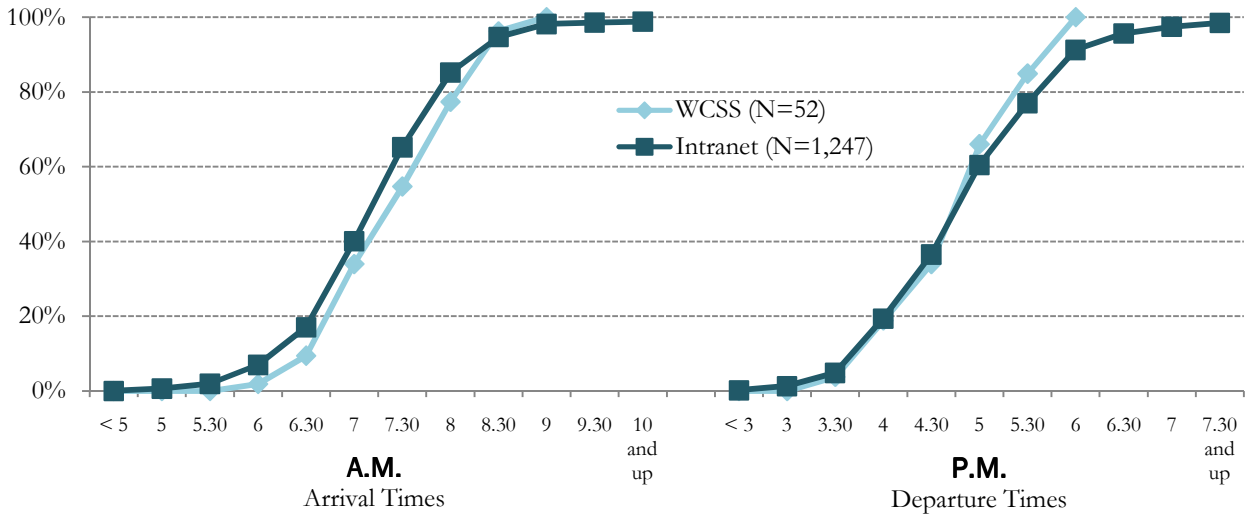
Source: WCSS 2004 analysis. N=52 (multiple answers possible)

Since most participants of the WCSS were least satisfied with both their route to work and their travel costs, it can be assumed that traffic congestion on major highways leading to higher travel costs is partly responsible for their discontent. The current increase in fuel prices aids to this dissatisfaction. Both of these issues can be addressed through TDM. However, in order to get employees to switch their mode of transportation, alternatives need to be made available to them and marketed in an attractive way. Part of effective marketing is knowing which transportation options are available to them based on working hours.

6.3.5 Working Hours

It is not only important how and from where employees commute but also during which hours. Introduced to distribute traffic volume during rush hour, more and more companies allow their employees to work on what is called 'flextime', a scheduling method established in the hope to reduce peak hour traffic and to accommodate personal schedules. Yet, there is evidence that most people either still choose to drive during rush hours or that the provided flexibility makes them want to use their car more (Stern et al 2002:126ff, Picado 2000:6). The survey results confirm that the majority of employees arrive and leave work during rush hour times and therefore strongly contribute to traffic congestion. For example, the Intranet survey results indicated that 85 percent of all SOV users arrived at the office before 8:30 a.m. and 76 percent departed before 6 p.m. (see Figure 6-9).

Figure 6-9: Arrival times [a.m.] and departure times [p.m.] of AEP employees



Source: Intranet survey 2005 and WCSS 2004 analysis (cumulative percent)

The arrival times were similar for alternative mode users where 90 percent arrived at work before 8:30 a.m. in the morning. However, significantly more participants in this group (89 percent) departed before 6:00 p.m. in the evening. In contrary, almost five percent of all car drivers stayed past 7 p.m. whereas every alternative mode user had left the workplace by that time. The WCSS results showed further that more than half of the respondents arrived at work by 8:00 a.m. and left between 5 p.m. and 5:30 p.m. in the afternoon.

These results indicate that many people continue to drive during peak hours and work a fairly rigid schedule. These fixed working hours could make them alternative mode users. However, other factors might influence their mode choice to which the next sections could give answers.

6.3.6 Importance of Transportation Services Attributes

The WCSS in particular requested the individual's ranking of certain transportation features. Two questions (Nr. 32 and 33) addressed this subject matter, where the former requested the ranking of 12 attributes from 1 to 12 (with '12' being the most preferred) and the latter demanded an orderly scaling of attributes from '1' being very unimportant to '5' being very important. The importance WCSS respondents placed on attributes regarding transportation services is listed in Table 6-4. While some of these attributes can be measured objectively, such as cost and time, others are subjective, such as safety or convenience. The difference in objectivity versus subjectivity needs to be kept in mind when developing marketing strategies.

The ranking order for both questions shows as follows: convenience/flexibility, then time, then cost. Time seemed to be the second most important factor in choosing a mode. However, the WCSS stated-ranking question (Nr. 41), which utilized plan cards derived through conjoint analysis, provided different results. This task asked participants to rank index cards that described feature characteristics of transportation choices by their preference (see Table 6-1). Only transportation attribute scenarios and attribute levels were provided to the participants, without referring each scenario to a particular mode.

Table 6-4: Importance of attributes by ranking and orderly scaling (SOV commuters, WCSS)

Attributes	Rank (Average)		Attributes	Scale (Average)
Convenience	11.02		Convenience	4.58
Flexibility	*9.96*		Short time	4.29
Travel time	8.66		*Safety*	*4.21*
Cost	8.6		Low cost	4.18
Comfort	7.87		*Car at work*	*3.87*
Pollution	6.06		No parking search	3.85
Parking	5.79		Less polluting	3.58
Relaxing/Reading	*4.96*		Comfort	3.57
Privacy	4.47		Privacy	3.21
Pick up others	4.43		Pick-up others	2.73
Socializing	*3.6*		Status	2.09
Status	2.6			

The italicized attributes were not asked in the respective question, prohibiting comparisons between the results.

Source: WCSS 2004 analysis. N=52 (Questions Nr. 32 and 33)

To determine the importance or utility individuals placed on each attribute by their rank choice, a simple regression analysis was performed. In this case, the rankings that a respondent gave to each scenario were coded from 9 being 'most preferred' to 1 being 'least preferred.' In addition, each attribute (flexibility, cost, and time) was dummy-effect coded. Each attribute contained three levels, however, only two (cost and time) clearly described situations that were better, the same, or worse than today. The attribute 'flexibility' described the levels as high, medium, or low. Each card received dummy codings for two of the three attribute levels: '1' represented 'yes' and '0' represented 'no' (see Table 6-5). The third level served as the default.

Table 6-5: Dummy coding of attribute levels per plan card

Cards	High Flexibility	Medium Flexibility	Higher Costs	Lower Costs	Higher Time Delay	Lower Time Delay
A	1	0	1	0	0	0
B	0	0	0	0	0	0
C	0	1	0	1	0	0
D	0	0	1	0	0	1
E	1	0	0	1	0	1
F	0	1	0	0	0	1
G	0	1	1	0	1	0
H	1	0	0	0	1	0
I	0	0	0	1	1	0

Source: WCSS 2004. 1=Yes, 0=No (Question Nr. 41)

For the regression analysis ($y = a + b_1x_1 + b_2x_2 + \ldots + b_jx_j$), the respondent's ranking per card served as the dependent variable (y) while the attributes and their parameter values served as the independent variables (x_j). The value of the constant (a) and the regression coefficients (b_j) were determined from the sample data. Therefore, the obtained regression coefficients (r^2) or utility values explain the influential strength of each independent variable (attribute) on the dependent variable (rank choice) for every individual.

Each respondent received a regression coefficient (r^2) per attribute based on his/her ranking. In this regard, the majority of respondents valued *time* the least of the three attributes when choosing between possible transportation scenarios. A total of 41 percent of the respondents valued *flexibility* most, 36 percent *cost savings*, and 21 percent *time*.

This discrepancy in results could be explained by the amount of savings (30 percent / 15 minutes) described in the plan cards, suggesting that the ranking order of attributes will change depending on the amount of money or time that could be saved. The results also indicate that costs become more important when a certain price level is reached. Thus, as costs rise, flexibility and time decrease in value. These results suggest that people need realistic scenarios in order to define which attribute is most important to them. It also confirms the assumption that people's behavior cannot simply be defined through sociodemographics or spatial analysis, but that advanced methods, such as conjoint analysis, are necessary to better understand the decision process. The fact that the importance level changes between these three attributes further illustrates that information related to the various modes needs to be easily available to people so that they can make educated decisions. Further research is necessary to define the threshold that will increase the value of *cost savings* or *time savings*.

The results of the Intranet survey cannot be compared to the WCSS results since the structure of the Intranet survey was different and did not involve plan cards with transportation scenarios. Participants of the Intranet survey simply had to rank the three variables based on importance. This approach resulted in the following statistics: the majority of SOV users ranked *flexibility* as their most important factor for choosing a mode (72 percent), followed by *time savings* (18 percent), and *cost savings* (ten percent).

This ranking is in contrast to alternative mode users where only 40 percent valued *flexibility* most, 36 percent valued *time savings,* and 24 percent valued *cost savings*. In addition, *flexibility* was not as important to employees who either experienced a very short commute (one to ten minutes) or a very long commute (46 to 60 minutes). *Cost savings*, on the other hand, became more important as total driving minutes increased, especially when the length of travel was greater than 60 minutes one way. *Time savings* was found to be very important for commuters with travel times of less than ten minutes, and least important for most commuters with travel times of 61 or more minutes one way. The difference in ranking the three attributes reveals that employees of greater distance placed more importance on cost savings, while employees of shorter trips valued time savings most. A so-called perception effect is often responsible for viewing the last five minutes of a trip as more critical the shorter the trip.

A good marketing plan can only be created if the various target groups are known. Based on the analysis above, it seems that the primary three attributes (flexibility, cost savings, and time savings) are valued differently throughout transportation groups and between employees with dissimilar travel distances to work. These variances should be acknowledged, considered in employers' transportation policies, and included in the marketing process. Chapter 7 describes different approaches on how to cluster participants of both surveys into target groups.

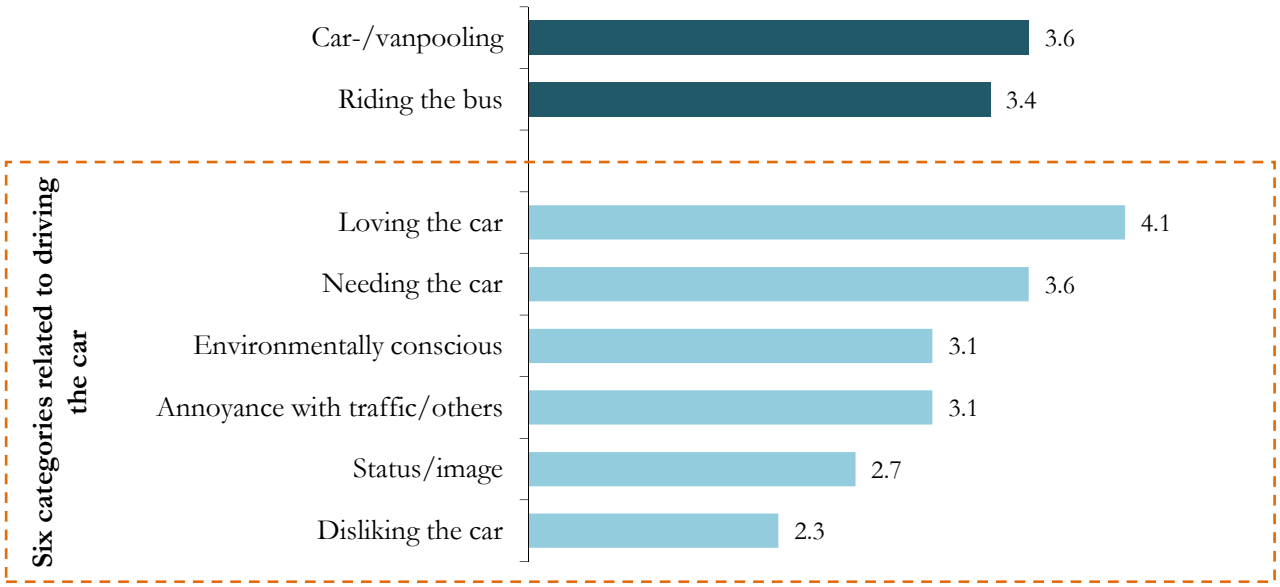
6.3.7 Attitudes and Perceptions

Not only the importance of transportation attributes but also the individual's attitudes towards the different modes of transportation are critical when creating marketing strategies. To better understand why SOV users do not choose alternative modes of transportation for their trip to work, it is important to identify the perceptions they currently carry towards the various transportation services. Figure 6-10 illustrates these attitudes. A score between 3.5 and 5.0 represents a more positive attitude and a score between 1.0 and 2.9 a rather negative one. All scores in-between indicate a somewhat neutral attitude.

The WCSS questions Nr. 36 through 38 were used to identify the various perceptions that SOV commuters have towards driving the automobile, ridesharing, or taking the bus. The results revealed that respondents ranked statements that related to the public transit system on average 3.4 out of 5 points. The global score for statements regarding carpooling and vanpooling was 3.6, showing a slightly more positive perception towards sharing a ride.

In order to better comprehend the general mindset of commuters in regard to driving the car, the 26 attitudinal statements of question Nr. 38 were divided into six categories as part of the analysis (see Appendix 8). Figure 6-10 illustrates that most people carried a much more positive attitude towards statements related to loving the car or needing the car than to statements related to the status or image of the car. The respondents were divided in their opinion on statements related to the *annoyance with traffic* or *being environmentally conscious*, resulting in an overall average of 3.1 index points.

Figure 6-10: Attitudes towards the various modes of transportation (in average index points) (SOV commuters, WCSS)



Source: WCSS 2004 analysis. N=52 [Index range from 1 = 'I don't agree at all' to 5 = 'I very much agree']

Most respondents acknowledged the fact that traffic has become significantly heavier over the last five years (4.3) and that this increase in automobile volume is the source of serious problems (3.9). That most commuters then still drive despite its negative impact does not

necessarily reflect a lack of concern but may instead simply result from the unavailability and unawareness of other comparable modes of transportation. The consequences of driving, such as traffic, air pollution, and an increased stress level associated with traffic congestion, are either accepted or not perceived to be a direct result of their driving. These results can be attributed to Huey and Everett's (1996) reinforcement delay theory mentioned in chapter 2.

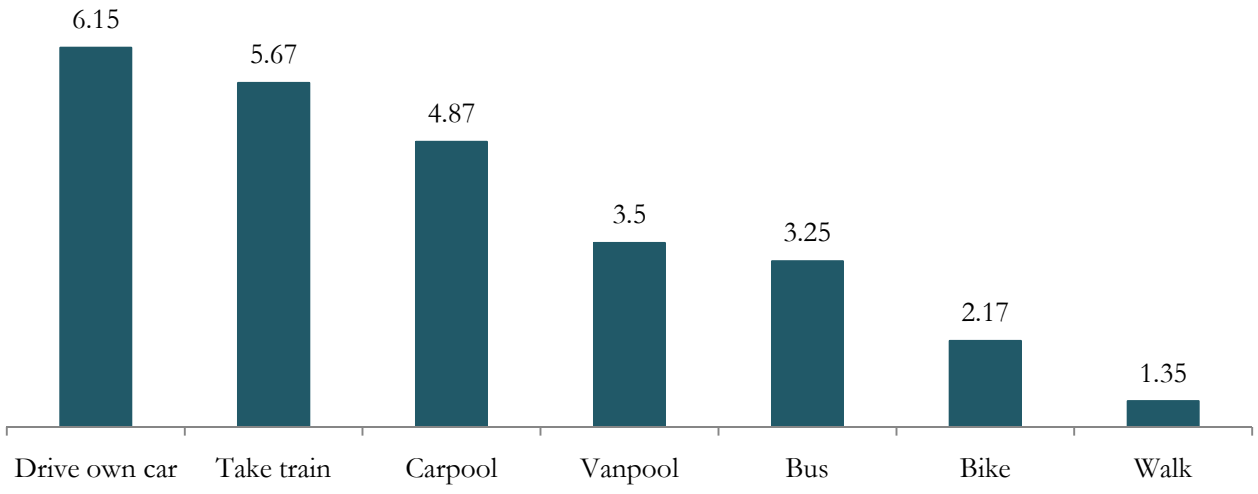
The overall attitudes towards bus service and its riders were generally less positive than for carpooling and vanpooling. A negative image towards the local transit system was also demonstrated throughout the comments provided by some of the Intranet survey participants (see Appendix 9). Such comments referred to inconvenient bus access points, long commute times, and unavailable information for bus stops and service frequency.

On a more positive note, more than half of all WCSS participants agreed with the statement 'I don't care about the mode of transportation as long as I get to work quickly', resulting in an average score of 3.3. This statement strengthens the idea that a mode switch could be possible. However, based on the feedback received from both riders and non-riders, the alternative modes of transportation need to be made comparably attractive to the automobile before a transformation in travel choices can take place. An important indicator for determining which transportation modes need the most attention in regards to image and service improvements is the rank order of the modes given by the participants.

6.3.8 Ranking of Transportation Modes

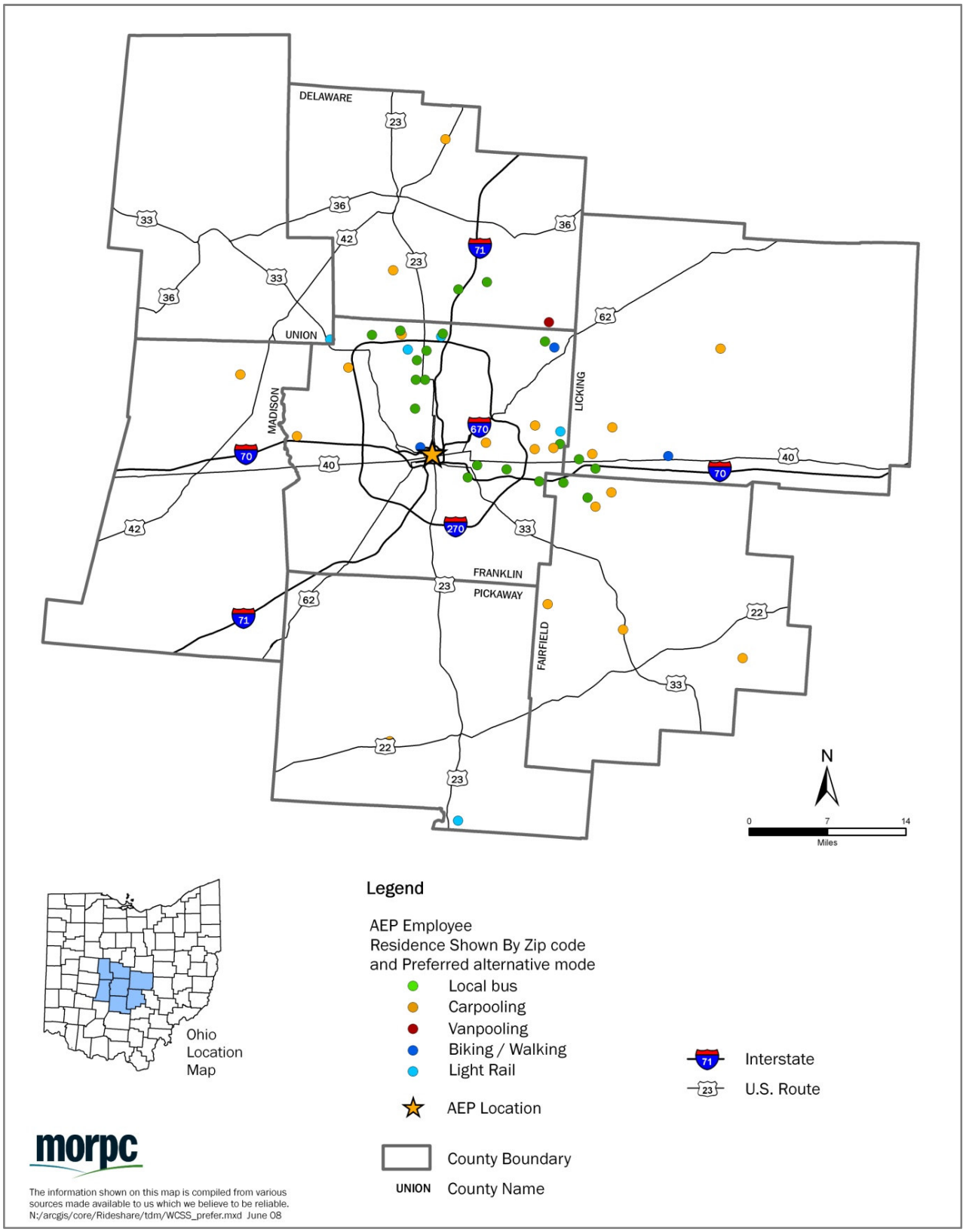
The WCSS asked the respondents to rank seven different transportation modes (car, train, carpooling, vanpooling, bus, biking, walking) based on their preference. The results showed that *biking* and *walking* were the least favored (see Figure 6-11). This lack of interest in non-motorized modes is often due to the distance of residency to work and to the unavailability of comprehensive bike and walking trails in the region (see chapter 5). Clearly, the car and train ranked highest, although a train is currently not an option for commuters in Columbus.

Figure 6-11: Ranking of seven different transportation modes (SOV commuters, WCSS)



Source: WCSS 2004 analysis. N=52 [Ranking from 7 = 'most preferred mode' to 1= 'least preferred mode']

Map 6-6: Preferred alternative mode of transportation if car was unavailable (SOV commuters, WCSS)



Source: MORPC, own design. Based on ODOT, MORPC, and WCSS 2004 data. N=52

Despite an overall favoring of the automobile, nine respondents did not choose the car as their first two options, showing their possible frustration with their current commute. Exploring

these candidates further, the majority of these participants experienced a drive of 30 minutes or more but lived within Franklin County, with the exception of two who lived in Fairfield County. Their most frequent reason for driving was the *absence of a reasonable bus option* (66 percent), followed by *It's my only choice/I have no alternative* (44 percent), and *I want to be flexible* (44 percent). In accordance with these statements, the overall likelihood of these nine respondents to switch to other means of transport was fairly high, with an average score of 2.2 out of 3 index points. Two-thirds of these employees would take the bus if no car was available, and the remaining would carpool, vanpool, or bike. The sociodemographics of this group did not seem to differ much from all other participants, except for showing a slightly higher percentage of women (33 percent).

In response to another question (Nr. 42) that asked for the preferred transportation mode if no car were available, riding the bus (40 percent) and carpooling (38 percent) were equally chosen as the alternative mode of transportation, especially since the choice of a light rail system was not given. Yet, of all possible ideal transportation modes (including trains) the bus ranked a fairly low score of 3.8 out of seven points.

Of the 21 commuters who chose the bus as the best alternative if no car was available, 76 percent lived in Franklin County which is serviced by the local bus authority. Nine percent lived in Delaware or Fairfield County. The carpoolers and vanpoolers resided in either county that composes the Columbus MSA, and the two bikers resided in Franklin County. These results suggest that most employees who lived close to a bus route were more interested in using public transportation than those who lived in more remote areas (see Map 6-6).

Overall, the survey answers signify that COTA's image needs to be modified. The bus still seems to be viewed as an option only for those who have no other choice, especially when the frequency and speed of bus services, particularly during rush hour, is not efficient enough. The likelihood to switch based on various incentives and restrictions is discussed next.

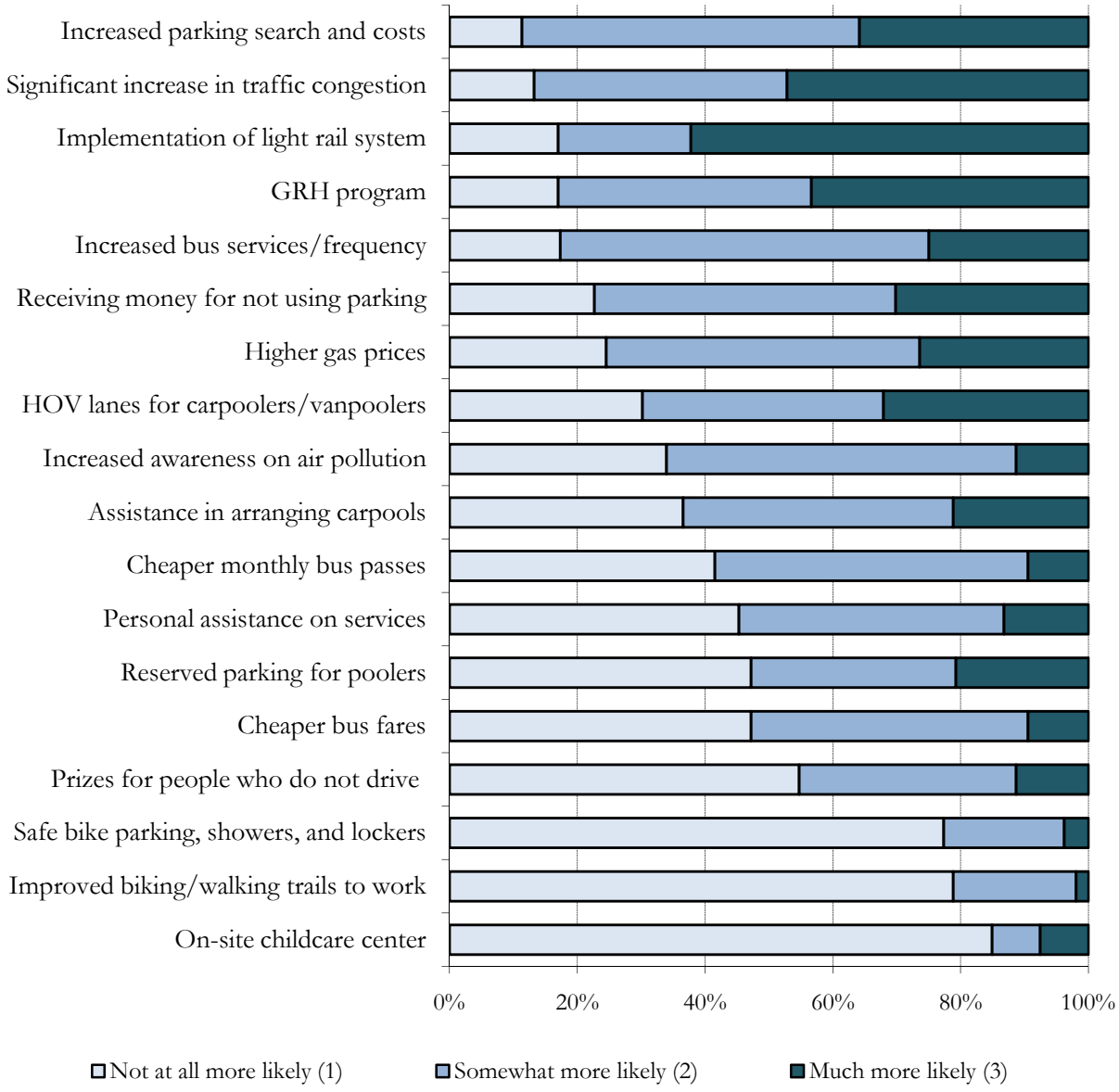
6.3.9 Likelihood to Switch

Each survey asked SOV commuters about their likelihood to alter their commute behavior given a set of both disincentives, such as additional costs or increased traffic, and incentives, such as services, transportation improvements, or financial incentives. A moderate interest in alternative modes of transportation was obvious throughout the WCSS. The results indicated an overall likelihood to switch of 1.9 out of 3.0 index points. More than 60 percent of the respondents would be much more likely, and 21 percent would be somewhat more likely, to switch modes if a light rail system were available to them (see Figure 6-12). More so, 85 percent of the participants (58 percent strongly) agreed with the statement *If there were a fast, clean train system, I would use it*. Unfortunately, at this point, plans for a light rail system are on hold. Instead, the city is now lobbying for a downtown streetcar system.

For 86 percent of all WCSS respondents, a higher likelihood of changing transportation modes could also result from a restrictive measure. A particular restrictive measure would be a considerable increase in traffic congestion. As already mentioned, traffic congestion is expected to grow significantly over the next two decades, and land resources to expand roadways are

scarce. Even if land was available, highway expansion cannot continue because it reduces the livability of a region and is simply not financially feasible. These facts combined with the obvious participants' frustration of traffic jams emphasizes the importance of establishing TDM measures now that increase alternative mode usage.

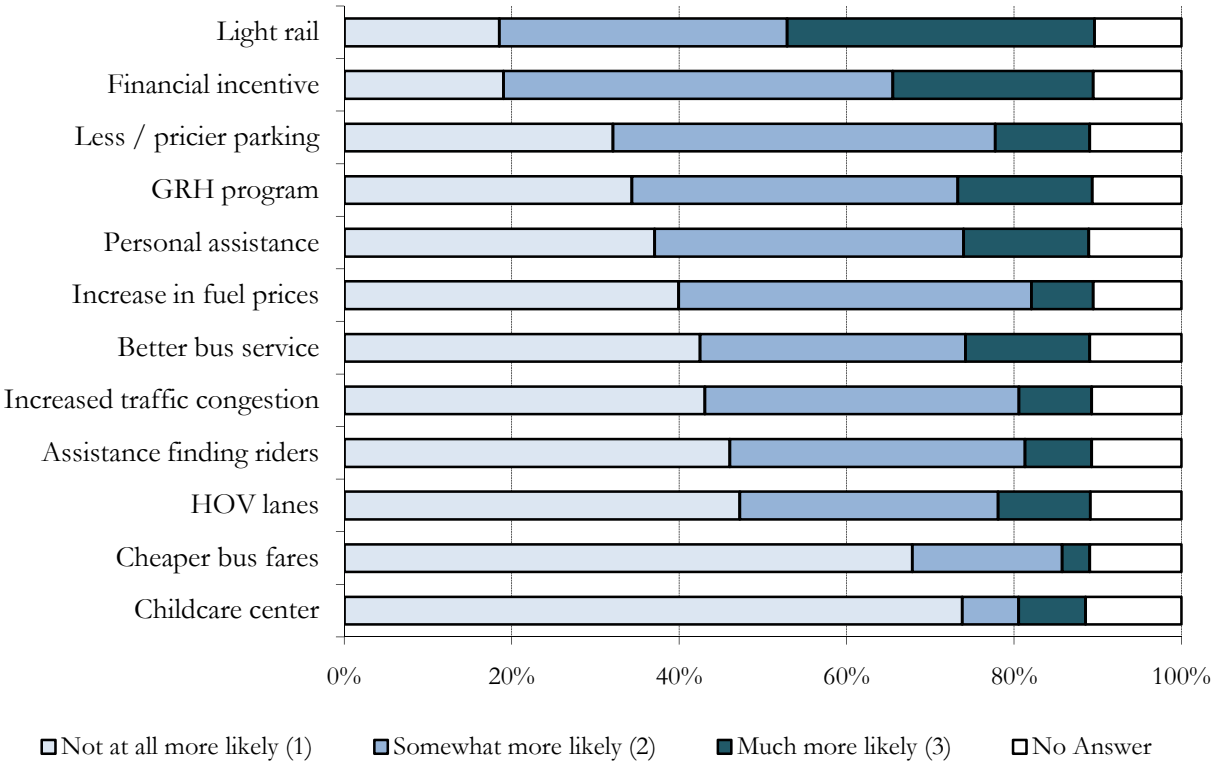
Figure 6-12: Likelihood to switch to alternative modes (SOV commuters, WCSS)



Source: WCSS 2004 analysis. N=52

Participants of the Intranet survey revealed a rather moderate likelihood to switch to other means of transportation with 1.7 out of 3.0 index points. These measures included the implementation of a light rail system, financial incentives, a GRH program, personal assistance, and improvements regarding the bus service (see Figure 6-13). Those participants who indicated a high likelihood to switch if gas prices increased to between $2.50 and $3.00 also showed a higher overall likelihood to switch (2.2 out of 3.0 index points). In contrary to the WCSS results, restrictive strategies, such as increased traffic congestion, were seen as less effective than incentive programs.

Figure 6-13: Likelihood to switch to alternative modes (SOV commuters, Intranet survey)



Source: Intranet survey 2005 analysis. N=1,173

Only four percent (47) of all SOV users of the Intranet survey revealed an overall high likelihood to switch (more than 2.5 out of 3.0 points) while 22 percent showed a moderate likelihood (between 2.0 and 2.5 points). Most participants revealed only a low likelihood to switch (less than 1.5 points). Of these, 76 respondents showed no likelihood at all to switch to other travel means. The majority (80 percent) of these respondents also stated that they would never use alternative modes regardless of gas prices. The 47 participants who demonstrated an overall very high likelihood to switch seemed to respond best to financial incentives, personal assistance for services, the implementation of a light rail system, the introduction of a GRH program, and improved bus services.

A total of 301 SOV users provided additional information about measures that would make them more likely to change their travel behavior. More than 30 percent of the responses were related to improving public transportation by offering better, region-wide service with safe P&R facilities and sheltered bus stops. Another 30 percent were interested in reinstating the company's private shuttle from their facility in the city of Gahanna to Columbus downtown. Nearly 20 percent of the SOV users emphasized that they would like to see the implementation of a light rail system, and 11 percent would enjoy increased possibilities for telecommuting. Improved and extensive biking and walking trails throughout the city was a measure suggested by seven percent of the respondents, and four percent of the participants indicated interest in a more predictable work schedule with less overtime (see Appendix 9 for full list of suggestions).

Both the Intranet survey and WCSS results indicate that disincentives were seen as less effective in altering SOV travel behavior than incentive programs. These results are similar to

both Baldassare et al (1998) and Shiftan and Suhrbier (2002) who found that commuters are more likely to change their driving habits when offered bonuses and incentives than when presented with fees. The highest likelihood to switch was seen in the implementation of a light rail system which confirms Bamberg et al's (2000:502ff) study results.

Since light rail is not realistic for Columbus' near future, other measures are needed now to improve the current infrastructure. To do so, financial incentives, the GRH program, personal assistance, and improving bus and carpool services seem to be some of the more effective strategies for changing employees' travel behavior.

6.4 Conclusions

The previous sections summarized the results of the survey questions with the goal to provide a general overview of the surveyed employees' characteristics. The analysis demonstrated that many different variables influence travel choices. The Intranet survey was particularly helpful in understanding the difference in characteristics between SOV and alternative mode users. The WCSS, on the other hand, provided an in-depth view into the mindset of SOV commuters. Key results for each 'box' from Figure 6-1 are summarized below.

Employer-related - The responses throughout the surveys indicated that many employees lack information about existing alternative mode programs, including the transportation programs provided by the company itself. While AEP offers discounted monthly bus passes to their employees, the majority (70 percent) of the Intranet surveyed employees were not aware of this program. Therefore, better and full accessibility to internal and external program information is necessary to assist employees in finding the alternative that best meets their need. On a positive note, several employees already take advantage of the flexible working hours and telecommute at least once a month.

City/Transit-related – The focus group and survey results indicate that the image of local transportation alternatives has to be improved. This recommendation needs to include increasing service frequency and speed of bus services, particularly during rush hour. A study described by Abdel-Aty et al (1996:1550ff) about the importance of public transportation information reinforces the need for reliable transit information. This study revealed that transit route maps as well as waiting time were seen as the most important items. The study's respondents also claimed that they would consider using transit if appropriate information was available to them. This statement led the authors to the conclusion that transit information has a promising effect on transit ridership. In addition to improving transit service, employees showed interest in improved bike facilities. The city of Columbus' bikeway and pedestrian plans are a first step in addressing the issue.

Spatial-related – The number of employees who could potentially utilize other modes of transportation besides solo driving was discussed in section 6.3.3. Using GIS methodology, employee housing residences were compared to the overall transportation network to determine its proximity to bus lines or bikeways as well as to other employees for carpooling options. The analysis concluded that, based purely on the transportation network, many

employees could make the choice to use transit or to carpool. The need to improve those services and market them is addressed in chapter 8.

Individual-related – Current sociodemographics, behavior, and attitudes to transportation modes were discussed in great detail with the objective to understand how behavior could be modified. For example, issues identified included an overall dissatisfaction with travel routes and costs as well as with the local bus system. Regarding the transportation attributes, flexibility, cost, and time were seen as most important. However, the priority order changed based on different savings levels. How the different variables intertwine with each other and relate to different types of people is discussed in the next chapter.

One particular survey result that was not discussed in the previous sections is related to trip-chaining or the lack thereof. It is commonly perceived that with the increased use of automobiles and the growing number of females in the workforce trip-chaining, also defined as running errands on one's way to or from work, becomes more popular and common (Palma and Fontan 2001). This theory was neither confirmed within a study by Handy et al (2005) regarding excess commuting nor within the analysis of the conducted WCSS. This result implies that most employees drive home before running errands during the week, with the exception of picking up children from school or daycare. Most commuters could therefore take advantage of alternative modes. The services provided by AEP as described in chapter 5 could have an impact on employees getting their errands done at work.

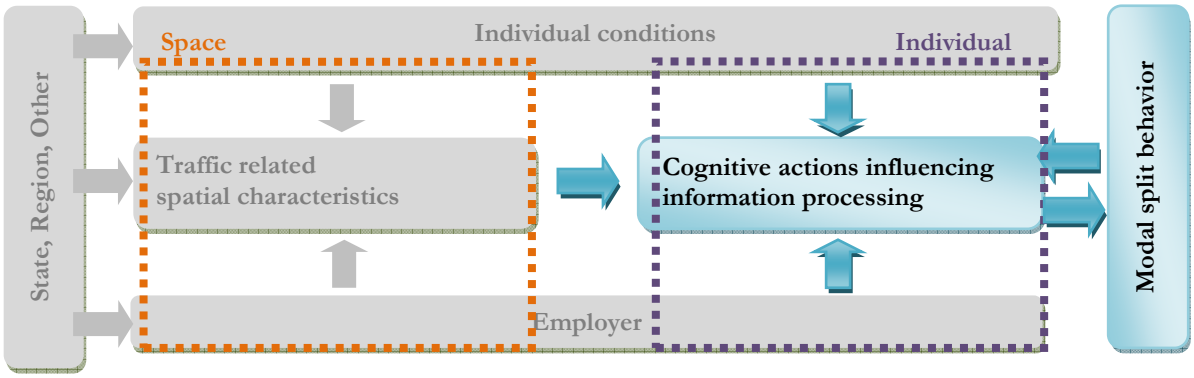
The following chapter deepens the analysis related to the cognitive actions that influence information processing, while keeping the need for marketing in mind. Regression, cluster, and factor analysis are utilized to develop target groups and to reduce the set of variables from the WCSS to a few key factors. Chapter 8 takes the results from chapters 6 and 7 into account to develop marketing strategies for the company.

"Different people must be treated in different ways because they are motivated by different factors and are affected in different ways by policy." - Anable 2005:66

7 Identifying Target Groups and Key Factors

Chapter 6 revealed important influential factors and their effect on modal split based on the model presented in chapter 1. The discussion was related to the individual, spatial, and employer-related factors. This chapter now summarizes and reduces the datasets with two objectives in mind: 1) to group the individuals into few clusters to help with the development of marketing strategies that are tailored to the characteristics of each target group, and 2) to determine if and which key factors underlie the large number of variables. This and the next chapter greatly relate to the decision-making component of Figure 2-3.

Figure 7-1: Research focus on cognitive actions influencing information processing



Source: Based on Figure 1-2, own design.

7.1 Identifying Target Groups

Marketing strategies are often directed towards specific target groups. In regard to TDM research, such target groups can be defined either by their travel behavior, their socio-demographics, or their values of transportation attributes. An analysis of the importance of transportation features, such as flexibility, time, and cost, implied that it would be most useful to divide commuters into each one of these groups. Understanding the type of individuals in each group can help in developing specific policies and TDM strategies catered to meet the commuters' needs. Doing so should result in a greater impact on reducing solo driving. For the research at hand, target groups were formed for each survey.

7.1.1 Forming Target Groups of SOV Commuters Utilizing the Intranet Survey Results

The Intranet survey asked respondents to rank the three attributes flexibility, time savings, and cost savings from 'most important' to 'second important' to 'third important.' Based on the participants' self-selection of which attribute carries the highest importance, SOV commuters were divided into three groups: *Flexibility* (group 1), *cost savings* (group 2), and *time savings* (group 3). Thus, every employee who perceived *flexibility* as the most important attribute for making a

transportation choice was included in group 1, and so on (see Table 7-1)[17]. The analysis discusses the group members by a variety of variables, including the likelihood to use other modes. It is assumed that members of a particular group will respond strongest to TDM measures that relate to the attribute they value most. The differences between memberships are described below.

Group 1 (Flexibility) - Members of group 1 tend to have the lowest likelihood to switch to alternative modes based on the TDM measures given in the survey (1.65) although 15 percent use other modes of transportation on occasion. This group also contains the highest percentage of employees who would not use alternative modes regardless of the increase in fuel prices. The 848 employees in this category ranked the implementation of light rail, the provision of financial incentives, and an increase in parking prices on average higher than other TDM strategies. Approximately one quarter of the group members provided additional suggestions on how to increase employee interest in using alternatives, particularly by requesting better bus service throughout the region.

Group 2 (Time savings) – Group 2 is comprised of more men than in any other group. Fifteen percent responded that they occasionally use alternative modes of transportation. Of those participants, nearly 50 percent carpool. Compared to the responses of participants in other groups, survey respondents in this group tend to experience shorter travel times. Furthermore, they have a higher interest in the implementation of a light rail system, the construction of HOV lanes, and would consider a mode switch if traffic significantly worsened. Their overall likelihood to switch to other modes (1.68) is only slightly higher compared to respondents of group 1.

Group 3 (Cost savings) – Group 3 contains the least amount of members but the hightest percentage of women compared to all other groups. The percentage of women in this group is also higher compared to the overall gender distribution at the company. Many employees who are members of this group have long commuting times. These cost-sensitive respondents also show the highest likelihood to switch to alternative modes (1.77). Although this group contains the least percentage of SOV commuters who occassionally use alternative modes, most of those who do ride the bus. The higher affinity to the bus makes sense for this group because it is indeed the cheapest mode and eliminates parking costs as a whole. In general, compared to the other groups, group 3 members seem to be more responsive to any measure related to travel costs, such as an increase of gasoline and parking prices, financial incentives, and reduced bus fares. However, they also show a higher interest in personal assistance for finding alternatives and carpool partners. In addition, over 50 percent of all participants would seriously consider a mode switch if gas prices ranged from $2.50 to $3.00 per gallon. Members of this group are the least informed about the company's offering of discounted bus passes, including many of those who currently use the bus occasionally. Last but not least, 13 percent of these group members feel that they have no alternative to driving alone. This number does not include any of the occasional alternative mode users.

[17] The analysis excluded those that answered the question wrong by giving several attributes the same weight.

Table 7-1: Characteristics of Intranet survey participants per attribute (SOV commuters only)

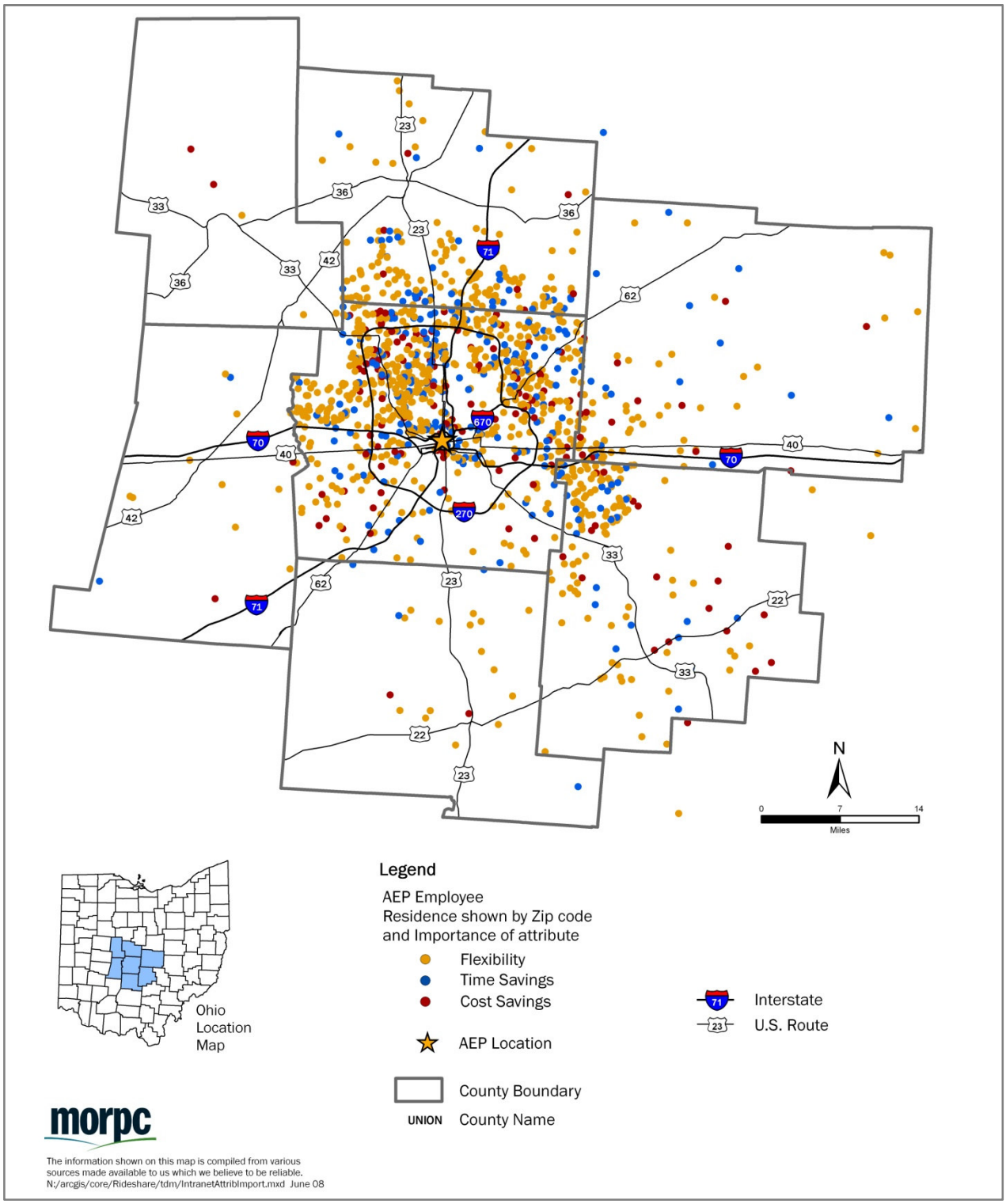
	Group 1: Flexibility (N=848)	Group 2: Time (N=215)	Group 3: Cost (N=112)
Gender			
Female	32%	29%	39%
Male	68%	71%	61%
Average driving time one-way (in minutes)	27.83	26.29	28.61
Occasionally use other modes to work	15 %	15 %	11 %
Carpool	45%	48%	25%
Bus	36%	32%	58%
Likelihood to switch …[a]	[Ø = 1.65]	[Ø = 1.68]	[Ø = 1.77]
… if gas prices increased	1.59	1.62	1.88
… if parking prices increased	1.71	1.79	2.03
… with financial incentives	2.00	2.06	2.47
… if traffic increased	1.58	1.69	1.62
… if rail was implemented	2.17	2.31	2.14
… if personal assistance were available	1.74	1.68	1.79
… if GRH was available	1.80	1.73	1.70
… if HOV lanes existed	1.54	1.72	1.71
… if better bus service was available	1.68	1.64	1.62
… if bus fares were cheaper	1.24	1.25	1.34
… if a childcare center was onsite	1.26	1.17	1.26
Suggestions to enable switch	[N = 220]	[N = 83]	[N = 34]
Better bus service	30 %	27 %	9 %
Implement light rail	13 %	18 %	18 %
More telecommuting	6 %	11 %	15 %
Better walking / biking trails	7 %	2 %	3 %
Fuel price increase to promote switch			
$2.50	5 %	6 %	16 %
$3.00	26 %	26 %	38 %
Gas prices are unimportant	24 %	17 %	12 %
Telecommute at least once a month	10 %	11 %	5 %
Knowledge that AEP offers discounted bus fares	26 %	32 %	23 %
Reasons for driving			
Convenience / Flexibility	43 %	40 %	30%
Flexible hours	13 %	8 %	7 %
No alternatives	7 %	8 %	13 %

[a] Respondents could rate their likelihood on a scale from 1 to 3, with 1 = 'not at all more likely', 2 = 'somewhat more likely', and 3 = 'much more likely.'

Source: Intranet survey 2005 analysis. N=1,175

While the analysis confirms the assumption that each group reacts to measures that would assist them in either maintaining flexibility, saving money, or saving time, the distinction between each group was not always clear. All groups seem to be cost-sensitive in one form or another because they showed the highest average likelihood to switch to financial incentives and increase in parking costs.

Map 7-1: Attribute group member's home locations by zip code (SOV commuters, Intranet survey)



Source: MORPC, own design. Based on ODOT, MORPC, and Intranet survey 2005 data. N=1,175

Map 7-1 illustrates that no clear correlation exists between the attribute an employee values and the location of his/her residence. The map reiterates the fact that spatial characteristics are not alone responsible for mode choice and that other factors, such as personal characteristics, play a strong role in determining if an employee uses another mode of transportation for his/her commute to work.

The next section uses the WCSS survey results to form similar target groups with a much larger set of variables. However, instead of simple crosstabulations, a multivariate statistical approach is applied to illustrate its usefulness in detecting differences between otherwise homogeneous groups.

7.1.2 Forming Target Groups of SOV Commuters Utilizing the WCSS Results

Chapter 6 described the various questions of the WCSS that were used to request the participant's ranking of attributes. While the results of two questions (Nr. 32 and 33) clearly determined the importance of flexibility, time savings, and cost savings, the ranking order of these three attributes differed based on the type of question. The stated-ranking question (Nr. 41) requested participants to rank index cards that described feature characteristics of transportation choices by preference (see Table 6-1). Conjoint analysis was used as a unique statistical tool to determine various scenarios of transportation attributes. These scenarios were listed on plan cards and participants were asked to rank them by preference (see section 6.3.6).

As section 6.3.6 illustrated, *time* received the lowest relevance when choosing between possible transportation scenarios, and *cost savings* became more important. This outcome is contrary to the results retrieved from the simple ranking questions. It seemed that many participants who initially stated that flexibility is most important to them perceived cost savings as more significant when tangible levels of cost savings were given. The following table illustrates the number of participants per plan card and ranking order.

Table 7-2: Number of participants per rank and plan card

	Plan Cards									
Rank Nr.	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***Total***
1 = highest			1		48	1		2		**52**
2	4	1	17	1	1	14		14		**52**
3	7	2	20		1	15		3	4	**52**
4	4	4	10	5		10	2	12	5	**52**
5	11	10	3	2	1	10		7	8	**52**
6	8	6	1	5	1	1	21	5	4	**52**
7	12	19		2		1	3	4	11	**52**
8	4	9		13			7	5	14	**52**
9 = lowest	2	1		24			19		6	**52**
Total	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	

Note: For the analysis, ranking values were reversed to give the first choice the highest weight.

Source: WCSS 2004 analysis. N=52

A simple regression analysis was applied to determine the weight respondents placed on a particular attribute (see section 6.3.6). Utilizing the regression coefficients (r^2) that were obtained from the analysis, target groups were defined based on the value each member placed on the attribute. To clearly understand which respondent fits into which attribute group, a cluster analysis was applied to create more or less homogeneous groups. The cluster analysis

for this research was performed using the Ward Method and the squared Euclidian distance (Backhaus et al 2000:365f). Table 7-3 illustrates the results. Since not all of the 52 surveyed SOV drivers answered the question 'correctly' by placing Card E as their first choice, only 48 participants were included in the analysis[18]. Of those, 21 were assigned to cluster 1 (flexibility), 22 to cluster 2 (cost savings), and only five to cluster 3 (time savings).[19]

Table 7-3: Three-cluster analysis using r^2 of each attribute

Flexibility (r^2) [Respondents per Cluster]				Cost Savings (r^2) [Respondents per Cluster]				Time Savings (r^2) [Respondents per Cluster]			
r^2	**1**	**2**	**3**	**r^2**	**1**	**2**	**3**	**r^2**	**1**	**2**	**3**
0.011	--	2	4	0.011	2	--	--	0.000	1	--	--
0.033	--	2	1	0.033	2	--	--	0.011	6	2	--
0.044	--	1	--	0.078	4	--	--	0.033	2	1	--
0.078	--	5	--	0.100	1	--	--	0.044	2	1	--
0.100	--	1	--	0.133	1	--	--	0.078	7	2	--
0.144	--	1	--	0.144	2	--	1	0.100	1	2	--
0.211	--	2	--	0.178	1	--	1	0.133	1	1	--
0.233	--	4	--	0.211	4	--	--	0.144	--	2	--
0.278	--	1	--	0.233	3	--	1	0.178	1	--	--
0.300	--	1	--	0.278	1	--	1	0.211	--	2	--
0.311	--	1	--	0.300	--	1	--	0.233	--	2	--
0.433	--	1	--	0.311	--	1	--	0.278	--	1	--
0.678	7	--	--	0.344	--	1	1	0.300	--	1	--
0.700	1	--	--	0.411	--	2	--	0.400	--	1	--
0.744	3	--	--	0.433	--	3	--	0.411	--	3	--
0.811	2	--	--	0.544	--	3	--	0.478	--	1	--
0.900	8	--	--	0.578	--	1	--	0.544	--	--	1
				0.633	--	2	--	0.633	--	--	1
				0.678	--	1	--	0.711	--	--	1
				0.744	--	5	--	0.811	--	--	2
				0.811	--	1	--				
				0.900	--	1	--				

Source: WCSS 2004 analysis. N=48 (Question Nr. 41)

Although the sample is small and limits results to be significant and representative, the analysis can show tendencies of the type of people in each group. Table 7-4 and Table 7-5 provide a short overview of the characteristics per group. The following paragraphs describe the characteristics of each cluster and how they differ from other clusters.

[18] Card E contained the best level for each attribute: highest flexibility, lowest costs, and shortest travel time.
[19] If groups were built based on basic ranking of attributes (Question Nr. 32), the majority (80 percent) of WCSS respondents was to fall into cluster 1 (flexibility).

Table 7-4: Characteristics of WCSS participants per attribute

	Cluster 1: Flexibility (N=21)	Cluster 2: Cost (N=22)	Cluster 3: Time (N=5)
Gender: Female Male	38% 62%	14% 86%	20% 80%
Primary age group(s)	46-55 (40%)	36-45 + 46-55 (64%)	any
Married	76%	90%	80%
Highest level of education	Varies from high school to PhD degree	All have continuing education	All have at least a bachelor's degree
Household income	$20,000 and up	$40,000 and up	$80,000 and up
Availability of bus stop at home	50%	27%	0%
Average driving time one-way	34.25 minutes	33.73 minutes	28.6 minutes
Occasionally use other modes	14%	31%	0%
Used alternative modes before	76%	77%	40%
If no car was available: Carpooling COTA Bus	 57% 29%	 32% 45%	 20% 20%
Overall satisfaction with commute (5=Very satisfied)	4.02 [Range: 3.1–5.0]	3.7 [Range: 2.8–4.8]	3.2 [Range: 2.7–3.5]
Pick up children	19%: daily 14%: 1–2 times/week	13%: daily 4%: 1–2 times/week	0%
Rank attributes[a] Convenience Cost savings Time savings	 1.7 4.9 3.7	 2.2 3.7 4.4	 1.4 3.4 3.8
Participants who rank … as most important:[a] Convenience/Flexibility Cost savings Short travel time	 76% 0% 9%	 73% 0% 5%	 80% 20% 0%
Importance of attributes[b] Convenience Cost savings Time savings	 100% 85% 100%	 100% 86% 86%	 100% 60% 100%
Attitudes toward different modes of transportation[c]	Bus: 3.4 Car/vanpooling: 3.5	Bus: 3.5 Car/vanpooling: 3.8	Bus: 3.3 Car/vanpooling: 3.5
Overall likelihood to switch (3=Very likely)	1.58	2.02	2.13

a. Within the survey question, participants were asked to rank 12 attributes from 1 = highest rank to 12 = lowest rank (Calculated: SUM Rank numbers divided by SUM Participants per attribute).

b. '%' indicates the combined percentage of participants who claimed that a particular attribute is either 'very important' or 'somewhat important' (Scale 1 to 5).

c. A list of 60 different attitudinal statements regarding travel behavior and transportation modes was provided to each participant, asking them to rank each one on a scale from 1 to 5 (5 = Strongly agree). The statements regarding bus usage and carpooling were then summarized and weighted to receive an overall score of the participant's attitude toward these modes. Therefore, 5 = positive versus 1 = negative attitude.

Source: WCSS 2004 analysis. N=48

Table 7-5: Characteristics of WCSS participants per attribute: Likelihood to switch if …

	Cluster 1: Flexibility (N=21)	Cluster 2: Cost (N=22)	Cluster 3: Time (N=5)
… GRH were available	2.19	2.32	2.00
… personal assistance on services, times, and schedules was offered	1.52	1.68	2.20
… a child care facility was on-site	1.19	1.23	1.20
… I received money for not using parking space	2.05	2.18	2.20
… prizes were given to people who don't drive	1.38	1.73	1.80
… if gas prices increased	1.71	2.27	2.00
… parking search and costs increased	1.95	2.45	2.40
… awareness of worsened pollution increased	1.48	1.95	1.80
… traffic conditions increased significantly	2.19	2.45	2.60
… I had help in arranging carpool/vanpool	1.50	2.05	2.40
… car-/vanpoolers received reserved parking	1.48	1.86	2.20
… HOV lanes existed	1.71	2.09	2.80
… bus fares were cheaper	1.52	1.64	1.80
… monthly bus passes were cheaper	1.57	1.73	1.80
… bus service increased	1.90	2.10	2.40
… a light rail was implemented	2.29	2.50	3.00
… biking /walking trails improved	1.15	1.32	1.20
… bicycle parking was secure	1.19	1.41	1.20

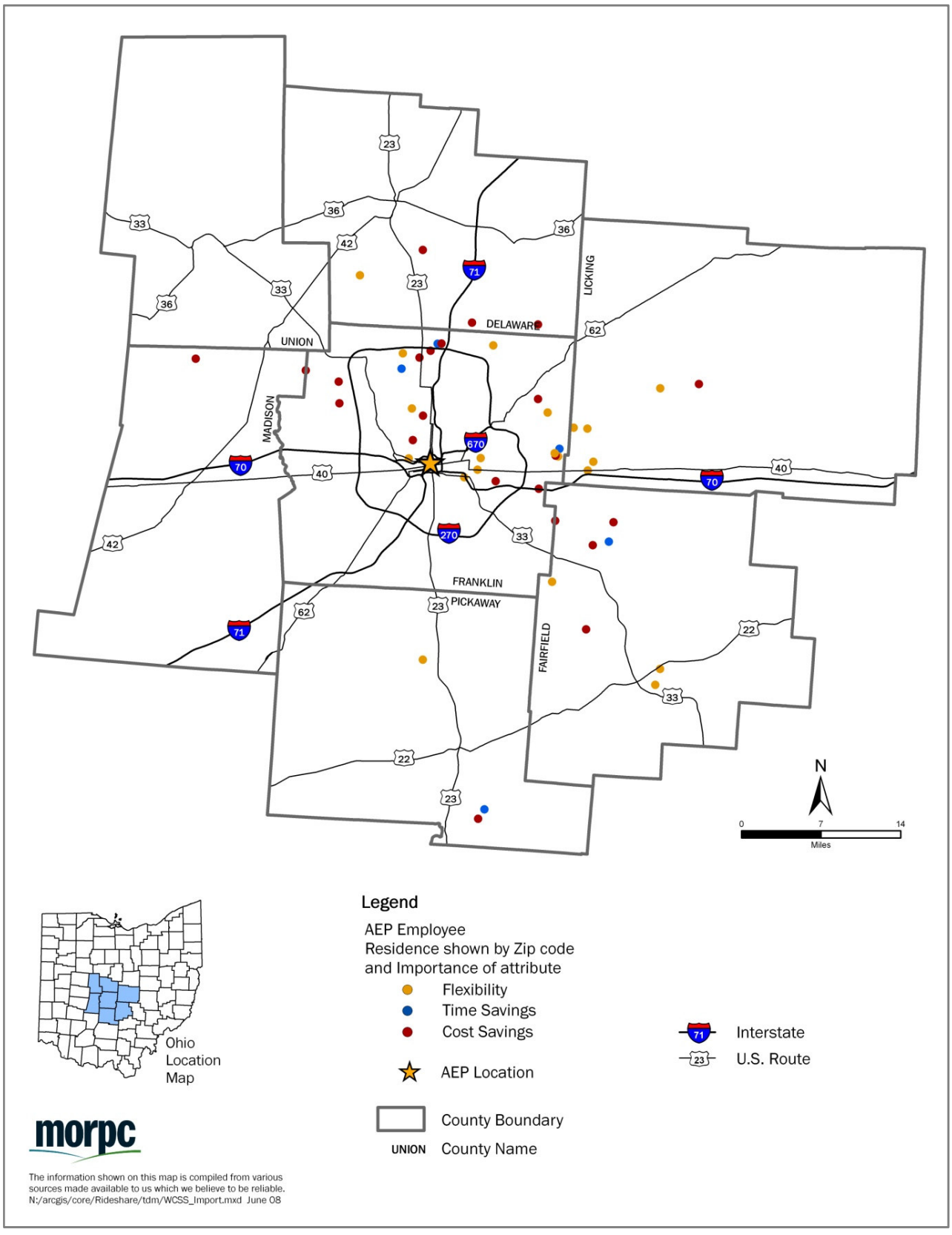
Source: WCSS 2004 analysis. N=48 [3=Very likely]

Cluster 1 (Flexibility) – This cluster consists of more women than in any other group. Half of these group members have a bus stop near their home. Yet, if no car was available, most would want to carpool. Clearly, cost savings are not very important. While many have to pick up their children before or after work, participants in this group demonstrate the highest overall satisfaction with their current commute. Consequently, members of cluster 1 indicate the least overall likelihood to switch to alternative modes, making them the most obstinate group. This attitude is further demonstrated in the fact that, except for the option to have a GRH program available, the members show the lowest likelihood per measure compared to the other two groups. In general though, more than 38 percent of the participants state that they are 'much more likely' to switch in response to only three scenarios: The implementation of a GRH program, increased traffic congestion, and the implementation of a light rail system. All measures relate to the aspect of convenience.

Cluster 2 (Cost savings) – Participants of this cluster are primarily employees with a college degree who tend to have a higher interest in public transportation. This group further contains a significantly higher percentage of employees who occassionally use alternative modes. Interestingly, none of the group members ranked cost savings as their most important transportation attribute when asked for direct comparison between attributes (see Map 7-2). This fact, again, emphasizes the need for real-life scenarios to understand people's attitudes. More than 41 percent of the interviewees in cluster 2 indicate a higher likelihood to switch to alternative modes of transportation if a GRH program were implemented, gas prices increased,

parking search and cost increased, congestion grew worse, or if a light rail system were implemented. Three of these measures clearly indicate their interest in cost savings.

Map 7-2: Attribute group member's home locations by zip code (SOV commuters, WCSS)



Source: MORPC, own design. Based on ODOT, MORPC, and WCSS 2004 data. N=48

Cluster 3 (Time savings) - In this cluster, members are all employees with a college degree and a household income of $80,000 or more. Similar to members of cluster 2 in regard to cost savings, most of the respondents of cluster 3 did not state that they valued time savings when asked directly. While none have a bus stop near their home, this group demonstrates the highest likelihood to switch. However, carpooling or the bus were not seen as potential alternatives by most. The measures that would make over 40 percent of the participants 'much more likely' to switch to other modes include the implementation of a GRH program, receiving money for not using a parking space, increased parking search and costs, growing congestion, assistance in arranging car- and vanpools, reserved parking, construction of HOV lanes, increased bus services, and the implementation of a light rail system. Six of these measures are noticeably related to time savings.

The results of the cluster analysis illustrate that while sociodemographics still play an important role in determining the type of individuals per cluster, other variables should not be neglected. Such factors include their current satisfaction with the commute or their overall likelihood to switch. Map 7-2 demonstrates similar results as Map 7-1. The importance of transportation attributes does not necessarily depend on the residential location but on other factors. However, the existing housing location as indicated in Map 6-6 influences the availability of transportation options and such limits the type of modes that can be offered to each individual.

7.1.3 Summary of Results

Once we understand how people think and what could trigger them to change their behavior, we can develop strategies to improve and market alternative modes of transportation. According to the presented research, it can be assumed that people's sensitivity to transportation attributes significantly influence their likelihood to make certain travel decisions, and that the value they place on travel characteristics cannot be elucidated by only their sociodemographic characteristics. When forming target groups by using these attributes, it is obvious that TDM concepts that value a particular attribute seem to work best for each group and should therefore be marketed accordingly. While GRH programs, increased congestion, and the implementation of a light rail system are of interest to all, others are more group-specific. For example, cost sensitive commuters, such as in cluster 2 (WCSS), will react quicker to obvious increases in travel costs, like parking or gas, while time sensitive employees, such as in cluster 3, should be provided with personal assistance for carpooling and transit. When implementing any one of the TDM strategies, it is important to market the qualities of each measure in such a way that it is compelling to the members of the group it addresses.

The difference in results between a question that simply asks for choosing the most important attribute of a list of attributes and one that demands ranking of real life scenarios by preference was again demonstrated here. Of the five participants who fell into cluster 3 based on the plan card question (WCSS), none ranked time savings as their most important attribute. In fact, the vast majority (80 percent) of these participants valued convenience or flexibility most. If we were to ask these participants about how to define these attributes, they might state that convenience equals shorter travel times. These attitudes and perceptions could be detected by utilizing real life scenarios.

It is important to note that the Intranet survey results indicated that 72 percent of the respondents were part of the flexibility group. This percentage reflects the WCSS results of the question where respondents were asked directly to rank the attributes but not the one where they had to choose between scenarios. Again, the design and analysis of the WCSS demonstrated that a shift in priorities for attributes takes place when participants are confronted with realistic situations. Obviously, not everyone has the resources to conduct a large study like the WCSS and to analyze the dataset in great depth. Furthermore, it can be very difficult to get a high number of people to respond to a long survey. In order to conduct similar studies of this kind, but with a greater number of participants, it is necessary to reduce the number of variables to a more manageable number, as shown in the next section.

7.2 Reducing the Number of Variables

Determining if a small number of factors could explain most of the variance observed in the much larger set of manifest variables is of great value for future research. Factor analysis is a analysis technique that attempts to reduce such a large set of variables to a more meaningful, smaller set of variables. This data simplification method is often used as a tool to remove duplicated information from a set of variables, or to simply group similar variables together. Factor analysis helps to describe the covariance relationship between many variables in regards to a few underlying factors. A factor analysis is conducted in the next section in order to identify clusters of variables that can be described by only a few key factors. Identifying the 'most influential factors' can especially be helpful for future research and marketing strategies.

As described in chapter 3, many forms of factor analysis are available. The PCA is most commonly applied and was also used in the following analysis. Within the PCA, the number of factors initially extracted is the same as the number of included variables. Each factor is viewed as a weighted combination of the input variables. Typically, the first extracted factor is responsible for the largest share of the dataset's total variance. Each subsequent factor is responsible for less and less of the total variance. The determined number of factors can then be redefined. Such redefinition is done through factor rotation, using the Varimax rotation. The rotation helps to define sharper distinctions by redistributing the explained variance among the newly defined factors.

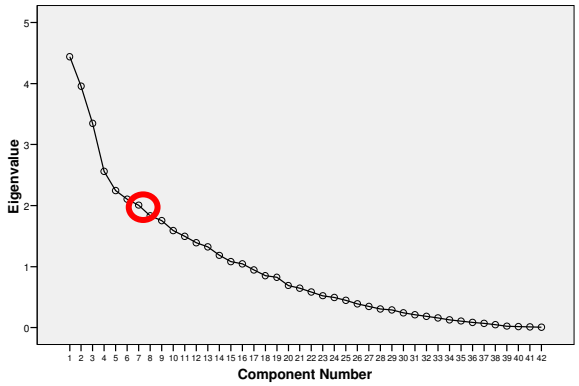
Chapter 2 described three basic categories that can help explain the influential factors on mode choice: spatial/situational constraints, personal/cognitive constraints, and decision-making/information advantages (see Figure 2-3). Due to the large amount of variables available through the survey, a division of the variables into content-specific areas seems useful. Five variable subsets are therefore pre-identified based on the three categories. Appendix 10 shows in greater detail which variables specifically were included in each of the following subsets:

- Personal and work characteristics;
- commute characteristics;
- attitudes to commute and environment;
- attitudes to the car; and
- attitudes to other modes of transportation.

In order to conduct the factor analysis, all responses of the survey were re-coded in such a way that the highest code represents the highest position or concern for the object of the response. This recoding required dummy variables in instances where variables allowed for several different answers, such as gender or marital status, and where one cannot choose one answer as 'better' than the other.

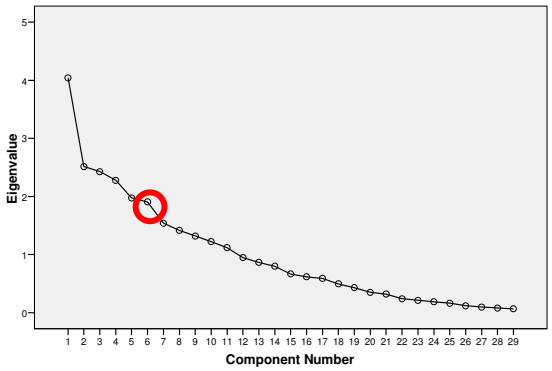
Figure 7-2: Scree plots to determine the number of factors for each category

Personal and Work Characteristics



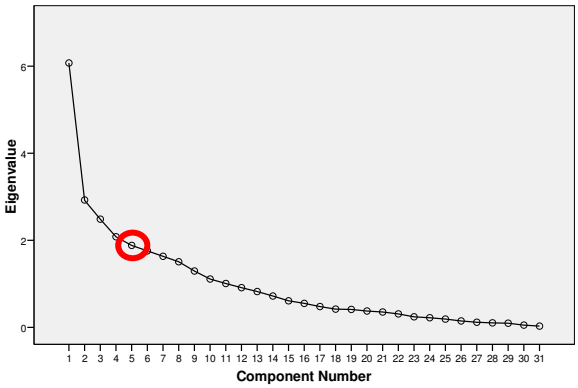
7 Factors (49.19% explained variance)

Commute Characteristics



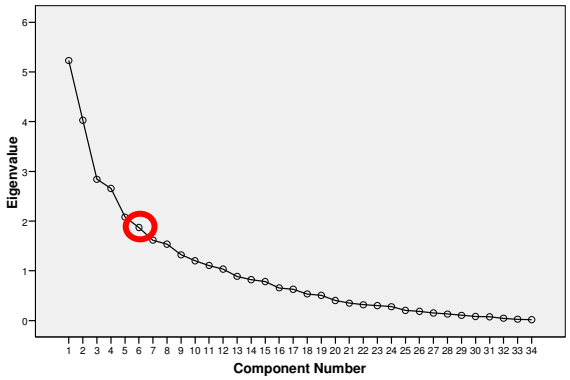
6 Factors (52.21% explained variance)

Attitudes to Commute and Environment



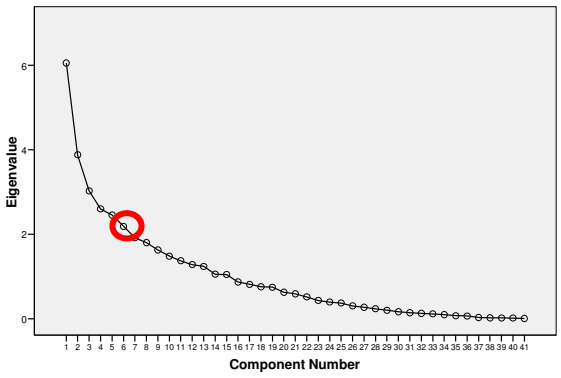
5 Factors (49.86% explained variance)

Attitudes to the Car



6 Factors (55.02% explained variance)

Attitudes to other modes of transportation



6 Factors (49.28% explained variance)

Source: Factor analysis based on WCSS 2004.

For the research at hand, the conducted factor analysis can only be viewed as an explorative analysis since the results do not show as significant (all test and KMO criteria were not satisfied). Therefore, the results act as creative directors to help detect patterns. In addition, only variables with a factor loading of 0.5 or greater were considered in the analysis in order to ensure that any one variable is only included once. This exclusion is important to keep the premise that factors should be independent from one another. The scree plots for each category of variables are displayed in Figure 7-2. The scree plots were used to determine the number of factors that could sufficiently explain the variances within each category.

Using the PCA and the Varimax rotation, a total of 183 variables could be reduced to only 30 factors. These factors were determined based on loadings of at least two variables each (see Appendix 11). The main factors for each subset are listed in Table 7-6.

Table 7-6: Identified factors per subset

1 - Personal and Work	2 - Commute Characteristics	3 - Commute and Environment	4 - Attitudes to car	5 - Attitudes to alternatives
▶ Lifestyle ▶ Personality ▶ Flexibility ▶ Neighborhood ▶ Money ▶ Employer loyalty ▶ Personal independence	▶ Travel distance ▶ Running errands ▶ Car affinity ▶ Bus interest ▶ Childcare need ▶ Working hours	▶ Environmental awareness ▶ Safety concern ▶ Transportation attributes ▶ Need for car ▶ Interest in alternatives	▶ Convenience ▶ Flexibility ▶ Car efficiency ▶ Joy of driving ▶ Satisfaction with driving ▶ Parking	▶ Attitude to carpool/vanpool ▶ Convenience of alternatives ▶ Bus schedule ▶ Bus riders ▶ Service frequency ▶ Attitudes to bus

Source: Based on WCSS 2004 factor analysis results. N=52

The different factor names were determined by interpreting an overarching meaning of the two or more variables that load highest on the factor. Therefore, the variable with the highest factor loading can serve as a representative for the factor when designing shorter surveys that incorporate these factors (see Appendix 11).

It is clear that the results cannot be viewed as representative using such a small sample set. However, they can give indication for the type of issues that should be examined further. They can also serve as a framework for designing a survey that would be used to evaluate the success of implemented strategies to see if former SOV commuters now use other modes of transportation and if their experience resulted in a new attitude and perception. For example, many SOV commuters have mentioned that they do not feel buses are reliable. Has this perception changed now that they are using the bus?

7.3 Summary

The use of qualitative methods and scenario-building tools, such as the conjoint analysis presented here, are examples of the potential in innovative methods for TDM. By conducting research on a small basis but with a large number of variables, it was possible to provide more insight into commuters' travel behavior and choices. Not only the type of survey methodology but also the type of analysis showed that advanced statistical methods used in combination

with each other can lead to increased knowledge on how to address TDM and develop appropriate strategies.

By identifying target groups based on a certain set of variables, marketing messages can now be customized and aimed at commuters with a similar set of attitudes and perceptions. The GIS analysis of the different group members indicated that the type of attitudes people carry is not related to their residential location. Therefore, the marketing of each mode needs to speak to the individual's personal characteristics and therefore address all three attributes.

The factor analysis was only exploratory but its results can still serve as a framework for future surveys. It demonstrated how the number of variables from extensive surveys can be reduced to only a few key factors that would explain much of the variance.

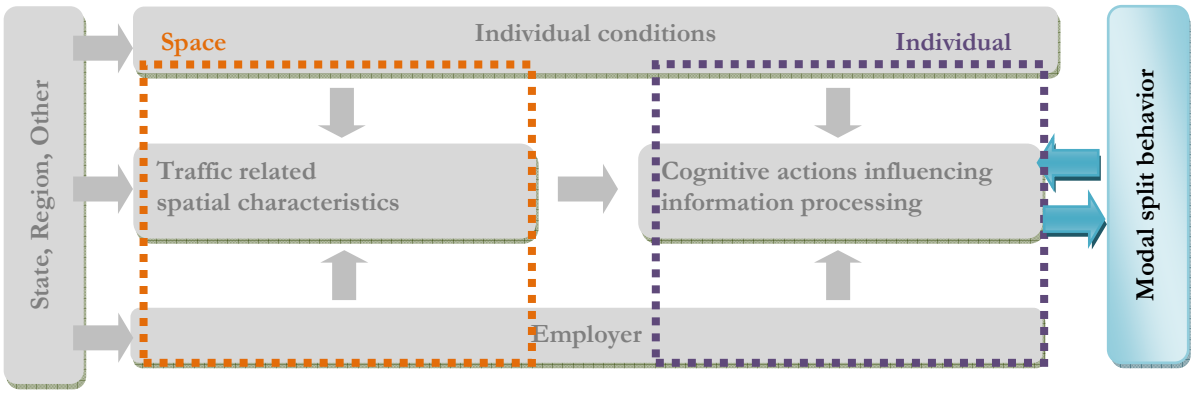
Since the objective of this thesis is not only to determine key factors that influence travel behavior and form target groups but also to identify and discuss employer-based TDM strategies, the next chapter focuses on that aspect. Chapter 8 describes the social marketing process and gives recommendations for customized TDM services utilizing the results from chapters 6 and 7.

„If we are not careful, we shall leave our children a legacy of billion dollar roads leading nowhere except to other congested places like those they left behind." – Author unknown

8 Development and Marketing of TDM Strategies

Modern transportation geography not only discusses issues on a physical level but also addresses the individuals who use the transportation system and the different players who provide for the network and the services. Therefore, the thesis at hand has been structured based on the concept of an applied geography. It discusses the need for reducing SOV travel and improving air quality from a descriptive, exploratory, and normative level. The previous chapters provide a lot of information about the various players involved in transportation planning, the different ways to study the individual's travel behavior, and the advantages of creating target groups utilizing the importance commuters place on the three transportation attributes called flexibility, cost savings, and time savings. All this knowledge is critical for actively inducing change and influencing a modal shift (see Figure 8-1). The development of customized TDM strategies is based on spatial and behavioral information, and the implementation and marketing of such are key elements in this process.

Figure 8-1: Research focus on influencing the modal split behavior through marketing

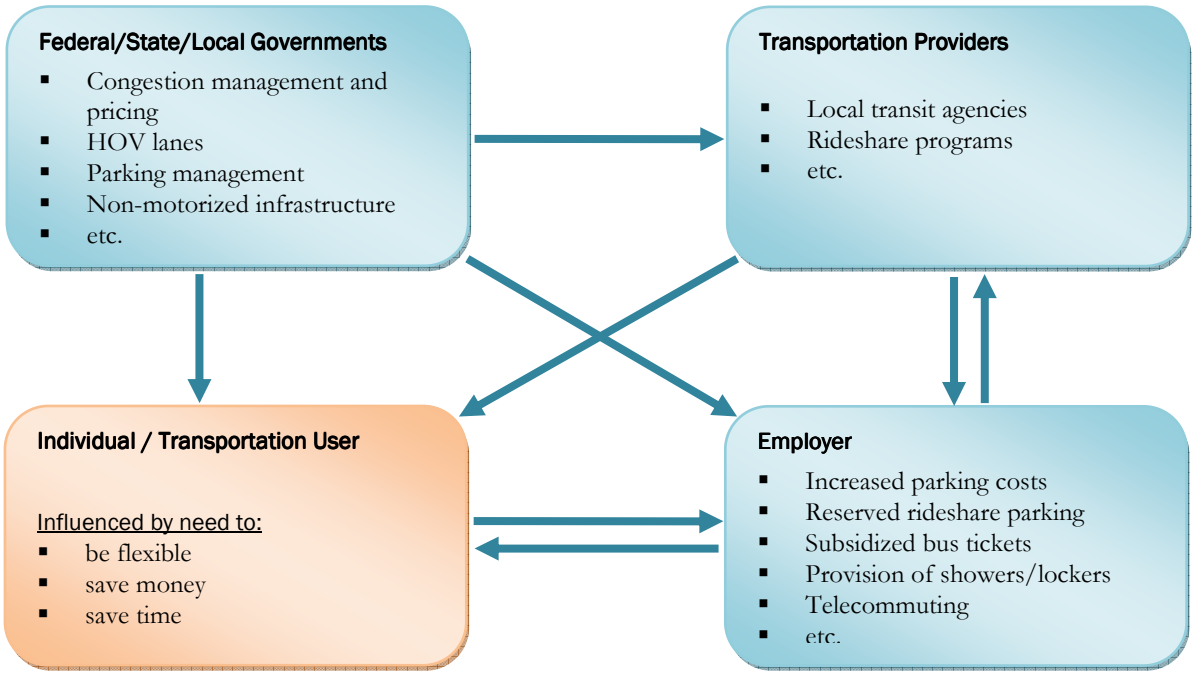


Source: Based on Figure 1-2, own design.

Rather than dictating the way that information is to be conveyed from the top down, transportation professionals are now learning to listen to the needs and desires of the target audiences themselves. This focus on the 'consumer' involves in-depth behavioral research and constant re-evaluation of every aspect of a program. In order to identify available TDM strategies and ways to implement them, the different players related to transportation planning are critical. Figure 8-2 illustrates the various tools each player has available to influence modal split. However, as the name 'employer-based TDM' already implies, the primary focus lies on the employer. While the employers' identification of TDM strategies greatly depends on the existing transportation infrastructure, they can also have an impact on changing the type of transportation services offered to their worksite. In addition, employers directly interact with their employees and therefore can best communicate the information to the individual commuter. Furthermore, TDM strategies initiated through the employer can usually be

implemented much quicker and provide for almost immediate results. As such, the development and marketing of TDM strategies proposed in this chapter are based on the employer's perspective but with all other players in mind. While this chapter discusses the various TDM strategies from a general perspective, it exemplifies each strategy based on the study site and research results.

Figure 8-2: Availability of services per player to reduce individual's SOV travel



Source: Based on Figure 1-1, own design.

The development and implementation of TDM strategies assimilates the social marketing process. Social marketing seeks to influence social behaviors not to benefit the marketer, but to benefit the target audience and the general society. Therefore, the goal of social marketing is to change attitudes, values, and belief systems to achieve a new behavior. Social marketing addresses specific target groups which each have a different set of attitudes and perceptions towards a certain product or service. In order to perform social marketing, knowledge of each target group is required. Such knowledge exists in form of sociodemographic characteristics, psychological profiles, or behavioral characteristics (Kotler and Roberto 1998:25ff).

As demonstrated in the previous chapter, the conducted research collected such knowledge and allowed for the formation of target groups. The description of these target groups was based on a variety of different variables related to attitudes, perceptions, and existing behavior. The social marketing process as illustrated below can now be followed to determine and market the various strategies to address employees' needs along with each player in mind.

8.1 The Social Marketing Approach to Change Travel Behavior

Creating a new service or product can only be successful if it indeed meets a need that currently is either not or not sufficiently enough satisfied. It is therefore imperative to understand the population who could benefit from the new product. "Many causes and social

change campaigns fail because their target-adopter group does not perceive a problem, want, or need" (Kotler and Roberto 1998:30). This 'non-identification' of a problem is a major challenge for the sector of commuter transportation. The in-depth survey with the plan card exercise was therefore crucial in identifying the need for transportation services to meet the three attributes of flexibility, cost, and time efficiency.

According to Kotler and Roberto (1998:28), four tasks need to be addressed in order to manage social change. Each of these tasks is described below based on the authors' view, but modified to specifically address TDM and changing travel behavior.

1) *Defining the 'fit'* for reducing SOV travel, namely by identifying the various alternative modes.

2) *Designing the 'fit'* to address the question of which transportation services and TDM strategies seem most successful in addressing the current transportation needs.

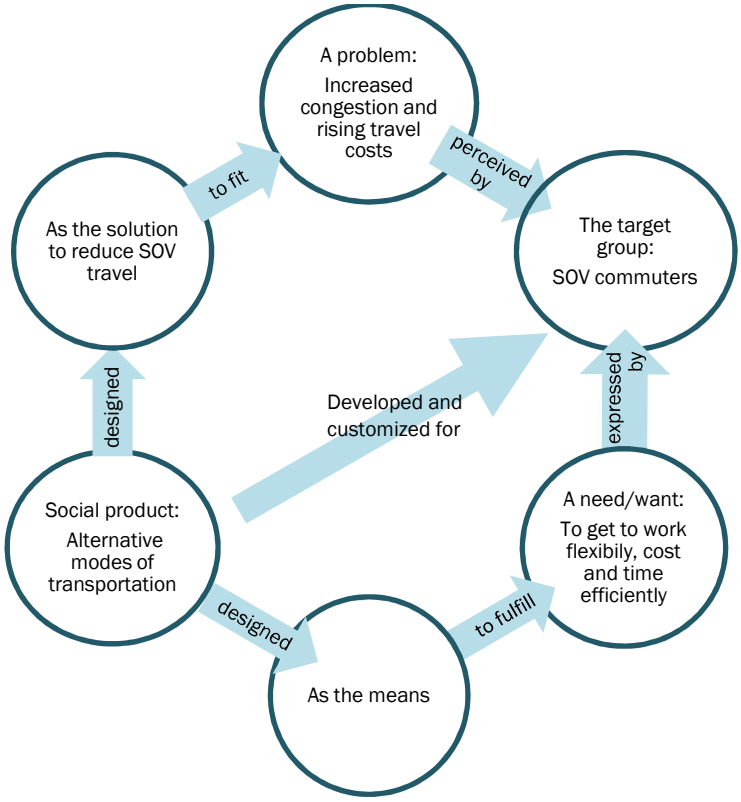
3) *Delivering the 'fit'* by understanding the various information and communication channels to persuade people to utilize the service.

4) *Defending the 'fit'* by constantly re-evaluating the concepts in regard to improving the information flow and services.

8.1.1 Defining the Fit

Similar to Kotler and Roberto (1998:29), the research at hand was based on a clear understanding of the problem, the target groups, and a solution (see Figure 8-3).

Figure 8-3: Understanding the relationship between a perceived problem and the solution



Source: Modified based on Kotler and Roberto (1998:29).

To briefly summarize these components in regard to this paper's objective, the growing congestion and rising travel costs are leading to an increasing number of SOV commuters who are unhappy with their commute. These employees are often influenced by their need or desire to have a transportation mode that is either flexible, affordable, or fast, characteristics they view can only be achieved by the car. While alternative modes have the chance to fulfill these criteria as well, they need to be marketed as such.

8.1.2 Designing the Fit

Once the product-market fit is defined and understood, the product or service itself needs to be designed. In the case of TDM, the actual product already exists in the various forms of alternative modes of transportation. However, it is not necessarily 'packaged' correctly to appeal to a large group of commuters in a particular region who have the choice between using their own car and sharing a ride. In order to present the solution effectively to the commuters, it is imperative to know how to best position the product and how to 'dress it up.' Dressing up a product includes the branding and both its symbolic and physical packaging (Kotler and Roberto 1998:30ff). For example, when the objective is to increase the number of transit commuters, it is important to make the bus system attractive through both service and appearance.

When implementing any one TDM strategy[20], it is important to market the qualities of each product in such a way that it is compelling to the members of the group it addresses, either by marketing its ability to be flexible, affordable, or fast. In reference to the main objective of this thesis to identify strategies that reduce SOV travel to work, TDM concepts can be clustered into three main categories:

A. Shifting vehicle trips to person trips
B. Reducing vehicle trips by increasing the number of commuters per vehicle
C. Eliminating trips through telecommuting

The following sections are structured using these categories. Each category relates to at least one of the three attributes and demonstrates practical examples of designing a fit.

8.1.2.1 Strategies to Shift Traffic

Strategies that address a commuter shift from motorized to non-motorized modes generally only apply to residents who live near their workplace. Non-motorized modes of transportation refer to walking and biking and tend to support an active lifestyle. The possibility, however, to promote non-motorized transportation modes greatly depends on the availability of accessible biking and walking trails throughout the city.

If sidewalk and bikeway connections are existing from and to the workplace, these non-motorized modes should be marketed with a particular focus on the aspect of exercise and being the most environmentally friendly. In regard to the three main attributes as defined

[20] The term strategy is related to implementing or incentivizing a product whereas the product is the transportation service itself.

through the research, these modes can satisfy the demand for flexibility and cost savings. In many cases, using non-motorized transportation can also decrease time because it eliminates dealing with congestion and parking search.

Specifically to AEP, the majority of AEP employees do not live close enough to the company to walk. However, nearly 300 employees live within a five mile radius to the company and could be encouraged to bike (see Map 6-4). As the survey results indicated, seven percent of all respondents who provided additional suggestions declared their interest in more biking and walking trails, which is something that needs to be addressed through the city (see Appendix 9).

Map 5-5 illustrated that many bike routes are only in their planning phases and are not existent at this time. It is therefore necessary for the company to work closely with the city of Columbus to demand the prioritization of sidewalks and bikeways near its facility. The timing would be right because the city has only recently released its bicentennial bikeway plan (Columbus 2008c) and established an Operation Safewalks program (Columbus 2008b).

8.1.2.2 Strategies to Reduce Traffic

Strategies that are related to reducing traffic include promoting the usage of transit and ridesharing. Each mode refers to an increase of people per vehicle and thus, a decrease in single vehicle trips made. The next two sections describe each concept in greater detail.

Promoting Public Transportation

Public transit refers to various forms of transportation vehicles, such as trains or buses, which are intended to convey a large number of people. One or more mass transportation services are generally available in every large urbanized area. By promoting these services and making them attractive to the commuting public, they stand a great chance in increasing their ridership. If well-developed, a public transportation system can address all three transportation attributes. It already tends to be one of the most cost-efficient transportation services, but express routes and frequent service times can also make it flexible and fast.

Many transit services in the United States, however, are established with the goal to function primarily as a social service to those who cannot afford or cannot drive a car. This image is often inhibitory when it comes to attracting those people that can make the choice. It is therefore critical for any public transit service to move towards an image that pertrays a transportation mode that is attractive to all population groups and is competitive to other modes. Within a qualitative study conducted by Mefford and Horner (2004:11) about accessibility and the transit planning process, the authors found that 'choice riders' can influence transit decisions much more than 'transit dependent riders.' Choice riders are defined as those who can afford to drive their own car but choose to use the bus or train instead. Choice riders often possess the resources to change policy decisions in their favor, such as route and service frequency. This result clearly demonstrates the need for employers to work with the public authorities to achieve a change in service to those routes that pass through neighborhoods with a high number of employees.

All players listed in Figure 8-2 are critical in increasing public transportation. An increase in public transit usage could be achieved much easier if everyone worked together. Specific suggestions on how to increase public transit usage include the following:

- Focus an information and marketing campaign on the routes most accessible to employees' homes and on stops nearest to the company's worksite. Such effort could potentially provide the information and motivation necessary to produce a modal shift for many employees. However, the company needs to provide transportation planners with a complete list of employee addresses, not only by zip codes, so that the actual potential per route is accurate.
- Focus TDM strategies on the implementation of high-speed transit routes connecting suburbs with downtown employment centers to make alternative modes competitive with automobiles. In general, service expansion, rather than decreased fares, has proven to be a more effective means of increasing ridership (Schimek 1996).
- Foster partnerships with nearby firms to promote existing routes or expand transit service. This cooperation can have a large impact, especially for companies that are located in downtown areas where transit service is underutilized. Section 8.2 describes the advantages of working together in greater detail.
- Ensure that the marketing messages portray a positive image of the transit agency and diminishes the known negative images by addressing them.
- To reduce car usage, employers could also get involved in assisting employees in relocating closer to the worksite or near a transit stop. Many cities offer partnerships with the transit authorities and local employers to assist workers through incentivized mortgage programs to move closer to a specific area, often the downtown. Such programs recognize the potential for employees to save on commuting expenses, enabling them to allocate more of their income towards the payment of a home located near a transit route (see Columbus Realtors 2008).

Specific to the study site and in response to the survey results, increasing transit routes and service could be particularly attractive to the nearly 60 percent of the workforce who lives in zip codes serviced by at least one bus line. Six bus lines were identified that service the home neighborhoods by zip codes of more than 400 employees, and ten additional lines service neighborhoods of 300 to 400 employees (see section 6.3.3). Unfortunately, due to the many stops along each route and the lack of designated bus lanes, travel time is often longer than traveling by car and, thus, is not attractive enough to tempt many SOV users to switch their mode of transportation. Therefore, the existing bus routes to the most populated areas should be examined for the possibility of shortening travel times or increasing service frequency during rush hours. Success in realizing additional bus lines could be secured if all surrounding employers worked in cooperation with the local transit authority to help sponsor such projects. In addition to establishing ridership with those employees who reside within a short walking distance to a bus stop, the P&R places should also be marketed effectively.

As previously mentioned, image improvements are critical when marketing the bus system. For example, the WCSS results showed an overall moderate attitude towards the cleanliness of buses (3.08 out of 5) and the bus as a 'stress reliever' (3.25 out of 5), yet there existed a somewhat more positive attitude towards being environmentally friendly (3.9), cost effective (3.83), reliable (3.7), and safe (3.7). The negative images need to be reversed while the positive ones should be reinforced.

Based on the research results, an effective marketing campaign should particularly emphasize the advantages towards cost savings, flexibility, and time. While travel time may be longer, using transit eliminates parking search and driving frustration. The time that would be lost by driving can now be utilized effectively by working, reading, or relaxing on the bus. In addition, walking to and from the bus stops provides for physical exercise which helps with the overall health and happiness of people. If service hours are frequent, flexibility of travel is also warranted.

Promoting Ridesharing

Ridesharing refers both to carpooling and vanpooling. Whereas carpooling consists of two or more commuters riding together in one's personal car, vanpooling consists of seven to fifteen people who ride together to and from work in a passenger van that is often provided by a commuter vanpool service. Either way, the vehicle passengers share the commuting costs but are bound to a specific departure schedule.

Ridesharing can be especially valuable to those who reside in areas without sufficient transit accessibility but with a high number of other employees living close by. Often, regional agencies take on the role of housing and maintaining a database that collects address and work schedule information of interested employees in the region. Any commuter can now ask the agency for a so-called match list of other commuters who live nearby, work nearby, and have a similar working schedule.

Carpooling and vanpooling is often not an option for people who want to be flexible since one rider depends on the other rider's schedule. Only a flexible ridesharing service could address this issue, but it is only successful if a very large population participated. Ridesharing can be a great alternative to solo driving for individuals who report moderate interest in alternative modes and show cost as well as time sensitivity (see chapter 7). While carpooling cuts travel cost in half or more, depending on the number of people per vehicle, it does not really save time. Yet, it also does not increase time significantly. The same is true for vanpooling. The vanpool program is ideal for employees who travel long distances in heavy traffic conditions on the way to work. The route, time, and van size is determined by the vanpool group. Passengers pay one low monthly fare that includes the use of the van, gasoline, parking expenses, mileage, insurance, and maintenance. The volunteer driver is generally allowed to ride for free and is also permitted limited personal use of the vehicle.

In regard to the research site, the housing distribution of AEP employees clearly indicated that the majority of employees reside within Franklin County and within a 30 minute driving distance to the worksite (see Map 6-2 and Map 6-5). Thus, carpooling, in the sense of picking each other up from home, could be a valid option for many employees to reduce their stress as

well as their commuting costs. It is not only an option based on the housing distribution but also based on the study results that indicated that most employees work a fairly regular schedule. The same is true for vanpooling.

While carpool and vanpool potential is clearly present for AEP, it should be marketed vigorously. The marketing should be in close cooperation with the regional rideshare program. Furthermore, other transportation stakeholders, such as the state and cities, should be involved to help determine possible P&P spaces where rideshare partners can meet and park their cars.

8.1.2.3 Strategies to Eliminate Traffic

The main strategy that eliminates both vehicle and person trips as a whole is often referred to as telecommuting. Telecommuting or telework refers to the practice of working from home and communicating with staff or customers via telephone or email. Telecommuting saves the employee from getting to and from work and therefore addresses all three attributes. It allows the employee to be flexible, and both commuting costs and travel time are zero.

While social contact and support is still a valuable criterion to everyday business, occasional telecommuting can be a great tool for employers to contribute to improving air quality by reducing the number of cars and therefore emissions on the roadways. In addition, telework can enhance the quality of work by limiting the stress of commuting. With increased advancements in technology, remote access to work desktops can be installed for each employee at relatively low costs. Telework can especially be beneficial to those who already own a computer at home, have sufficient internet access, and do not need to attend meetings.

However, not all types of jobs lend themselves to telework. Telecommuting is also a TDM strategy that relies solely on the employer. If telework is (partially) possible, then a telework arrangement should be offered on a trial basis for a specified period of time. The policy should clearly state what criteria will be used to evaluate the arrangement. Evaluation may include the following items:

- Meeting deadlines;
- overall employee productivity;
- progress of individual or team assignments;
- availability to receive and return calls;
- impacts on the employee at home as well as other staff in the office;
- customer service delivery; and/or
- ability to attend meetings, even on short notice.

According to the Canadian Center for Occupational Health and Safety (CCOHS 2007), there are several advantages and disadvantages to telework. These factors are illustrated in Table 8-1.

As for AEP, telecommuting is currently used by nearly ten percent of all employees at least once a month (section 6.3.2). The comments of several Intranet survey participants indicated more interest in it. Therefore, the option of telecommuting should be explored as a broader company policy.

Table 8-1: Advantages and disadvantages for allowing telecommuting

	Advantages	Disadvantages
Individual	▪ Less distractions from co-workers ▪ Better personal time management ▪ Savings in time and commuting costs ▪ Higher job satisfactions	▪ More distractions from family ▪ Isolation ▪ Lack of separation between home and work ▪ Potential for excessive working hours ▪ Less awareness of changes in company ▪ Fear of being undermanaged
Company	▪ Improved employee retention ▪ Often higher productivity ▪ Fewer lost hours due to traffic issues ▪ Reduced absenteeism ▪ Increased number of potential job candidates	▪ Contacting employee ▪ Maintaining adequate communication between other employees or with customers ▪ Possible delay in customer service

Source: Based on CCOHS 2007, own design.

8.1.3 Delivering the Fit

The various strategies illustrate the wealth of information, both spatially and behaviorally, that is available to make customer-oriented solutions and to identify the different transportation services for specific population groups. Once those services are ready to be delivered, two factors determine the type of steps that need to be taken. These factors are the tangibility or lack of tangibility of a product, and the need for personal service to introduce the product (Kotler and Roberto 1998:32). While the introduction process of a social product is similar to any other product, utilizing communication media and public relations, TDM strategies can also benefit from personal presentation or assistance to the service. In the case of TDM, tangibility refers to target group marketing, and personal service refers to the availability of information either through mobility managers or easily accessible and understandable online trip planners. Making the information available is as important as providing the service itself.

The need for marketing services was also greatly demonstrated by the survey results as only 28 percent of car drivers knew that their company offered reduced bus fares. These results were similar to the indicated interest of a GRH program which already 'unknowingly' exists. Even within the group of alternative mode users, only slightly more than half were knowledgeable about discounted monthly bus passes offered through the company. Overall, the importance of increasing the awareness and usage of existing benefits, such as the dock3 services mentioned in section 5.3.2, is obvious.

Delivering a new product can be very challenging. Partly responsible for this challenge is the complex decision process of the consumer. While people can be clustered into various groups based on similar sociodemographic characteristics, attitudes, or beliefs, each individual is still different in the way she or he makes decisions. As mentioned in chapter 2, forming new habits is a very multifaceted and intricate process and requires constant positive feedback that the new behavior is better than the old one. Since every individual defines 'better' differently, it increases the challenge for one product or service to address all of these issues globally. 'Better' can stand for cheaper, faster, more comfortable, or anything else.

8.1.3.1 Assisting with the Decision Process

In the case of TDM, personal assistance is a very important aspect of making a product or service successful. Often, mobility managers or so-called ETCs are hired to help the company with its marketing and the commuters with their travel choices. Hammond et al (1999:47ff) state that it is important to think of all possible alternatives in order to make a good decision. Only by considering all available services, one has a better chance of finding a fit. It is not recommended to choose the first possible solution but weigh the alternatives based on the individual's interests. Within the decision-making process, it appears to be helpful to assume that no constraints, neither real nor assumed ones, exist, and to create alternatives that reflect its absence. Setting targets that seem beyond reach will stretch the thinking and allow the consumer to be open-minded (Hammond et al 1999:50ff).

Due to missing information, transportation users often act upon subjective assumptions when making a mode choice. In order to increase transit usage or carpooling, making the information available is critical. While restrictive measures may make people aware of an unsatisfying commute, as long as information and availability of alternatives is not accessible to them and is not perceived as more attractive, a switch to alternative modes will not easily take place. It is important to present detailed information on all modes for the complete trip, from door to door.

Personal Assistance

The Association of Commuter Transportation (ACT) found that employees who had commuter assistance were nearly eight times more likely to use public transportation than employees without assistance. However, only 17 percent of employees have access to such assistance through their employers (ACT 2004:20). Therefore, establishing a contact person within the company who is responsible for personal assistance in all commuting matters tends to be very effective. The firm's ETC works on an individual basis with employees helping them to find the alternative which best fits their needs by assisting them through the decision process. Within complex decisions, it is often necessary to give up something on one objective to achieve more in terms of another. Making wise tradeoffs is one of the most important and most difficult challenges in decision making. In order to enable tradeoffs, several steps are required. These steps are described below.

The first step is to find and eliminate dominated alternatives: If alternative A is better than alternative B on some objectives and no worse than B on all other objectives, B can be eliminated from consideration because B is dominated by A (Hammond et al 1999:83ff). This can be achieved by creating a so-called Consequences Table where the values of all important variables for each alternative are compared, and the alternatives are ranked (see Table 8-2).

The second step is to make tradeoffs using the so-called Even Swap Method, for example. This method helps to determine if an even swap increases the value of an alternative in terms of one objective while decreasing its value by an equivalent amount in terms of another objective. Even swaps can be accomplished by making the easier swaps first. One should focus on the amount of a swap and not on the perceived importance of the objective. This method further emphasizes the importance to make consistent swaps while being fully informed about all

alternatives (Hammond et al 1999:87ff). This type of decision-making process can well be used for transportation choices, and ETCs can utilize these steps to help commuters with the process. The trade-off methodology is described in an example below to demonstrate its adoptability to TDM.

Example ~ Assume the following situation: Employee A lives within the catchment area of her workplace and within a two minute walking distance from a bus stop. The bus leaves approximately every six minutes during peak hours and has a stop within a three minute walking distance from her company. The company is about six miles away from her home.

Employee A defines cost, time, and flexibility as the three major attributes for choosing a transportation mode while emphasizing the importance for costs. She realizes that there are only three real options to select from: Driving alone, sharing a ride, or taking the bus.

Table 8-2: Consequence table for making a transportation choice

	Car alone	Carpool	Bus	Vanpool	Bike/Walk
Travel costs	\$135/month[a]	\$67/month	\$25/month	*n/a*	*n/a*
Parking costs	\$60	\$30	\$0	*n/a*	*n/a*
Time (one-way)	12 min	12-15 min	30 min	*n/a*	*n/a*
Flexibility	High	Medium	High/Medium[b]	*n/a*	*n/a*

[a] The driving costs are based on the U.S. average of 56.2 cent per mile (Internet Auto Guide 2005).
[b] Depends on time of use: If many students are on board, then the bus makes longer stops.

Source: Own design. [n/a = not applicable]

As Table 8-2 illustrates, the bus seems to be the most time-consuming option for employee A. However, it is also by far the cheapest of all transportation modes. It is therefore necessary to make an even swap in order to compare travel times and costs. Such a swap, for example, is possible by taking the length of the bus trip down to 15 minutes while increasing the price by 10 cent increments per lost minute, thus:

$$(30 \text{ minutes both ways } \times \$0.10) \times 20\text{days} = \$60/month$$

The new consequence table is displayed below.

Table 8-3: New consequence table for making a transportation choice

	Car alone	Carpool	Bus
Travel costs	\$135/month[a]	\$67/month	\$85/month
Parking costs	\$60	\$30	\$0
~~Time (one-way)~~	~~12 min~~	~~12-15 min~~	~~15 (30) min~~
Flexibility	High	Medium	Medium

[a] The driving costs are based on the U.S. average of 56.2 cent per mile (Internet Auto Guide 2005).

Source: Own design.

Carpooling can now be eliminated from the consequence table because the car dominates through its flexibility advantage and the bus through its cost advantage (travel plus parking

costs). Next, driving alone can be removed as an option because it is clearly more expensive. Even if the flexibility for riding the bus would be increased to 'High' and in exchange the monthly price would go up another $30, the bus would still dominate the car. As such, riding the bus is considered the best choice in Employee A's case.

The above demonstrated swap is only an example. Based on the importance a person places on each attribute, the outcome could be different. The individuality of attitudes and perceptions towards the different modes of transportation can therefore not be stressed enough.

The lack of behavioral and cognitive conformity in regard to transportation choices stresses once more the need for personal assistance. If information about the different modes is readily available, commuters can make more informed decisions. Furthermore, they will show a greater interest in participating in the decision process, which, in return, results in a higher chance of action.

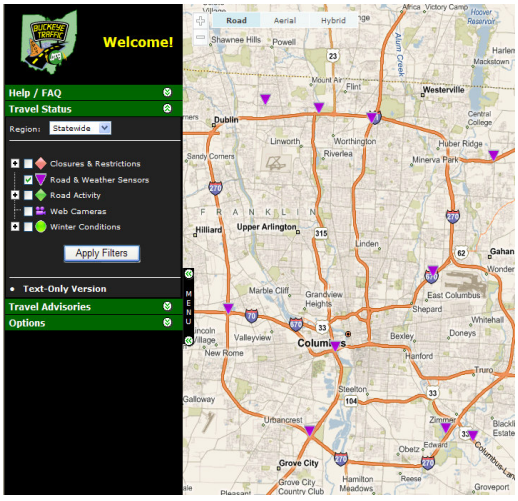
Traveler Information Systems

While personal assistance with transportation choices is very effective in working with employees to enable a mode switch, it is also very time-consuming and costly for the company. Therefore, a regional online multi-modal transportation information system could function both as an information and marketing tool for TDM. The tool could particularly address 'negative marketing' by showing high congested highways during peak hours, regular traffic crashes, and work construction projects. All these elements greatly impact the efficiency of the transportation system.

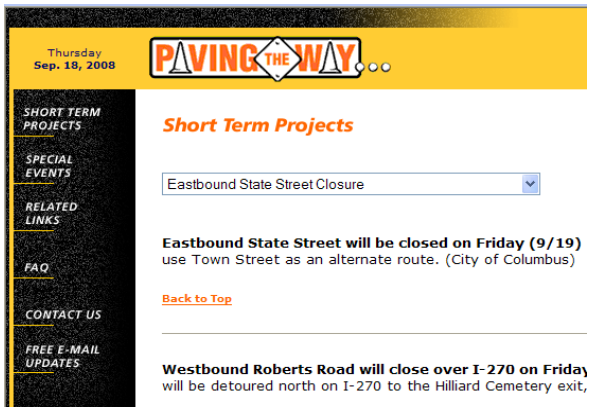
In the example of Columbus, several traveler information systems exist both on a state and local level. Both ODOT and the city of Columbus have a website that provides construction and incident-related information for federal and state highways and for major local arterials (see Figure 8-4). However, neither of these websites reveal congestion-related information by marking roadways in different colors based on their capacity level.

Figure 8-4: Traffic and roadway information systems in central Ohio

Buckeye Traffic



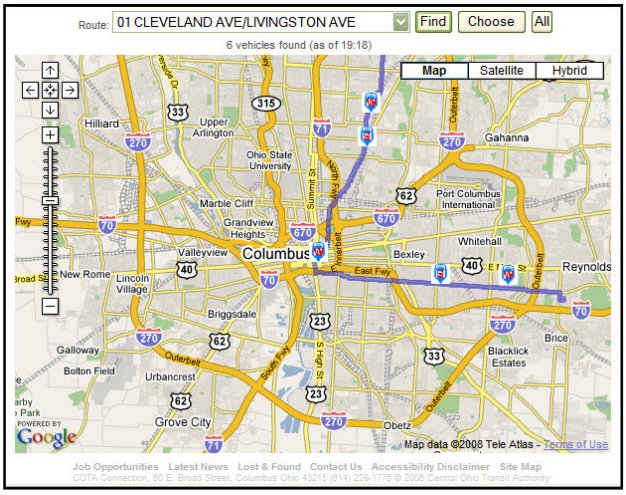
Paving The Way



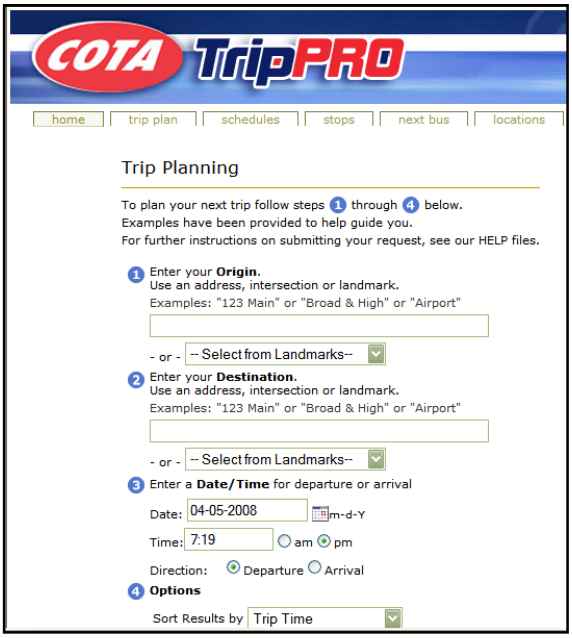
Sources: ODOT 2008 and Paving the Way 2008.

Figure 8-5: Local transit trip information systems for central Ohio

Real-time bus locator



Trip Planner



Sources: COTA 2008a and COTA 2008b.

In addition to showing current travel and weather conditions, COTA's website offers both a trip planner and a real-time bus locator tool (see Figure 8-5). These tools increase the credibility of the local transit system and offer the public with easy access to route and scheduling information.

While each is a well-functioning online tool for the region, they are all separate efforts. It is therefore recommended to study the feasibility of a regional multi-modal traveler information system. Such a study should include best practices from other regions, an inventory of all public and private traffic information systems in the Columbus MSA, and a cost estimate. The outcome of the project should include a system that provides trip information for each mode as well as non-recurring congestion information such as weather emergencies or traffic incidents. One regional trip planner tool allows for easy access to all transportation-related information.

8.1.3.2 Supporting Strategies

Along with offering ETCs or online traveler information systems comes the need to promote these services and to offer incentives or restrictive measures that further encourage a modal shift. In general, TDM strategies can be marketed three-fold: 1) by simply providing information about the different transportation services, 2) by offering 'soft' incentives or restrictions, such as prizes or discounts, or 3) by providing 'hard' incentives related to facility changes. Each strategy is described below.

Information Dissemination

There are many ways to disseminate information, such as with the distribution of *flyers* or *newsletters* that inform employees about carpooling and vanpooling services, the GRH program, about local transit routes, or the reduced transit fares. Other communication channels include the *internet*, *intranet*, or *email.* (Online) information in the form of facts, short movies, maps, cost calculators, or direct links to the various transportation providers and services provide information in a fun and time-efficient manner.

A map that represents the employees' housing distribution as a *visual tool* in combination with *short presentations* on-site can help inform employees about alternative modes of transportation and options available to them. These presentations could be held within so-called *transportation fairs* that are being organized between regional and local transportation providers and the cities. Applications for employees to add their names and addresses into a ridesharing database should be distributed to save employees the time to sign up for it later.

'Soft' Incentives

In addition to disseminating information about the various programs, the company should also consider providing incentives to their employees so that they think about using these services. For example, Fujii and Kitamura (2003:81ff) demonstrated the success of creating a mode switch where people had the opportunity to ride the bus for free, and where the trip was experienced positively. Therefore, handing out free bus passes to encourage employees to try the bus could be successful in achieving a modal shift in the long term.

In general, many employees state that a *financial incentive* would influence their decision to switch. Thus, providing employees who regularly use alternative modes of transportation with free parking four times a month in cases where they need to use the car, or offering discounted monthly bus passes, could in fact increase overall employee interest in alternative modes. In addition, offering *monthly drawings* for workers who do not drive alone to work can also increase interest in alternative modes. Such prizes could include gift cards to a biking store, a shoe store, or for a monthly electric bill. If a GRH program does not already exist in the region, the company should consider implementing one at their own costs.

As demonstrated throughout the report, *restrictive measures* are often effective in facilitating behavioral change, but only in combination with incentive programs. By offering sufficient parking spaces for every employee who drives to work, a company is encouraging the use of cars. By reducing the amount of parking available and increasing costs, and at the same time offering valuable alternatives, commuters would be more likely to consider switching modes. Other restrictive measures that cannot be controlled by the employer include the increase in *traffic congestion* and *rising fuel prices*. However, facts about these issues need to be presented in a way that easily explains the advantage of alternative modes.

'Hard' Incentives

Besides these promotional channels, *facility changes* should also be considered. As one example, designated carpooling or vanpooling parking spaces have proven to be an effective incentive in

persuading commuters in their mode choices (Brownstone and Golob 1992). Safe and roofed bike lockers, free use of showers, or repair services could also help increase employees' usage of non-motorized transportation modes. Other facility changes that would need to be built with the help of players other than the company are roofed bus shelters or safe sidewalks and bikeways.

The marketing options described above are all focused on how a company, such as AEP, can become proactive in promoting alternative mode usage. However, to have a regional impact, neighboring companies need to work together, and the city and transportation providers need to be actively involved. The power of cooperation is described in section 8.2.

8.1.4 Defending the Fit

The previous sections provide a good overview of the social marketing process and how it can be applied to TDM. But research and data can only provide so much information about who, what, and how to market a product. Only critical observation and continuous surveying can confirm how well the product is accepted, and how the product or its marketing need to be modified to improve it. It is therefore not only sufficient to convince commuters to choose another mode but also to make that particular ride an enjoyable one. Once a choice has been made and action has been taken, the person will evaluate the experience. A satisfactory experience increases the possibility of a person choosing the particular product or service again. If the mode of transportation is then used repetitively, a habit emerges (Golledge and Stimson 1997:35).

Kotler and Roberto (1998:37) refer to social marketing as a "management process that requires vigilant, active management as well as planning." Therefore, the re-evaluation process is crucial to the success of the product and should be part of any TDM strategic plan.

8.2 The Advantage of Working Together

As alluded to throughout the thesis, employer-based TDM is most successful if conducted in cooperation with all players. Thus, governments, transportation providers, and employers need to work together in order to efficiently utilize existing resources and collaboratively manage travel demand.

Müller and Wixey (2003:5ff) provide recommendations for a better integration of mobility management or TDM into local and national policies based on the 'P.A.I.R. Scheme' (Policy, Actors and Structures, Integration, Resources). The authors clearly state that TDM is a cooperative and integrative process and needs to market sustainable transportation systems with all players and resources in mind. One of the first steps includes the identification of barrier and support structures for mobility management on a local, regional, or national level, and to detect the areas for action by the degree of importance and simplicity. If an array of mobility options is available, it will be important to integrate multi-modal policies into leading policy documents along with guidance on how to advance them (Müller and Wixey 2003:9). Only with the involvement of state and cities could system-wide restrictive measures to driving the car take place. These measures include the implementation of increased road pricing or

higher parking costs. The same is true for incentives. For example, preferential bus lanes or HOV lanes have to be implemented at the government level (see Figure 8-2).

While policy decisions are clearly needed to offset a project-based and single-mode-based transportation planning process towards a holistic multi-modal land use and transportation planning approach (Ankner 2005:272), the private industry can be a large player in supporting this attitude. There are a variety of reasons for businesses to get involved in transportation planning and TDM in particular. In fact, Meyer (1999:578) quotes Gerwig (1996) when stating that there are ten 'business' reasons. These are as follows:

- Improves public health through lessened air pollution and stress levels;
- enhances economic health by improving regional mobility;
- enhances customer access;
- utilizes existing technologies (such as remote desktop access) to reduce travel trips;
- decreases parking demand while reducing congestion;
- offers alternative work hour programs to extend service hours;
- offers a wide variety of travel choices to enhance the ability to recruit and retain staff;
- allows for creative and flexible space planning and sharing;
- mitigates new development traffic impacts at a fraction of the cost for new physical improvements; and
- improves productivity through relaxed and satisfied employees.

While some states are fairly advanced in offering and requiring TDM programs for commuters, others still lack the federal encouragement and subsidies to work with local employers to implement effective strategies. In this regard, the BWC effort as mentioned in chapter 1 can be particularly helpful in promoting the success of well-developed TDM programs to both local and state governments. MPOs are also a good source to assist with this effort and to encourage its members and the region's employers in participating.

In general, legislation to require commute trip reduction strategies should be made mandatory not only for states with existing traffic problems but also for those that will be facing such issues in the future if countermeasures were not implemented now. However, if such laws do not currently exist, companies can become active themselves and take the lead for TDM in a particular region. A cooperation of nearby companies can lead to a unified front in the move towards improving public transportation, biking lanes, and sidewalks. Working with other companies on raising awareness of alternative modes can significantly increase the employees' interest in sharing a ride. There is potential that if employers are actively involved in their workers' travel choices, the success rate for switching to alternative modes is higher. Table 8-4 and Appendix 12 provide examples for a project schedule and a detailed plan of action for companies interested in pursuing TDM.

Table 8-4: Example of a TDM project schedule

Phase I: Conducting a Status Quo Analysis	
Analyze the Problem	Example: "Not enough parking spaces"
Formulate the Company's Goal	▪ Allocate and protect needed parking spaces for all user groups ▪ Distribute parking lots in a transparent and fair manner ▪ Utilize the existing parking lots optimally and most cost efficient
Create a Strength / Weakness Profile	▪ How are the employees residences distributed? ▪ Is the company connected to public transportation? ▪ What are current conditions for bicycle usage? ▪ What are current conditions for building carpools?
Phase II: Developing Strategies to create a mobility concept	
Detect Potential per Transportation Mode	▪ How many employees could use public transportation? ▪ How many employees live close enough to bike or walk to work? ▪ How many employees could carpool or vanpool?
Develop Objectives	▪ Increase transit ridership ▪ Increase bicycle usage ▪ Increase carpooling
Develop Strategies: *Incentives*	▪ Implement a bus job ticket ▪ Provide financial subsidy for bicycle purchases ▪ Hire a mobility consultant
Develop Strategies: *Restrictions*	▪ Implement parking restrictions for SOV drivers ▪ Levy parking fees
Vote on the type of measures	▪ Within management ▪ Through the staff association
Phase III: Implementing the company's mobility concept	
Realize the Concept	Once everyone has agreed on strategies, work towards implementing the TDM measures
Control the Success of each Program	▪ Survey employees after implementation of strategies ▪ Monitor usage of offered TDM programs ▪ Re-evaluate marketing

Source: Own design.

In a world of increasing concern for environmental and health issues, and in a time where financial resources for the transportation system are scarce, it is more important than ever to change our thinking and behavior towards a sustainable lifestyle that encourages walking, biking, and mass transportation. As the quote at the beginning of this chapter so clearly states, it is imperative to act now because „if we are not careful, we shall leave our children a legacy of billion dollar roads leading nowhere except to other congested places like those they left behind." By working together, we can achieve great things with the best use of our resources.

"Believing that each generation owes something to those which follow, we will create environmentally literate citizens who embrace sustainability as a way of living. We will be wise stewards of scarce resources and, in seeking to develop the whole person, be aware that our individual and collective actions have economic, social, and environmental consequences locally, regionally, and globally." - Author unknown

9 Critical Review of Results and Future Research Perspectives

Although not every urbanized area has suffered the same losses as the research site in their CBDs, many Midwestern cities are struggling today to keep their downtowns vital communities while slowing down the outward housing and business expansion trend. The negative consequences related to the growing number of cars on the roads cannot be overlooked anymore. Increased congestion and air quality issues are clearly impacting the quality of life and affecting the economic prosperity of a region (see chapters 1 and 4).

It is therefore imperative to produce change. Four key players related to transportation planning can help affect that change. These players are the federal, state, and local governments, transportation providers, employers, and individuals. While it takes time to make policy changes and to convince residents to change their behaviors, private businesses can do their part now in addressing the issues through TDM strategies directed at their employees. Employers can play an important part in achieving a modal shift for several reasons. First of all, employee commuting is much easier to capture than any other type of travel due to the repetitive nature of work trips. Second, companies have a direct relationship to their employees so they can study this subset of commuters and develop customized strategies that are aimed towards each individual's travel needs in a fairly short amount of time. Third, private businesses typically have the communication capability to most effectively distribute information about other modes. Lastly, employers tend to have the resources to provide their workers with incentives that could increase their likelihood to use other modes.

For these reasons, the research was conducted at a large private company with nearly 3,000 employees in downtown Columbus, Ohio. Columbus was chosen as the study site because its layout is typical of the urban structure of many American cities. The city is deficient in non-motorized transportation infrastructure, and public transportation is faced with a shortage of consistent ridership and funding. While congestion levels are comparatively lower than in other cities of its size, VMT and emission levels are steadily increasing. The rising problems regarding transportation and environmental issues are compounded by the fact that central Ohio is one of the fastest growing areas in the Midwest, both spatially and demographically. Due to these pressing issues, preventative measures need to be taken in order to curb travel delays, and in the process enhance air quality. While programs have been implemented, such as the metropolitan-wide rideshare program, which encourages carpooling and vanpooling, public awareness of alternatives is still lacking (see chapter 5).

The company was selected due to its location within the CBD where transit options are better than in suburban or rural areas. Although the firm has engaged in efforts to support transportation alternatives for their employees, it still encourages SOV travel by providing

sufficient parking at highly subsidized prices. It does not come as a surprise that nearly 90 percent of the workforce still drives alone to work.

In order to better understand the reasons behind driving, two surveys were conducted at the company's site using advanced methodologies that have not been widely applied to detect the factors involved in mode choice and travel behavior. The surveys were developed with the understanding that a comprehensive survey design that tries to encompass most every aspect of a mode choice decision making process is still missing. Furthermore, advanced statistical analysis is still lacking in the scientific literature to aid in the understanding of commute behavior and the development of TDM marketing strategies (see chapters 2 and 3). Therefore, the main survey of this study was qualitatively oriented and directed only at SOV commuters in the company. Referred to as the Work Commute Satisfaction Survey (or WCSS), this inclusive questionnaire was 11 pages long and utilized sophisticated techniques, such as conjoint analysis, to identify the importance of specific transportation attributes when making a mode choice. Another quantitative survey was done via the Intranet with all the company's downtown employees. This questionnaire was used to assess the full modal split and other transportation-related issues among the workers. Both the WCSS and the Intranet survey's objectives were to detect current and latent travel behavior to help determine potential TDM strategies that could encourage more employees to use alternative modes.

The use of these surveys was necessary to illustrate that standard questionnaires are not always the best method to study a spatial-behavioral problem. The innovative use of the less conventional methodology of applying qualitative research was crucial in gaining real answers to mode choice. While the method is exhaustive and therefore relies on population samples that cannot be claimed as being statistically representative, it provides in-depth information about people's attitudes and perceptions.

Only by using both the spatial and behavioral aspects of an employee's travel behavior can a more complete picture be developed. The spatial analysis takes into account the existing transportation infrastructure in relation to the job site and the employees' residences. For a long time, this perspective was seen as sufficient for understanding transportation choices, but the last decades have shown a shift from purely aggregate thinking to also considering the individuality of choice. This research acknowledges and emphasizes that modern transportation geography is about utilizing its spatial knowledge to enhance behavioral research, and to apply both to the development of marketing concepts so that change can be induced. This thesis has therefore assumed a comprehensive modal split model that takes all players, every spatial aspect of the commuting process, and the cognitive decision processes of the individual into account. The research results demonstrate the merit of such an approach. For example,

Map 7-1 greatly illustrates how spatial characteristics provide only limited information about the reasons for mode choice. Instead, the value individuals place on transportation attributes, such as flexibility, cost, and time, give much more detailed information about their transportation decisions (see chapters 6 and 7).

The conjoint analysis element was particularly valuable in demonstrating how going beyond hypothetical ideas and using real-life scenarios allows for more detailed answers. It clearly demonstrated how the results change when asking participants indirectly as to the importance of attributes rather than directly without scenarios. In fact, the vast majority (80 percent) of the survey participants stated that they value convenience or flexibility most. However, when confronted with realistic situations, a shift in priorities took place and only 50 percent of the respondents found flexibility to be their most important attribute. These results suggest that every individual defines the three main transportation attributes (flexibility, cost savings, and time savings) differently and can only truly answer what type of transportation mode they would choose if given real life examples.

Knowing that the values of the three main attributes change with the conjoint analysis question is helpful in using the results of this question via cluster analysis. This analysis is critical for grouping respondents into clusters based on these attributes so that they can now be targeted through customized marketing concepts. Group specificity enables the employer as well as local transportation agencies to better promote and customize transportation programs based upon the needs of each target group. For example, employees that value cost savings as the most important attribute could consider discounted transit passes as an incentive encouraging them to ride the bus. Customization is key in successfully marketing transportation options. While this statement holds true, it is also very important to evaluate the success of such marketing strategies through short and simple surveys that can be held on a regular basis.

The research at hand recognized that exhaustive surveys are not feasible to most researchers and practitioners who want answers quickly and in a representative fashion. Therefore, factor analysis was applied to show how the number of variables can be reduced to only a few key factors. Using the principal component analysis and varimax rotation, a reduction from 183 variables to a total of 30 factors was achieved. Although the survey only sampled a small portion of the employee population, the analysis could demonstrate its usefulness for TDM research on an exploratory level (see chapter 7).

In order to take the research one step further towards implementation, a variety of TDM strategies were identified that either shift motorized trips to non-motorized trips, reduce the number of vehicle trips, or eliminate trips as a whole. The multidisciplinarity of the research topic was again illustrated by applying a social marketing approach to the development of effective strategies. The development of different strategies shows the wealth of information, both spatially and behaviorally, that is available to transportation planners in making customer-oriented solutions. The strategies are based on the various players and the results of the survey (see chapter 8).

The importance of different players who all have a strong impact on mode choice and on reducing the number of vehicles on the roadways was repeatedly demonstrated throughout the paper. Without involving all stakeholders in the TDM process, most concepts will not be

viable. For example, both studies revealed that incentives (as opposed to disincentives) were preferred by most employees as a way to encourage change in travel behavior. In fact, the most compelling incentives included the improvement of public transportation, financial incentives, and personal assistance. Some of these incentives can only be provided in cooperation with players other than the employer.

The question asked at the beginning of this paper of whether other modes of transportation can compete with the automobile can be answered with a yes, but with the premise that transportation planners and policy makers must work with both the residents, to really understand their transportation needs, and the transportation providers, to support and fund their services. In addition, private employers are asked to do their part in actively promoting and incentivizing the usage of alternative modes of transportation to their workforce. TDM strategies have the potential to impact travel behavior if properly selected and implemented. Therefore, the effectiveness of TDM will depend on the market response to travel changing incentives and disincentives.

Although it is nice to know that a change in travel behavior can be achieved, it is not a matter of 'can' anymore but of 'must.' The increase in environmental issues, the arising financing crisis for the transportation infrastructure, the deepening health concerns due to the high degree of physical inactivity, the loss of economic competitiveness, and the dispersion of population all emphasize the need to create a transportation system that is multi-modal and affordable. If not us, who? If not now, when? If not here, where?

Future Research Perspectives

Travel behavior is a complex process that promises to remain a rich area for transportation research. Based on the study results, a variety of future research possibilities can be identified related to both the statistical methodologies and the involvement of players for the research.

The use of qualitative methods and scenario-building tools, such as the conjoint analysis presented here, are examples of the potential for utilizing innovative methods in TDM. While the research at hand only provided for a snapshot of these methods, further investigation into the type of scenarios and the parameter values that seem most appropriate as thresholds to determine when commuters change the ranking of attributes should be studied. In addition, the results of this study and the identified clusters should be examined in regard to their representativeness of a larger population. However, such comparison might be difficult now since gas prices have increased significantly and would, with great probability, influence the order of given attribute scenarios.

In regard to other statistical methodologies, the use of factor analysis should be expanded to establish factors, or variables, that seem to provide the best answers to travel behavior, and therefore could be used for standardized surveys around the United States. This idea goes along with the need to help employers, developers, and public agencies to study TDM. Practical methodologies are desired to assist in assessing the type of strategies needed for their clientele, as well as the costs and benefits of the different TDM programs. One attempt to do just that was done with research conducted under the TCRP Project B-4 which resulted in two guidance reports. One is called 'Public Agency Guidance on Employer-Based TDM Programs'

and the other is named 'Employer Technical Memorandum: Characteristics of Effective TDM Programs' (Jenks 1997:1ff). However, these documents are over ten years old and need to be re-evaluated.

Current literature on travel behavior recognizes the potential of employer-based research and transportation initiatives. Employers play a significant role in achieving commuter modal shift. As such, more research should be conducted to identify successful means of encouraging companies to actively participate in local transportation projects, and as a result implement strategies that are responsive to their employees' travel needs. Many case studies have shown that if one employer becomes actively involved in commuter choice programs and starts to receive recognition for its efforts, most likely other surrounding employers will follow. Cooperating with surrounding companies could then lead to more effective strategies aimed at improving public transportation, biking lanes, and sidewalks. Therefore, future research should also include the type of impact that multiple employers can have on changing basic transportation policies when cooperating with the city and public transit agency.

Based on the idea of intercultural differences, further research about cultural and social boundaries that impede mass transportation would also be interesting. As this research was conducted in a very auto-oriented environment, it opens up the question if similar results would be obtained when studying a commuter population in a city with much more transit-oriented land use and service coverage.

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NOTE: If no page number is provided after a reference, then no page numbers were available or applicable (e.g. web source).

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Hollback, J. (2005). Head of the Environmental Department at American Electric Power. Interview in Columbus, Ohio.

Kühnel, I. (2003). Employee with Kreisverkehr Schwäbisch Hall. Presentation in Regensburg, Germany.

Lawler, R. (2007). Transportation Director at the Mid-Ohio Regional Planning Commission. Interview in Columbus, Ohio.

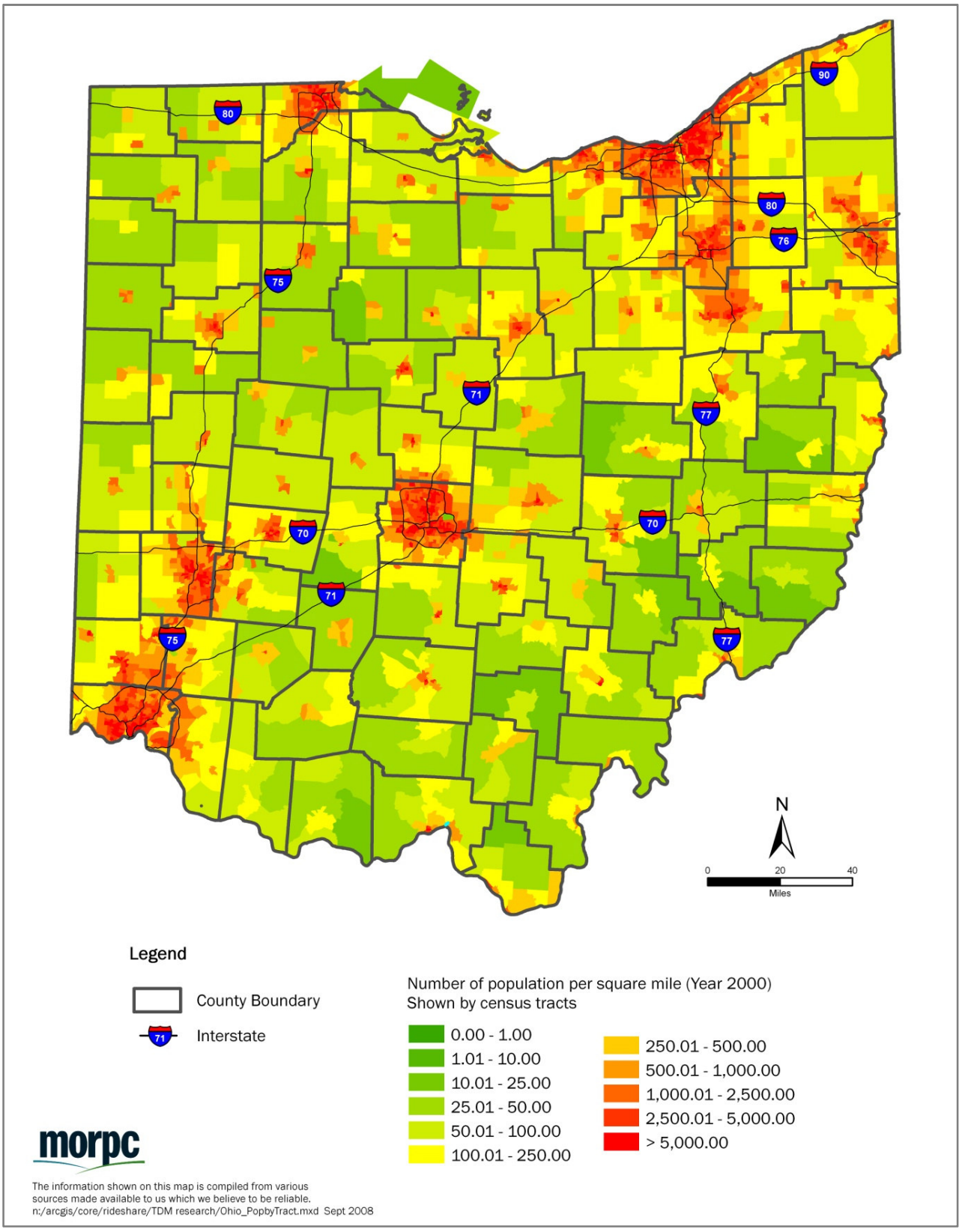
Lhota, B. (2005). Executive Director of the Central Ohio Transit Authority. Presentation in Columbus, Ohio.

McCann, M. (2008). Planner at the Central Ohio Transit Authority. Interview in Columbus, Ohio.

Schreffler, E. (2004). Transportation Consultant. Phone interview to San Diego, California.

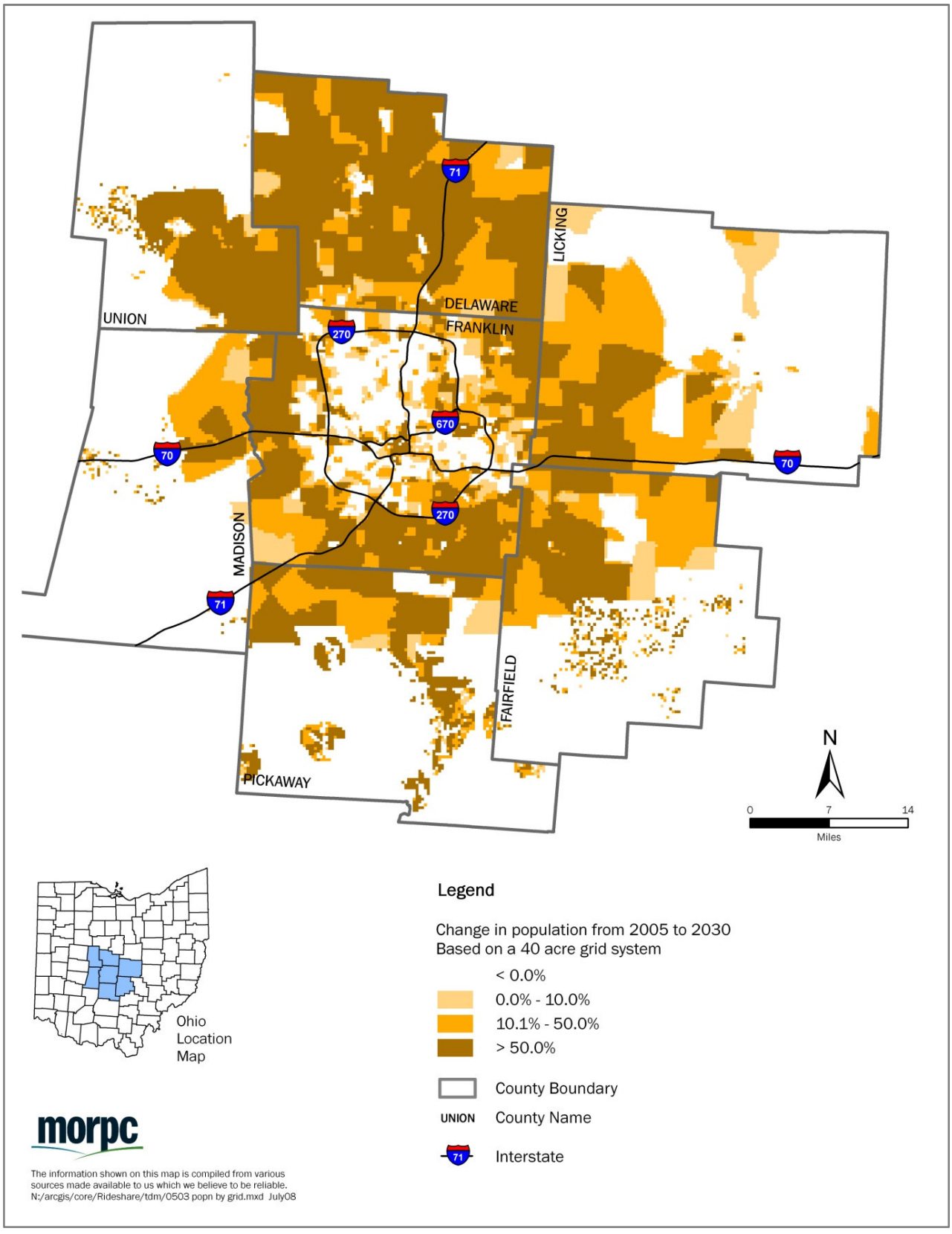
Appendices

Appendix 1: Population density per square mile by census tracts in Ohio, 2000



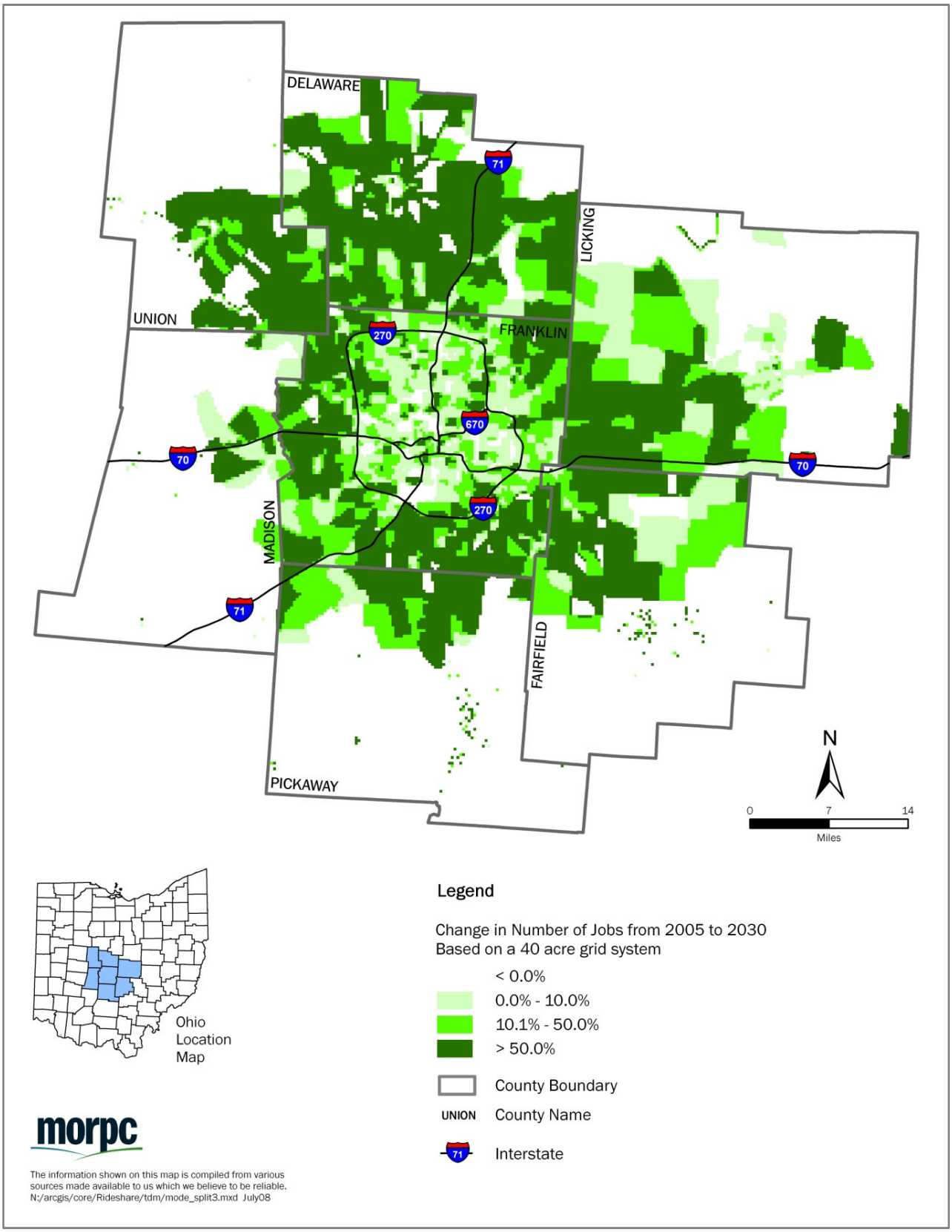
Source: MORPC, own design. Based on Census 2000, ODOT, and MORPC data.

Appendix 2: Change in population from 2005 to 2030 in central Ohio



Source: MORPC, own design. Based on Census 2000, ODOT, and MORPC data.

Appendix 3: Change in employment from 2005 to 2030 in central Ohio



Source: MORPC, own design. Based on Census 2000, ODOT, and MORPC data.

Appendix 4: Material for recruiting companies to participate in research project

A. Cover letter and fact sheet

May 18, 2004

{*Company Name*}
Attn: {*Name*}
{*Company Address*}
{*City and Zip* code}

Dear {Name}:

As an employer, one of the most important aspects of your job is to make sure your employees arrive at work on time, fully prepared for their day. Join {*Name of sister company in another city*} which already actively offers their employees attractive and stress free alternative modes of transportation to and from work. This is in an effort to reduce severe traffic congestions leading to delayed arrival times and parking shortages at worksites that could be very costly. Offering these types of benefits can aid in recruitment and the retaining of employees. For their efforts, your sister-branch has been nationally recognized by achieving the EPA designation as one of the *Best Workplaces for Commuters*^{SM}.

Also, central Ohio is facing serious consequences due to poor air quality. By taking pro-active measures, such as promoting alternative modes of transportation to your employees, your company can help reduce ozone and particle pollution levels in the region and become publicly recognized as a **Champion of the Clean Air Challenge**.

The Mid-Ohio Regional Planning Commission has a non-profit program, Ride**Solutions**, which provides free assistance to employers and commuters regarding carpooling, vanpooling, and transit in an 11-county service area. At no cost to you, your organization can benefit in many ways, including free transportation management services, national and international recognition, and help impact Central Ohio's air quality.

Ride**Solutions** can provide you these and other **benefits**:

- ✓ Free transportation management and consulting services.
- ✓ Cost savings for you and your employees.

  For example: since January 1, 2002, the federal tax code allows employers to offer their employees up to $100 per month in tax-free benefits for transit and vanpool passes.
- ✓ Assistance in receiving public recognition for your efforts.

Please contact Kerstin at *614-805-9774* or via Email: *ridesolutions@morpc.org* to set up an initial meeting to further discuss your needs and concerns. Feel free to share and forward this letter to any person in your company who might be interested.

Thank you for your time and interest! We look forward to hearing from you soon!

Sincerely,

Lynn Jones – Program Manager

http://ridesolutions.morpc.org

Did you know?

- Eight of ten U.S. workers believe commuter benefits are valuable to employees.
- Since 1982, the U.S. population has grown 20%, but the time spent by commuters in traffic has grown by 236%.
- Last year, commuters in the United States spent $60 billion in gasoline traveling to and from work – more than double the annual revenues of Microsoft Corporation.
- On average, an employer with 1,000 employees that offers commuter benefits can take credit for taking 175 cars off the road, saving 44,000 gallons of gasoline per year.
- By offering commuter benefits, a company with 1,000 employees can lower its annual parking expenses by more than $70,000 and save participating employees $13,000 each year in taxes and $160,000 each year in gasoline, parking, and vehicle costs.

 To see general cost savings, visit: *http://www.bwc.gov/resource/calc.htm* and take the test!

Providing your employees with Commuter Benefits has many advantages:

- ✓ Attract and retain a Qualified Workforce in a competitive economy.
- ✓ Use benefits to increase employees' Happiness, Job Satisfaction and Productivity.
- ✓ Solve Parking Challenges and Costs and reduce Traffic Congestion.
- ✓ Show that your company is committed to a more Sustainable Future by reducing environmental impacts, improving air quality and conserving energy.
- ✓ Enjoy the Media Coverage opportunities and setting an example by being an exhibit leader and corporate citizen.

Be one of the first companies in Ohio providing Commuter Benefits!

Nearly 600 employers across the nation, representing more than 1.2 million employees, are already participating as *Best Workplaces for Commuters*[SM], but only four (federally supported) employers in Ohio have received this award, two of them are DSCC[21] and DFAS[1].

As a local example, 19 vanpools today serve the DSCC/DFAS base, taking some 228 cars off of Columbus area highways. Computed at American Automobile Association's (AAA) estimate of 13.6 cents per mile, the combined vanpoolers save an average of $850,000.00 in one year as compared to driving alone, not including depreciation due to accumulated high mileage.

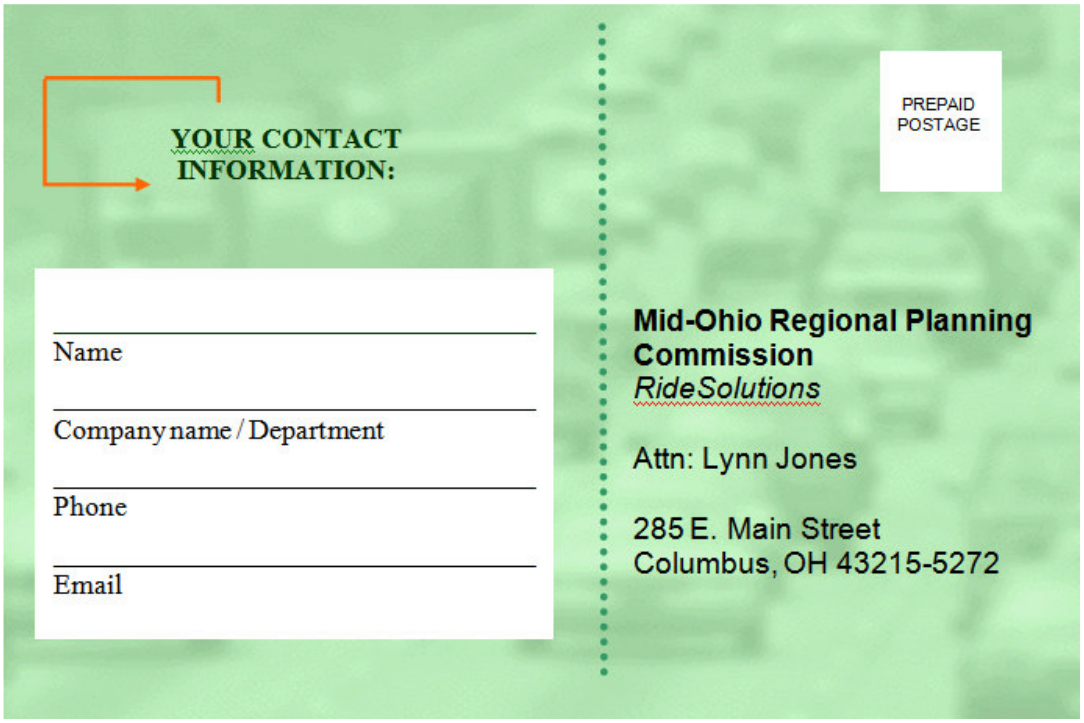
Local transportation services offered by MORPC:

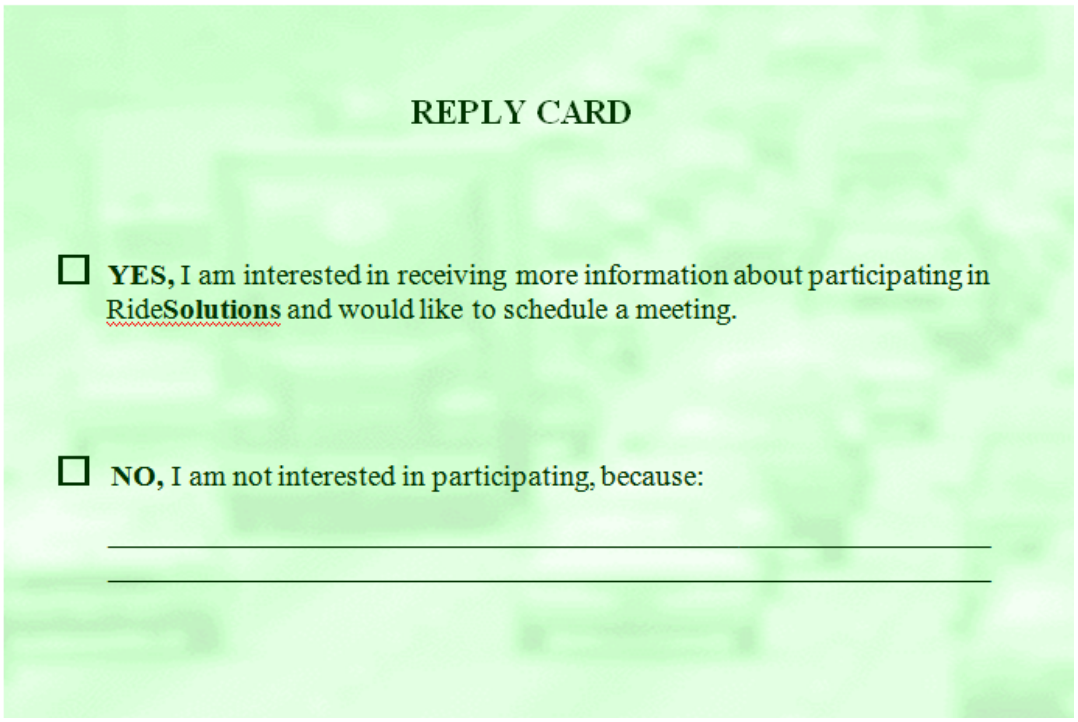
Ride**Solutions** is a program of MORPC, providing free assistance to employers and commuters regarding carpooling, vanpooling and transit in an 11-county service area. Ride**Solutions** is committed to the national objectives of reducing traffic congestion, lowering commuter costs, conserving energy and improving air quality:

- ✓ Planning your transportation program, conforming to your guidelines.
- ✓ Offering the Guaranteed Ride Home program to employees.
- ✓ Holding vanpool information and formation meetings and presentations on site as necessary.
- ✓ Staffing transportation events to attract additional commuter interest in ridesharing.
- ✓ Providing match lists to interested employees for carpooling and vanpooling.
- ✓ Recognition for improving air quality of Central Ohio.

[21] DSCC=Defense Supply Center Columbus - DFAS=Defense Finance And Accounting Service

B. Response postcard





Appendix 5: Focus group material

A. Invitation letter

06-22-2004

Dear Participant:

Thank you for accepting our invitation to talk about your daily commute to work by car!

The Mid-Ohio Regional Planning Commission (MORPC), together with the University of Regensburg, is holding this focus group to learn about your attitudes and perceptions towards all types of transportation services, such as single car usage, carpooling, vanpooling, and riding the bus. MORPC is interested in the comments of all employees that drive their car alone to work and enjoy driving their car.

The group will be held:

Thursday, June 24th
11:30 to 12:30 p.m.
MORPC-Building
285 E. Main Street, **Conference Room ABC** – just sign up at the front desk
Columbus, OH 43215-5272

Free parking is available on-site.

It will be a small group of eight to ten people. MORPC will have free lunch arranged for you during the session.

If for some reason you won't be able to join us, please call as soon as possible so we can find another participant. If you have questions, please call Kerstin at 805-9774.

We are looking forward to meeting you Thursday.

B. Focus group surveys

We would greatly appreciate if you could fill out the following questions to help us receive a better overview of our participants today.

Gender: □ male □ female

Age group: □ 18-25 years □ 26-35 years □ 36-45 years □ 46-55 years □ 56-65 years □ 66 or older

Work hours: □ Flextime
□ Office hours: _____ *a.m.* to _____ *p.m.*
□ Shift hours: _____ *a.m./p.m.* to _____ *a.m./p.m.*

Marital Status: □ Single □ Married □ Other

Children: □ Yes, I have _____ children → please provide their ages: _____
□ No, I don't have children

Nr. 1

We would greatly appreciate if you could fill out the following questions to help us receive a better overview of our participants today.

Gender: □ male □ female

Age group: □ 18-25 years □ 26-35 years □ 36-45 years □ 46-55 years □ 56-65 years □ 66 or older

Work hours: □ Flextime
□ Office hours: _____ *a.m.* to _____ *p.m.*
□ Shift hours: _____ *a.m./p.m.* to _____ *a.m./p.m.*

Marital Status: □ Single □ Married □ Other

Children: □ Yes, I have _____ children → please provide their ages: _____
□ No, I don't have children

Nr. 2

We would greatly appreciate if you could fill out the following questions to help us receive a better overview of our participants today.

Gender: □ male □ female

Age group: □ 18-25 years □ 26-35 years □ 36-45 years □ 46-55 years □ 56-65 years □ 66 or older

Work hours: □ Flextime
□ Office hours: _____ *a.m.* to _____ *p.m.*
□ Shift hours: _____ *a.m./p.m.* to _____ *a.m./p.m.*

Marital Status: □ Single □ Married □ Other

Children: □ Yes, I have _____ children → please provide their ages: _____
□ No, I don't have children

Nr.3

C. Moderator's Guide

Focus Group Question-Guideline

Good afternoon and welcome. Thanks for taking the time to join the discussion on commute travel. My name is {*Name*}, and I am moderating this focus group today for MORPC. I am unattached to the researcher. I simply volunteered to lead the discussion today. I know though that MORPC is very interested in your own experiences and feelings regarding your daily travel to work.

There are no right or wrong answers. We expect that you will have differing points of view. Please feel free to share your point of view even if it differs from what others have said.

We are recording the session because we don't want to miss any of your comments. No names will be included in any reports. Your comments are confidential. **Keep in mind that we're just as interested in negative comments as we are in positive comments, and at times the negative comments are the most helpful.**

We have name tents here in front of us tonight. They help me remember names, but they can also help you. If you want to follow up on something that someone has said, you want to agree, or disagree, or give an example, feel free to do that. Don't feel like you have to respond to me all the time. Feel free to ask questions, listen, and make sure everyone has a chance. And if you aren't saying much, I may call on you. We just want to make sure we hear from all of you.

Feel free to get up and get more refreshments if you would like. Let's begin. Let's find out some more about each other by going around the room one at a time. → Question 1

- Please turn off cell phone
- Directions to bathroom

5 minutes

Opening and Introductory Question:

5

1. Please tell us your name, where you live and how long it took you today to drive to work with your own car.
2. Can you describe your trip to work **today**, from leaving your house to arriving at work (walking time to and from car, parking search, coffee stop, etc.)? If you didn't work today, just tell us about your average trip to work.

   Also, do you have to pay for parking at your work-site? If yes, how much per month?

Transition Question:

5

3. What do you like or dislike about driving the car? *[Assistant: List answers]*

Key Questions:

15

4. Having talked about the 'likes' and 'dislikes' of driving the car, what would make your trip more enjoyable? What would you like to change?
5. My assistants will now hand out cards to you that contain different attributes regarding the travel to work. Please sort the attributes by importance to you (first = most important).

   [Assistant: Hand out cards]

   Now, could you please read your rankings out loud so we can write them down on the flip chart?
6. Please explain your choice of ranking.

15

7. If you think of Carpooling, Vanpooling, or Riding the bus[22], what are the positive and negative sides that come to your mind for each type of transportation? → Brainstorming

   [Assistant: List answers to appropriate category: Carpooling, Vanpooling, Bus]
8. How could the negative sides be improved? Be creative and imaginative, even if the implementation of your idea seems impossible!

7

9. What are your monthly costs for driving your own car to work? (If not sure, a rough estimation as well as listing the different cost sources is fine).
10. Do you believe that carpooling, vanpooling, or riding the bus would be cheaper, more expensive or equal to your monthly car costs? *[Assistant: write down answers]*

6

11. How would you describe people that ride the bus, carpool, or vanpool?
12. Do your friends, neighbors, or co-workers also drive to work by car or do they use other modes?

Ending Questions:

2

13. *[Moderator: Short summary].* If the improvements to bus, carpooling, or vanpooling were made, would you consider using them for your travel to work?
14. Was there any question that I didn't ask but you would have liked to comment on?

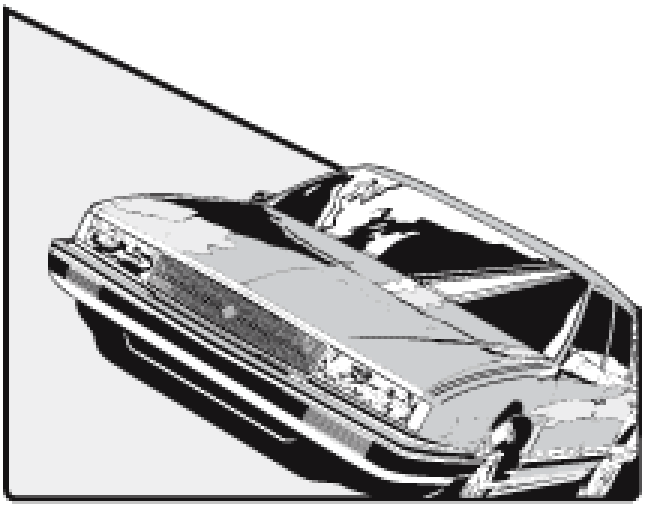
[22] Explanations: A *carpool* is two or more people riding together to and from work.
A *vanpool* carries 7 to 15 commuters to work in a van with a volunteer driver from the group. One can join an existing vanpool or, with RideSolution's help, form a new vanpool.

Appendix 6: Work Commute Satisfaction Survey (WCSS)

The Mid-Ohio Regional Planning Commission (MORPC)

in cooperation with the University of Regensburg, Germany

2004



Work Commute Satisfaction Survey

Quick Instructions:

- There are no right or wrong answers! Your answers are **strictly confidential** and your participation stays anonymous, so please be open and honest in your responses.
- Your initial answer is the one most important to us. That is why we ask you to not go back to any question, unless you realized you made a mistake before.
- To ensure the validity of the survey, we need you to answer **every** question on the survey.

Please feel free to ask the assistants at any time if something is unclear to you!

- The following terms frequently used in the survey are defined as follows:

Carpool = 2 or more people riding together in a car to and from work

Vanpool = 7 to 15 people travel to and from work in a van with a volunteer driver from the group.

A. Work & Home

1. Where do you live?

ZIP-Code: __ __ __ __ __ City: _____

Nearest major intersection from home: _____

2. Why did you choose this location? ***(Please check all that apply)***

❑ Close to work ❑ Close to my partner's work ❑ It's our old family home
❑ Good Neighborhood ❑ Good school for children ❑ I have always lived there
❑ Affordable price ❑ Close to shopping facilities

❑ Other (describe): _____

3. Where do you work?

ZIP-Code: __ __ __ __ __ City: _____

Nearest major intersection from work: _____

4. Why did you choose this work place? ***(Please check all that apply)***

❑ Good employer (benefits) ❑ Close to my partner's work ❑ Only employer in town I could find
❑ Close to home ❑ I have always worked there ❑ Close to children's daycare/school
❑ Great career options ❑ Salary level

❑ Other (describe): _____

5. How long have you worked at this work place?

_____ year(s)

6. Do you work full- or part-time?

❑ Full-time (30-40 hrs a week) ❑ Part-time (less than 30 hrs a week)

7. Which work model are you in?

❑ Flexible working hours ❑ Normal Business hours (e.g. 8-5) ❑ Alternate Shift

8. What is your main route to work? ***(Please check all that apply)***

❑ I-71 N / S ❑ I-70 E / W ❑ I-270 ❑ I-670 E / W ❑ 315 N / S
❑ High Street ❑ Broad Street

❑ Other (specify): _____

9. Do you have a local (COTA) bus stop within walking distance of your home (accessible by foot)?

❑ Yes ❑ No ❑ I don't know

10. How often do you need to wear a business attire to work?

❑ Daily ❑ At least once a week ❑ Rarely ❑ Never

11. How often do you need to transport large and heavy items to or from work?

❑ Daily ❑ At least once a week ❑ Rarely ❑ Never

B. Your Commute Travel

12. How did you travel and will you travel to work each day this week?

Pick the number that matches the commute mode, or reason for not commuting for each day of the week. Enter those numbers in the boxes below. If you used more than one mode of transportation for the trip to work, choose the number, which accounts for the largest segment of your trip.

	Commute Mode	*Reasons for not commuting to work*
___ MON	1 Drive alone	9 Worked from home/Telecommuted
___ TUE	2 Motorcycle/Moped	10 Reported to another worksite
___ WED	3 Carpool	11 Traveled on business
___ THU	4 Vanpool	12 Regular Day off
___ FRI	5 Bus	13 Compressed work week day off
	6 Walked	14 Sick day / Other occasion
	7 Bicycled	
	8 Was dropped off	

13. Is this week typical?

❑ Yes ❑ No, I usually _____

14. Do you occasionally use other modes of transportation for your trip to work? *(Please check all that apply)*

❑ No, never

❑ Yes → ❑ Carpool ❑ Bus from home ❑ Park & Ride ❑ Motorbike ❑ Bike ❑ Walk

❑ Other (specify): _____

15. What is the model and year of the car that you use for driving to and from work?

Car model: _____ Year: _____

16. When do you usually arrive at work and when do you usually leave work to return home?

I arrive at approx.: _____ am / pm ***and*** I leave at approx.: _____ am / pm

17. How many minutes, on average, does it take for you to drive from and to work one-way?

approx. _____ minutes ❑ Don't know

18. What is the approximate distance (in miles) between your home and work one way?

approx. _____ miles ❑ Don't know

19. How many of each of the following vehicles are owned by your household? *(Please provide the quantity)*

☐ Car/Van/SUV/Truck ☐ Motorcycle ☐ Bicycle ☐ Other (specify):_____

20. How satisfied are you with the following concerning your current commute?

	Very satisfied	Somewhat satisfied	Neither satisfied nor unsatisfied	Somewhat unsatisfied	Very unsatisfied
Travel time **to** work	❑	❑	❑	❑	❑
Travel time **from** work	❑	❑	❑	❑	❑
Route to work (congestion, lanes etc.)	❑	❑	❑	❑	❑
Travel costs	❑	❑	❑	❑	❑
Travel comfort	❑	❑	❑	❑	❑
Level of convenience/flexibility	❑	❑	❑	❑	❑
Searching time for a parking spot	❑	❑	❑	❑	❑
Distance from parking spot to work place	❑	❑	❑	❑	❑
Cost of parking	❑	❑	❑	❑	❑
Car size	❑	❑	❑	❑	❑
Car gas mileage	❑	❑	❑	❑	❑

21. On your main route to work, is there anything that could be improved? ***(Please check all that apply)***

❑ Reduced number of trucks ❑ Implementation of bus routes ❑ More lanes
❑ Increased speed limit ❑ Implementation of light rail ❑ More frequent bus service
❑ Reduced speed limit ❑ Carpool (HOV) lanes ❑ More biking trails
❑ Other (describe): _____

22. How long do you **usually** search for a parking space?

_____ minutes ❑ None, I have an assigned parking space

23. Where do you **usually** park? ***(Please indicate only one)***

❑ Parking garage (1 RP) ❑ Parking garage (Spring Street) ❑ Along the street
❑ Other (specify): _____

24. How far away is the parking space from your work place (either in minutes OR in feet, please circle)?

_____ minutes / feet

25. What are your monthly parking fees?

$ _____

26. How often do you generally run the errands listed below on your trip to or from work?

	Daily	*3-4 times per week*	*1-2 times per week*	*Less than 1 time per week*	*Rarely*
Bring / take children	❑	❑	❑	❑	❑
Bring / take others	❑	❑	❑	❑	❑
Shopping / Groceries	❑	❑	❑	❑	❑
Dry cleaning	❑	❑	❑	❑	❑
Stop for meals / coffee	❑	❑	❑	❑	❑
Stop for gas	❑	❑	❑	❑	❑
Other (specify):_____	❑	❑	❑	❑	❑

4

27. What are your main reasons for driving alone to work? *(Please check all that apply)*

- ❑ I need my car at work for company business
- ❑ I need my car at work for personal business
- ❑ Parking is free or inexpensive
- ❑ I need to run errands before/after work
- ❑ I prefer to drive my own car
- ❑ I need to transport children
- ❑ It's a habit
- ❑ It's most reliable
- ❑ I want to be flexible
- ❑ There is no reasonable bus option
- ❑ Riding the bus costs too much
- ❑ I need to get home in an emergency
- ❑ I don't have anyone to ride with
- ❑ I don't like to depend on others
- ❑ Poor bicycle and pedestrian access
- ❑ Anything else takes too much time
- ❑ I have an irregular work schedule
- ❑ I have safety concerns
- ❑ It's cheap
- ❑ It takes the shortest time
- ❑ I have luggage
- ❑ It's my only choice / no alternative

❑ Other (specify): _____

28. Would you like (at least once a week) to have the opportunity to work from home (telecommuting) instead of physically going to your work location?

❑ Yes ❑ Maybe ❑ No ❑ I already do

29. Would you welcome the opportunity of a compressed work week (only work 4 days but 10 hours each)?

❑ Yes ❑ Maybe ❑ No ❑ I already do

30. How do the following types of personalities apply to you?

	All the time	*Most of the time*	*Some of the time*	*None of the time*
I would consider myself a shy person	❑	❑	❑	❑
I like taking risks	❑	❑	❑	❑
I would consider myself frugal	❑	❑	❑	❑
I am a hectic person	❑	❑	❑	❑
I would rather be alone than with others	❑	❑	❑	❑
I don't mind working overtime	❑	❑	❑	❑
I have an easy time adapting to new situations	❑	❑	❑	❑
I feel easily stressed	❑	❑	❑	❑
I enjoy walking	❑	❑	❑	❑
I enjoy biking	❑	❑	❑	❑
I often make small-talks with strangers (e.g. in store, at the doctor's office…)	❑	❑	❑	❑
I need to feel safe	❑	❑	❑	❑

31. How important is it for you …

	Very important	Somewhat important	Neither important nor unimportant	Somewhat unimportant	Very unimportant
… to protect nature and environment	❑	❑	❑	❑	❑
… to attain wealth	❑	❑	❑	❑	❑
… to strive for safety	❑	❑	❑	❑	❑
… to help other people	❑	❑	❑	❑	❑
… to have power and influence	❑	❑	❑	❑	❑

32. Please rank the following attributes by their importance to you for creating an ideal transportation service, even if it doesn't fit your current commute, from1 = most important to 12 = least important.

	Convenience
	Socializing
	Comfort
	Privacy

	Status / Image
	Cost Savings
	Flexibility
	Less Polluting

	No Parking Search
	Short Travel Time
	Relaxing / Reading
	Easy pick-up of others

C. Your Opinion

33. Please tell us how important each of the following is to you in determining your travel to work.

	Very important	Somewhat important	Neither important nor unimportant	Somewhat unimportant	Very unimportant
Short travel time	❑	❑	❑	❑	❑
Low commuting costs	❑	❑	❑	❑	❑
Having a vehicle at work	❑	❑	❑	❑	❑
High comfort/relaxation level	❑	❑	❑	❑	❑
High convenience level	❑	❑	❑	❑	❑
No parking search	❑	❑	❑	❑	❑
Reducing pollution	❑	❑	❑	❑	❑
High safety assurance	❑	❑	❑	❑	❑
Being able to pick up others	❑	❑	❑	❑	❑
Status / Image	❑	❑	❑	❑	❑
Having my privacy	❑	❑	❑	❑	❑
Other (Specify): _____	❑	❑	❑	❑	❑

34. What aspects should be improved on local public transportation? *(Please check all that apply)*

❑ Timetables that match working hours
❑ Improved service frequency
❑ Reduced bus fares
❑ More bus stops at residential areas
❑ More bus stops near work place
❑ Shorter trip times
❑ Easier to understand timetables
❑ More comfort and cleanliness
❑ On-time service
❑ Safer bus stops and buses
❑ More connections with no transfer needs
❑ Other (describe): _____

35. Would any of the following make you more likely to try a carpool, vanpool, the local bus or bike and walk to work? Is that much more likely, somewhat more likely, or not at all more likely?

	Much more likely	Somewhat more likely	Not at all more likely
A guaranteed (emergency) ride home program from work	❑	❑	❑
Personal assistance on services, times and schedules	❑	❑	❑
On-site childcare center	❑	❑	❑
Receiving money for not using a parking space	❑	❑	❑
Prizes / drawings for people who do not drive alone to work	❑	❑	❑
Higher gas prices	❑	❑	❑
Increased parking search and parking costs	❑	❑	❑
Increased awareness of worsened air pollution	❑	❑	❑
A significant increase in traffic congestion	❑	❑	❑
Assistance in arranging a carpool/vanpool and finding riders	❑	❑	❑
Reserved parking spaces for carpoolers/vanpoolers	❑	❑	❑
Separate and fast lanes for carpoolers/vanpoolers	❑	❑	❑
Cheaper bus fares	❑	❑	❑
Cheaper monthly bus passes	❑	❑	❑
Increased bus services, more frequent bus times	❑	❑	❑
Implementation of a light rail system	❑	❑	❑
Improved biking / walking trails to work	❑	❑	❑
Secure bicycle parking, showers and lockers	❑	❑	❑
Other (describe): _____	❑	❑	❑

36. How strongly do you agree or disagree with the following statements about riding the bus?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
If I ride the bus, my co-workers or friends will look at me strangely.	❑	❑	❑	❑	❑
Bus riders are frugal.	❑	❑	❑	❑	❑
Traveling by bus is mainly for people who can't afford anything better.	❑	❑	❑	❑	❑
The bus is used by students, elderly and the poor.	❑	❑	❑	❑	❑
Buses are usually reliable.	❑	❑	❑	❑	❑
Buses are clean.	❑	❑	❑	❑	❑
I don't like the bus because it gets too crowded.	❑	❑	❑	❑	❑
Riding the bus is relaxing.	❑	❑	❑	❑	❑
Riding the bus is cost saving.	❑	❑	❑	❑	❑
Riding the bus is environmentally friendly.	❑	❑	❑	❑	❑
Riding the bus is safe.	❑	❑	❑	❑	❑
Riding the bus is comfortable.	❑	❑	❑	❑	❑
It is safe to walk to and from the bus stop.	❑	❑	❑	❑	❑
The bus system should be expanded.	❑	❑	❑	❑	❑
I don't know how and where to receive all the information I need to use the bus.	❑	❑	❑	❑	❑
The timetables are too complicated.	❑	❑	❑	❑	❑
If there was a fast, clean train system, I would use it.	❑	❑	❑	❑	❑

37. How strongly do you agree or disagree with the following statements about carpooling or vanpooling?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I would carpool if there were people that were close and convenient to carpool with.	❑	❑	❑	❑	❑
I would carpool if there was a program that ensures me to get home in any emergency.	❑	❑	❑	❑	❑
I would like to car- or vanpool so I don't have to drive during rush-hour every day.	❑	❑	❑	❑	❑
I don't like the fact that I would have to talk to other people if I carpooled or vanpooled.	❑	❑	❑	❑	❑
People who share rides can relax more.	❑	❑	❑	❑	❑
Carpooling is a good idea but it is too restrictive for my commute schedule.	❑	❑	❑	❑	❑
Carpooling/Vanpooling is cost saving.	❑	❑	❑	❑	❑
Carpooling/Vanpooling reduces stress.	❑	❑	❑	❑	❑
Carpools/Vanpools are usually reliable.	❑	❑	❑	❑	❑
Carpooling/Vanpooling is environmentally friendly.	❑	❑	❑	❑	❑
Carpooling/Vanpooling is safe.	❑	❑	❑	❑	❑

38. How strongly do you agree or disagree with the following statements about driving a car?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I don't like driving my car but I have to do it to get everything done.	❑	❑	❑	❑	❑
It is very important to me to have the ability to decide spontaneously, when and where I want to go.	❑	❑	❑	❑	❑
People who have children need a car.	❑	❑	❑	❑	❑
If I am honest, using my car is all about convenience.	❑	❑	❑	❑	❑
To have a chance in the job market, people will need to have a car.	❑	❑	❑	❑	❑
People without a car have to depend on others.	❑	❑	❑	❑	❑
Using my car saves me a lot of time.	❑	❑	❑	❑	❑
The growing use of private cars causes serious problems.	❑	❑	❑	❑	❑
I would not give up driving my car for the sake of the environment.	❑	❑	❑	❑	❑
I am sure that the environmental problems caused by cars will soon be solved through technological advancements.	❑	❑	❑	❑	❑
Traffic definitely got worse over the last 5 years.	❑	❑	❑	❑	❑
I think it is important to increase fuel prices and use the money to improve public transportation.	❑	❑	❑	❑	❑
I would still drive even if gas prices go up further.	❑	❑	❑	❑	❑
People without a car are not well respected in our society.	❑	❑	❑	❑	❑
I like to have a car that turns people's heads.	❑	❑	❑	❑	❑
My car is like a good friend for me.	❑	❑	❑	❑	❑
I sometimes tailgate or flash my lights if someone goes slowly on the highway just in front of me.	❑	❑	❑	❑	❑
The police should ticket more people for going too slowly.	❑	❑	❑	❑	❑
I don't care about the appearance of my car as long as it works when I need it.	❑	❑	❑	❑	❑
Driving the car is stressful and causes me anxiety.	❑	❑	❑	❑	❑
I feel comfortable and safe in my car.	❑	❑	❑	❑	❑
Everyone else drives their car, so why shouldn't I?	❑	❑	❑	❑	❑
I seriously think/thought about getting rid of my car.	❑	❑	❑	❑	❑
I really think carefully about using my car before each trip.	❑	❑	❑	❑	❑
I don't care about the mode of transportation as long as I get to work quickly.	❑	❑	❑	❑	❑

39. How much do you know about the following environmental issues?

	A lot	Some	Nothing
Air quality issues	❑	❑	❑
Ozone issues	❑	❑	❑
Preserving green space (parks, farmland etc.)	❑	❑	❑
Recycling issues	❑	❑	❑
Water quality issues	❑	❑	❑
Global warming issues	❑	❑	❑
Energy conservation issues	❑	❑	❑

40. Please rank the following 6 travel options for your current commute, with "1 being the most preferred" and "7 being the least preferred".

Rank	*Transportation*
	Take Bus / Park & Ride
	Take Train (imagine it was available) / Park & Ride
	Drive own car
	Carpool (2 or more people riding together in a car to and from work)
	Vanpool (7 to 15 commuters travel to work in a van with a volunteer driver from the group)
	Biking
	Walking

10

D. Suppose …

41. The attached cards feature characteristics of transportation choices.

Thinking of your current housing location and finances, please rank each of the 9 cards according to your level of preference as described below:

1. Choose the card that you prefer most. Then, write the letter of that card next to Rank "1" and set that card aside.
2. Out of the remaining, choose the one you next prefer most. Then, write the letter of that card next to Rank "2" and set that card aside.
3. … Repeat these steps until you are at Rank "9".

→ Please remove card file!

Rank	Please fill in **Card Letter**
1 (most preferred)	
2	
3	
4	
5	
6	
7	
8	
9 (least preferred)	

42. If you had no car available at home, what transportation option would you prefer to use? ***(Please check only one)***

❑ COTA-Bus ❑ Carpooling ❑ Vanpooling ❑ Biking ❑ Walking

❑ Other (describe): _____

43. Did you ride the COTA-Bus in Columbus in the last 12 months? ***(Please check all that apply)***

❑ Yes ❑ No

→ If YES: For what purpose? ❑ Shopping ❑ Work ❑ Leisure/Visit friends

44. Have you ever, on a regular basis and for any job, carpooled, vanpooled, used the bus or train, biked or walked before?

❑ No, I always used my car

❑ Yes → ❑ Carpool ❑ Vanpool ❑ Bus ❑ Train ❑ Bike ❑ Walk

→ If YES: Has it been to the same work place as it is today? ❑ Yes ❑ No

→ If YES: In what year(s)?

E. About You

45. These final few questions will be used for statistical purposes only. Please check or fill in the information that describes you and your household. Please keep in mind that all of your responses are strictly confidential and in no way will be identified by individual.

Gender

❑ Female ❑ Male

Age

❑ 18-25 ❑ 26-35 ❑ 36-45 ❑ 46-55 ❑ 56-65 ❑ 66 and older

Marital status

❑ Single ❑ Domestic partner ❑ Married ❑ Separated/Divorced ❑ Widowed

Highest level of academic education

❑ No high school degree ❑ High school degree ❑ Associate's degree ❑ Vocational degree ❑ Bachelor's degree ❑ Master's degree ❑ PhD ❑ Other

Do you rent or own your apartment / condominium / house?

❑ Own ❑ Rent

Number of children (under 18) living in your household

_____

Number of licensed drivers in your household, including you

_____

Total household income before taxes:

❑ $20,000 or less ❑ $20,001-$40,000 ❑ $40,001-$60,000 ❑ $60,001-$80,000
❑ $80,001-$100,000 ❑ $100,001-$120,000 ❑ $120,001-$140,000 ❑ $140,001 or higher

How long have you lived in the United States?

❑ I was born and raised here ❑ Since _____

Please feel free to write down any comments you might have regarding the survey or the question topics:

_____

_____

_____

Thank you again for your participation!

12

Appendix 7: Intranet Survey

A. Email Introduction to Survey

As you might recall from a message I sent 1RP and Arena Building employees last October, AEP is working with the Mid-Ohio Regional Planning Commission (MORPC) to find out more about the transportation and commuting habits of AEP employees who work in downtown Columbus.

I represent AEP as a member of MORPC's Air Quality Committee. Our AEP work with MORPC, including our promotion of last week's Clean Air Fair in the Arena District, is another important opportunity for AEP to demonstrate our commitment to environmental stewardship.

We are now asking for your input to assist in determining what measures might be helpful to enhance the commuting options for our downtown Columbus employees in a region of increasing traffic volume. You can help by responding to the following approximately 5 to 10 minute, anonymous survey: http://iam/activewebsurvey/Survey.asp?nSurvey=221. Please complete the survey no later than Wednesday, May 25.

Thank you for your help!

{Signed by Head of Environmental Department}

B. Intranet Survey Questions

Please respond to the questions below to assist with a transportation and commuting study involving AEP and the Mid-Ohio Regional Planning Commission (MORPC). Most employees will take the complete survey; please remember to answer every survey question. Some employees will be instructed to bypass some questions; in that case, please answer all questions to which you are directed. When you have completed the survey, simply hit the "Submit" button at the end of the survey.

Thank you for your assistance!

1. What Zip code do you live in?

2. How many minutes, on average, does it take for you to drive from or to work (one-way travel time)?

3. How do you **mainly** travel to work each day in a week?

Drive alone
Carpool (including riding with your partner/spouse)
Vanpool
Bus
Motorcycle/Moped
Bicycle
Walk
Dropped off
Work from home/Telecommute

Other

4. What is your primary reason for choosing this main mode of transportation to work?

If you mainly “drive alone” to work, please answer ALL of the following questions. If NOT, please proceed to Question 22.

5. If you drive alone, do you **occasionally** use other modes of transportation for your trip to work?

Yes
No

6. If you answered **yes** to question 5, please indicate which alternative mode of transportation you use. If you answered **no**, please select “I always drive alone.”

Carpool
Vanpool
Bus
Motorcycle/Moped
Bike
Walk
Other

I always drive alone

7. How likely would it be for you to use alternative modes of transportation to work if traffic congestion increased significantly?

Much more likely
Somewhat more likely
Not at all more likely

8. How likely would it be for you to use alternative modes of transportation to work if there was a Guaranteed (emergency) Ride Home program?

Much more likely
Somewhat more likely
Not at all more likely

9. How likely would it be for you to use alternative modes of transportation to work if personal assistance on services, times, and schedules was available to you?

Much more likely
Somewhat more likely
Not at all more likely

10. How likely would it be for you to use alternative modes of transportation to work if a childcare center was on-site?

Much more likely
Somewhat more likely
Not at all more likely

11. How likely would it be for you to use alternative modes of transportation to work if gasoline prices increased?

Much more likely
Somewhat more likely
Not at all more likely

12. How likely would it be for you to use alternative modes of transportation if parking space availability decreased and parking costs increased?

Much more likely
Somewhat more likely
Not at all more likely

13. How likely would it be for you to use alternative modes of transportation to work if you received a financial incentive for not using a parking space?

Much more likely
Somewhat more likely
Not at all more likely

14. How likely would it be for you to use alternative modes of transportation to work if you had assistance in arranging a carpool/vanpool and finding rides?

Much more likely
Somewhat more likely
Not at all more likely

15. How likely would it be for you to use alternative modes of transportation to work if separate and fast lanes for carpoolers/vanpoolers existed?

Much more likely
Somewhat more likely
Not at all more likely

16. How likely would it be for you to use alternative modes of transportation to work if bus fares were cheaper?

Much more likely
Somewhat more likely
Not at all more likely

17. How likely would it be for you to use alternative modes of transportation to work if bus services improved and more frequent bus times existed?

Much more likely
Somewhat more likely
Not at all more likely

18. How likely would it be for you to use alternative modes of transportation to work if a light rail system were implemented?

Much more likely
Somewhat more likely
Not at all more likely

19. If there are any other factors that would make you **much more likely** to switch to alternative modes of transportation to work, which would those be? If there are none, please proceed to Question 20.

20. What would gasoline prices per gallon have to be for you to seriously consider using alternative modes of transportation to work?

$2.50 per gallon
$3.00 per gallon
$3.50 per gallon
$4.00 or more per gallon

I would not use an alternative mode of transportation regardless of gas prices.

21. Please estimate the total costs for your vehicle per mile (including gas, insurance, depreciation, etc.). Please take your best guess.

0-15 cents
16-30 cents
31-45 cents
46-60 cents
61-75 cents
More than 76 cents

The following questions should be answered by everyone:

22. Do you know that AEP offers substantially reduced bus fares for its employees?

Yes
No

23. Do you telecommute at least once a month?

Yes
No

For the next 3 questions – 24, 25, and 26 – please rank order how important the factors of flexibility, cost savings, and time savings would be in affecting your decision on your mode of commuting.

24. In making commuting decisions, I would consider “flexibility” as being:

Most important
2nd-most important
3rd-most important

25. In making commuting decisions, I would consider “cost savings” as being:

Most important
2nd-most important
3rd-most important

26. In making commuting decisions, I would consider “time savings” as being:

    Most important
    2nd-most important
    3rd-most important

27. At approximately what time do you usually arrive at work?

28. At approximately what time do you usually leave work to return home?

29. What is your gender?

    Female
    Male

Appendix 8: Categorization of transportation mode attitudes (WCSS questions Nr. 36 to 38)

A. Attitudes about the car

1. *Attitude about needing the car*
   - I don't like driving my car but I have to do it to get everything done.
   - People who have children need a car.
   - To have a chance on the job market, people will need to have a car.
2. *Attitude about loving the car*
   - It is very important to me to have the ability to decide spontaneously, when and where I want to go.
   - If I am honest, using my car is all about convenience.
   - Using my car saves me a lot of time.
   - I feel comfortable and safe in my car.
3. *Attitude about disliking the car*
   - Driving the car is stressful and causes me anxiety.
   - I seriously think/thought about getting rid of my car.
   - I really think carefully about using my car before each trip.
   - I don't care about the mode of transportation as long as I get to work quickly.
4. *Attitude about environment and car*
   - The growing use of private cars causes serious problems.
   - I would not give up driving my car for the sake of the environment.
   - I am sure that the environmental problems caused by cars will soon be solved through technological advancements.
   - I think it is important to increase fuel prices and use the money to improve public transportation.
   - Everyone else drives their car, so why shouldn't I?
5. *Attitude about status and car*
   - People without a car are not well respected in our society.
   - I like to have a car that turns people's heads.
   - My car is like a good friend for me.
   - I don't care about the appearance of my car as long as it works when I need it.
6. *Attitude about being annoyed with traffic*
   - Traffic definitely got worse over the last 5 years.
   - I sometimes tailgate or flash my lights if someone goes slowly just in front of me.
   - The police should ticket more people for going too slowly.

B. Attitude scores [# represents number of respondents, ∅ represents average score]

Overall attitude towards riding the bus (∅ = 3.4)

Negative scores	#	*Negative to neutral scores*	#	*Neutral to positive scores*	#	*Positive scores*	#
2.7	1	*3.0*	1	*3.5*	3	*4.0*	2
2.8	1	*3.1*	4	*3.6*	6	*4.1*	1
2.9	5	*3.2*	8	*3.7*	2	*4.3*	1
		3.3	1	*3.8*	3	*4.6*	1
		3.4	8	*3.9*	4		

Overall attitude towards carpooling / vanpooling (∅ = 3.6)

Negative scores	#	*Negative to neutral scores*	#	*Neutral to positive scores*	#	*Positive scores*	#
2.0	1	*3.0*	1	*3.5*	6	*4.0*	3
2.3	1	*3.1*	3	*3.6*	4	*4.1*	2
2.9	2	*3.2*	3	*3.7*	6	*4.2*	3
		3.3	1	*3.8*	3	*4.4*	2
		3.4	4	*3.9*	4	*4.5*	2
						4.6	1

Attitude towards needing the car (∅ = 3.6)

Negative scores	#	*Negative to neutral scores*	#	*Neutral to positive scores*	#	*Positive scores*	#
1.8	1	*3.0*	6	*3.8*	10	*4.0*	9
2.3	1	*3.3*	4			*4.3*	5
2.5	1	*3.5*	7			*4.5*	3
2.8	3					*4.8*	1
						5.0	1

Attitude towards loving the car (∅ = 4.1)

Negative scores	#	*Negative to neutral scores*	#	*Neutral to positive scores*	#	*Positive scores*	#
2.0	1	*3.0*	1	*3.8*	9	*4.0*	7
2.8	1	*3.5*	7			*4.3*	7
						4.5	10
						4.8	6
						5.0	3

Attitude towards disliking the car (∅ = 2.3)

Negative scores	#	*Negative to neutral scores*	#	*Neutral to positive scores*	#	*Positive scores*	#
1.0	1	*2.3*	10	*3.0*	4		
1.3	3	*2.5*	6	*3.3*	5		
1.5	7	*2.8*	5	*3.5*	2		
1.8	4						
2.0	5						

Attitude towards being environmentally conscious: (∅ = 3.1)[23]

Negative scores	#	*Negative to neutral scores*	#	*Neutral to positive scores*	#	*Positive scores*	#
1.8	2	*2.8*	6	*3.6*	4	*4.0*	1
2.0	2	*3.0*	5	*3.8*	2	*4.2*	2
2.2	5	*3.2*	9			*4.6*	1
2.4	2	*3.4*	9				
2.6	2						

Attitude towards status / image: (∅ = 2.7)

Negative scores	#	*Negative to neutral scores*	#	*Neutral to positive scores*	#	*Positive scores*	#
1.0	1	*2.3*	8	*3.0*	3	*4.3*	2
1.3	1	*2.5*	9	*3.3*	6	*4.8*	2
1.5	2	*2.8*	4	*3.5*	2		
1.8	5			*3.8*	5		
2.0	2						

Attitude towards annoyance of traffic / others (∅ = 3.1)

Negative scores	#	*Negative to neutral scores*	#	*Neutral to positive scores*	#	*Positive scores*	#
1.7	2	*3.0*	6	*3.7*	7	*4.0*	3
2.0	4	*3.3*	6			*4.3*	5
2.3	5					*4.7*	1
2.7	12					*5.0*	1

Source: WCSS 2004 analysis. N=52

[23] The statements *I would still drive even if gas prices go up further* (overall score: 3.9 agreement) and *I wouldn't give up my car even for the sake of the environment* (overall score: 2.7 disagreement) are not necessarily meaningful, since the rating might be different if attractive alternatives existed. Thus, even if one wanted to switch, they might not have the opportunity or the necessary information about riding the bus or about carpooling and vanpooling.

Appendix 9: Suggestions given by Intranet respondents about increasing alternative mode use

Suggestions	Number of respondents	Percentage of respondents
Better bus service	99	32.46
Implementation of light rail	54	17.70
Telecommute/Alternative local work sites	34	11.15
Better and more biking / walking trails	20	6.56
More and safer P&R places	15	4.92
Assistance in finding riders for car-/vanpools	12	3.93
More predictable work schedule	12	3.93
Use of company parking at reduced fee/free	10	3.28
Implementation of HOV lanes	8	2.62
More alternatives	8	2.62
GRH program	7	2.30
Increased time / faster	7	2.30
Increased costs / cheaper	7	2.30
Reinstate company Gahanna shuttle	7	2.30
Childcare on-site	6	1.97
Financial incentives	4	1.31
Changed image of buses	4	1.31
Assistance in relocating	4	1.31
Region-wide solutions necessary	4	1.31
Bus stop closer to company	3	0.98
Express routes take too long	3	0.98
Flexible carpooling service	2	0.66
More information on services	2	0.66
More shopping facilities downtown	2	0.66
Move office to suburbs	2	0.66
Sheltered and safe bus stops	2	0.66
Implementation of subway	2	0.66
No fuel available	2	0.66
Compressed work week	2	0.66
"Alternatives would have to exist first"	2	0.66
"Beaming"	2	0.66
Increased bus safety	1	0.33
Subsidize vanpools	1	0.33
Other (see next page)	21	6.89
Total number of answers	**371**	

Source: Intranet survey 2005 analysis. N=305 (Comment summary)

Other suggestions:

- Make it a requirement for all employees who live within a 10-mile radius to use alternative modes.
- CEO should lead by example.
- "I will change my employment if the traffic situation doesn't improve."
- "If I needed to waste an hour a day, I would use alternative modes."
- Hire more employees to avoid overtime.
- Commute is so short that gas prices etc. are not an issue.
- Reduce pollution.
- Transport laptop.
- Workable ride space, e.g. laptop plugs.
- Geographic access to light rail stations.
- I would like to move out if easy commute was available.
- "I like subsidized parking."
- Provide a shuttle service around town.
- "I will move and then I walk to work."
- "I live close by and don't think alternatives apply to my situation."
- I used to take the bus but now I have a dog that I need to come home to often.
- I used to ride the bus until I moved and had no bus stop close by.
- Increased crime.
- "Combine higher gas prices with significantly increased congestion (taking my commute to over 40 minutes one-way) and more frequent bus times and better assurance of security at bus stops, I would much more likely use bus service."
- "Move my job OUT OF DOWNTOWN. You are treating the symptom, not the cause of the problem. Stop encouraging businesses to locate downtown."
- "I won't bother with COTA. The buses in town are slow, prone to breakdown, uncomfortable, and I feel they aren't any greener than the cars they replace. They seem to be fume-heavy. Telecommuting is nice but I feel that unfortunately telecommuters are often seen as secondary employees not participating fully and this limits their career growth. […] The city's greatest option would be light rail. The outer belt and 71/70 highways can't be built up every 3 years. Buses are lousy, telecommuting is undervalued, carpools don't work for everyone and carpool lanes may be unenforceable without physically separating them (which takes us back to more construction). The only ways I could see personally giving up driving to work would be 1) working from home, which is completely unlikely for most people, or 2) taking light rail into downtown. And I feel that city, county and state governments have never been serious about light rail."

Appendix 10: Survey questions by subset used for factor analysis (N=52)

1. Personal & Work Characteristics

Question Number	Type of Content	Answer Type	Number of Items
1	*Residence*: Franklin County	Yes/No	1
2	*Home Choice*: Close to work; It's old family home; Good neighborhood; Good school for children; I have always lived there; Affordable price; Close to shopping facilities	Yes/No	7
30	*Personality*: I'm not a shy person; I don't mind taking risks; I consider myself frugal; I'm not a hectic person; I'd rather be alone than with others; I don't mind working overtime; I have an easy time adapting to new situations; I don't feel easily stressed; I enjoy walking; I enjoy biking; I often make small-talks with strangers; I don't need to feel safe.	5 = All the time	12
45	*Gender*: Male	Yes/No	1
45	*Age*: Young (18-35)	Yes/No	1
45	*Marital Status*: Domestic partner/Married	Yes/No	1
45	*Education*: Master's degree or higher	Yes/No	1
45	*Number of children*: At least one child	Yes/No	1
45	*Household Income*: Up to $80,000 per year	Yes/No	1
27	*Reasons for driving*: I need my car for personal business; It's a habit; I want to be flexible; I need to get home in an emergency; I have safety concerns; It's cheap	Yes/No	6
4	*Workplace Choice*: Good employer (benefits); I have always worked there; Great career options; Salary level	Yes/No	4
5	I have worked at AEP 5 years or more	Yes/No	1
7	Flexible working schedule	Yes/No	1
27	*Reasons for driving*: I need my car for company business; I have luggage	Yes/No	1
28	I'm interested in telecommuting/already do	Yes/No	1
29	I'm interested in a compressed work week	Yes/No	2
	Total Items		**42**

The following variables were excluded since all participants answered them the same: Full-Time (Question 6) ~ Work at AEP (Question 3) ~ Solo drive every day to work (Questions 12 and 13) ~ Nobody parks along street (Questions 23) ~ Close to partner's work (Question 2) ~ Work is close to children's daycare/school (Question 4)

2. Commute Characteristics

Question Number	Type of Content	Answer Type	Number of Items
9	Bus stop close by	Yes/No	1
14	I occasionally use other modes to work	Yes/No	1
15	Car year: 2000 or younger	Yes/No	1
16	I usually arrive at work by 8 AM	Yes/No	1
	I usually depart work by 5 PM	Yes/No	1
17	My commute takes 15 minutes or less (one way)	Yes/No	1
	My commute takes 30 minutes or more (one way)	Yes/No	1
19	I own 3 or more cars	Yes/No	1
	I own at least one bicycle	Yes/No	1
22	I need 5 minutes or more to find a parking space	Yes/No	1
24	I need to walk 5 minutes or more from my parking spot to my work site	Yes/No	1
25	My monthly parking costs are $60 or more	Yes/No	1
26	*Running errands*: Bring/take children; Bring/take others; Shopping/Groceries; Dry cleaning; Stop for meals/coffee; Stop for gas	Daily = 5	6
27	*Reasons for driving*: Parking is free/inexpensive; I need to run errands before/after work; I need to transport children; There is no reasonable bus option; I don't have anyone to ride with; Anything else takes too much time; I have an irregular work schedule; It takes the shortest time	Yes/No	8
42	If no car, I'd carpool If no car, I'd take the bus If no car, I'd bike	Yes/No Yes/No Yes/No	1 1 1
	Total Items		**29**

3. Attitudes to Commute & Environment

Question Number	Type of Content	Answer Type	Number of Items
21	*Route Improvement*: Reduced number of trucks; Increased speed limit; Reduced speed limit; Implementation of bus routes; Implementation of light rail; Carpool (HOV) lanes; More lanes; More frequent bus service; More biking trails	Yes/No	9
31	*What's important*: It's important to protect the environment; It's important to attain wealth; It's important to strive for safety; It's important to help other people; It's important to have power and influence	Very important = 5	5
33	*Importance of commute criteria*: Short travel time; Low commuting costs; Having a vehicle at work; High comfort/relaxation level; High convenience level; No parking search; Reducing pollution; High safety assurance; Being able to pick up others; Status/Image; Having my privacy	Very important = 5	11
38	*Attitudes towards driving the car (Environment)*: The growing use of private cars causes serious problems; I would give up my car for the environment; I'm sure that the environmental problems caused by cars will not be solved through technological advancements; It's important to increase fuel prices and use the money to improve transit; Everyone else drives their car, so why shouldn't I?	Strongly agree = 5	5
39	*Knowledge of environmental issues*: Air quality issues; Ozone issues; Preserving green space; Recycling issues; Water quality issues; Global warming issues; Energy conservation issues	A lot = 3	7
	Total Items		**37**

4. Attitudes to Car

Question Number	Type of Content	Answer Type	Number of Items
20	*Satisfaction with current commute*: Travel time to work; Travel time from work; Route to work; Travel costs; Travel comfort; Level of convenience; Searching time for a parking spot; Distance from parking spot to work place; Cost of parking; Car size; Car gas mileage	Very satisfied = 5	11
27	*Reasons for driving*: I prefer to drive my own car; Driving the car is most reliable; Driving the car is my only choice/alternative	Yes/No	3
38	*Attitude towards driving the car (Love & Status):* It's very important to me to have the ability to decide spontaneously, when and where I want to go; Using my car is all about convenience; Using my car saves me a lot of time; I would still drive even if gas prices went up; My car is like a good friend for me; Driving the car is stressful/causes anxiety; I feel comfortable and safe in my car; I don't really consider getting rid of my car; I don't think carefully about using my car before each trip; I don't care about the mode of transportation as long as I get to work quickly; People without a car are not well respected in our society; I like to have a car that turns people's heads; I don't care about the appearance of my car as long as it works when I need it.	Strongly agree = 5	13
38	*Attitude towards driving the car (Need)*: I don't like driving my car but I have to do it to get everything done; People who have children need a car; To have a chance in the job market, people need to have a car; People without a car have to depend on others.	Strongly agree = 5	4
38	*Attitude towards driving the car (Traffic):* Traffic definitely worsened over the last 5 years; I sometimes tailgate/flash my lights if someone goes slowly on the highway in front of me; The police should ticket more people for going too slow.	Strongly agree = 5	3
	Total Items		**34**

5. Attitudes to Other Modes

Question Number	Type of Content	Answer Type	Number of Items
27	*Reasons for driving*: I don't like to depend on others; Poor bicycle and pedestrian access	Yes/No	2
34	*Improvements for public transportation*: Timetables that match working hours; More bus stops at residential areas; Easier to understand timetables; Safer bus stops and buses; Improved service frequency; More bus stops near work place; More comfort and cleanliness; More connections with no transfer needs; Reduced bus fares; Shorter trip times; On-time service.	Yes/ No	11
36	*Attitude towards riding the bus*: If I ride the bus, my co-workers/friends will not look at me strangely; Bus riders are not frugal; Traveling by bus is not only for people who can't afford anything better; The bus is used by students, elderly and the poor; Buses are usually reliable; Buses are clean; The bus usually doesn't get too crowded; Riding the bus is relaxing; Riding the bus is cost saving; Riding the bus is environmentally friendly; Riding the bus is safe; Riding the bus is comfortable; It's safe to walk to and from the bus stop; The bus system should be expanded; I know how and where to get all the information I need to use the bus; The timetables are not too complicated; If there was a fast, clean train system, I would use it.	Strongly agree = 5	17
37	*Attitude towards carpooling/vanpooling*: I'd carpool if there were people that were close and convenient to carpool with; I'd carpool if there was a program that ensures me to get home in an emergency; I'd like to car/vanpool so I don't have to drive during rush-hour every day; I don't mind that I would have to talk to other people if I car/vanpooled; People who share rides can relax more; Carpooling is not too restrictive for my commute schedule; Car/Vanpooling is cost saving; Car/Vanpooling reduces stress; Car/Vanpools are usually reliable; Car/Vanpooling is environmentally friendly; Car/Vanpooling is safe.	Strongly agree = 5	11
	Total Items		**41**

Appendix 11: Factor analysis results (Component matrices)

Subset 1: Personal and Work Characteristics

	1	2	3	4	5	6	7
Close to work					**0.670**		
It's our old family home				-0.575			
Good neighborhood				**0.823**			
I have always lived there				-0.567			
Good employer				0.571			
I have always worked there						0.597	
Salary level					0.654		
I have worked at AEP at least 5 years						**0.844**	
It's a habit			0.536				
I want to be flexible			0.593				
I need to get home in an emergency							**-0.725**
It's cheap		-0.682					
I have luggage	0.627						
I'm not a shy person		0.569					
I like taking risks		0.525					
I'm not a hectic person	**-0.737**						
I rather be with others than alone		0.620					
I have an easy time adapting to new situations		**0.764**					
I enjoy biking				0.525			
I often make small-talks with strangers			-0.504				
I don't need to feel safe			0.555				
Male			**0.593**				
Young (18-35)	0.639						
Married	-0.608						
At least one child living in household							-0.683
Income up to $80,000	0.512						

= Variable that loads highest with each factor and could therefore be used as a representative variable for the factor in future surveys.

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax wit Kaiser Normalization. Rotation converged in 11 iterations.

Subset 2: Commute Characteristics

	1	2	3	4	5	6
Bus stop at home	-0.783					
Arrive at work by 8 AM						0.599
Depart work by 5 PM						0.584
Commute time takes 15 minutes or less one way	-0.687					
Commute time takes 30 minutes or more one way	**0.795**					
3 or more cars per household			**0.707**			
More than 5 min for parking search						**-0.702**
More than 5 min distance from parking space						-0.558
Running errands - pick up children					0.795	
Running errands - shopping / groceries		**0.736**				
Running errands - dry cleaning		0.695				
Running errands - meals / coffee		0.688				
Running errands - gas	0.549	0.546				
Parking is free or inexpensive			0.535			
I need to run errands before/after work			0.533			
I need to transport children					**0.815**	
There is no reasonable bus option	0.677					
Anything else takes too much time			0.577			
If no car was available, I'd ride the bus				0.800		
If no car was available, I'd carpool				-0.698		

= Variable that loads highest with each factor and could therefore be used as a representative variable for the factor in future surveys.

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax wit Kaiser Normalization. Rotation converged in 10 iterations.

Subset 3: Commute and Environment

	1	2	3	4	5
Reduced number of trucks				**-0.617**	
Implementation of bus routes					**0.671**
Increased speed limit		**-0.713**			
Implementation of light rail		0.510			
More biking trails					0.635
Having a vehicle at work is important				-0.526	
High comfort/relaxation level is important			0.597		
High convenience level is important					-0.593
No parking search is important				-0.561	
Reducing pollution is important		0.624			
High safety assurance is important		0.529			
Status / Image is important			**0.686**		
Having my privacy is important			0.679		
The growing use of private cars causes serious problems		0.528			
Knowledge on air quality issues	0.798				
Knowledge on ozone issues	0.803				
Knowledge on preserving green space	0.733				
Knowledge on recycling issues	0.838				
Knowledge on water quality issues	0.712				
Knowledge on global warming issues	0.783				
Knowledge on energy conservation issues	**0.839**				

= Variable that loads highest with each factor and could therefore be used as a representative variable for the factor in future surveys.

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax wit Kaiser Normalization. Rotation converged in 12 iterations.

Subset 4: Attitudes to car

	1	2	3	4	5	6
Satisfaction with travel time to work	**0.764**					
Satisfaction with travel time from home	0.750					
Satisfaction with route to work	0.683					
Satisfaction with travel costs	0.761					
Satisfaction with travel comfort					0.505	
Satisfaction with searching time for a parking spot						0.775
Satisfaction with distance from parking						**0.806**
Satisfaction with cost of parking					**0.772**	
Satisfaction with car size			0.579			
Satisfaction with car gas mileage			0.609			
I prefer to drive my own car		0.537				
It's my only choice/no alternative	-0.616					
It is very important to me to have the ability to decide spontaneously, when and where I want to go		0.647				
If I am honest, using my car is all about convenience		0.547				
Using my car saves me time	0.545					
I would still drive even if gas prices go up further					0.504	
My car is like a good friend for me		0.580				
Driving the car is stressful and causes me anxiety				**-0.716**		
I feel comfortable and safe in my car				0.590		
I don't really consider getting rid of my car			0.673			
I care about the mode of transportation				0.557		
I like to have a car that turns people's heads			-0.541			
I care about the appearance of my car	-0.593					
I don't like driving my car but I have to so I get everything done				-0.589		
To have a chance in job market, people will need to have a car		0.572				
People without a car depend on others		**0.666**				
I sometimes tailgate or flash my lights if someone goes slowly on the highway just in front of me			**-0.754**			
The police should ticket more people for going too slowly			-0.589			

= Variable that loads highest with each factor and could therefore be used as a representative variable for the factor in future surveys.

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax wit Kaiser Normalization. Rotation converged in 9 iterations.

Subset 5: Attitudes to alternatives

	1	2	3	4	5	6
I don't like to depend on others					0.512	
Timetables that match working hours					**0.629**	
Improved service frequency		0.630				
More bus stops at residential areas		0.575				
More bus stops near work place					0.563	
Easier to understand timetables			-0.567			
On-time service					0.600	
Safer bus stops and buses						**0.623**
Bus riders are not frugal				**0.576**		
The bus is not only used by students, elderly and the poor				0.562		
Buses are usually reliable			0.513			
Buses are clean			0.660			
The bus doesn't usually get too crowded				0.576		
Riding the bus is relaxing				0.517		
Riding the bus is cost saving						0.613
Riding the bus is environmentally friendly	0.529					
I know how and where to receive all the information I need to use the bus			**0.799**			
The timetables are not too complicated			0.765			
I would carpool if there were people that were close and convenient to carpool with		**0.703**				
I would carpool if there was a program that ensures me to get home in any emergency		0.546				
I would like to car- or vanpool so I don't have to drive during rush-hour every day		0.699				
Carpooling is not too restrictive for my commute schedule				0.528		
Carpooling/vanpooling is cost saving	0.778					
Carpooling/vanpooling reduces stress	0.699					
Carpools/vanpools are usually reliable	0.735					
Carpooling/vanpooling is environmentally friendly	**0.806**					
Carpooling/vanpooling is safe	0.611					

= Variable that loads highest with each factor and could therefore be used as a representative variable for the factor in future surveys.

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax wit Kaiser Normalization. Rotation converged in 12 iterations.

Appendix 12: Various steps to create a company's TDM action plan

A. Get departments within your company involved that can assist in communicating behavioral change, such as:

- Human Resources → Increase employee benefits
- Environment → Improve local air quality
- Facility Management → Reduce company costs
- Communications → Increase company's image

B. Discuss the alternative modes you want to focus on first, such as:

- Public Transportation (Bus / Train)
- Carpooling / Vanpooling
- Walking / Biking
- Telecommuting
- Assistance in residence relocation close to the company

C. Discuss strategies for each alternative mode, such as:

- *Public Transportation*: Reduced bus fare, more bus lines, increased service frequency during rush hours
- *Carpooling / Vanpooling*: Reserved parking spaces, downtown database for matching riders, vanpool subsidy
- *Walking / Biking*: Safe lockers, free shower use
- *Telecommuting:* Technology at home

D. Apply for the Best Workplaces for Commuters program and collaborate in achieving the national standard of excellence.

- Go online to www.bestworkplaces.org and apply as a *Best Workplace for Commuters*
- Eligibility: Offer a package of TDM strategies

E. Discuss all marketing channels that your company can provide to promote alternative mode usage, such as:

- Flyers
- Newsletters / Newspaper
- Email / Intranet / Internet
- Short movies in cafeteria
- Informational meeting with different target groups
- Transportation fairs

F. Discuss the type of advertisement that is most appealing to your employees, such as:

- Serious (newspaper) text
- Quick informational sheet
- Fact sheet, incl. conservation of natural resources, cost reduction, or stress relief
- Guide on how to use alternative modes
- Quotes of current users (with photo)
- Short (fun) texts with photographs of alternative modes

G. Organize a meeting with the surrounding companies to discuss and define common topics, such as:

- Establishing contact person(s) in each company
- Estimating the potential of bus riders / carpoolers
- Defining major commute routes
- Discussing subsidy for vanpooling
- Creating an employer district marketing plan

H. Involve transportation agencies, such as the local transit authority, regional planning agencies, or the state, to discuss and refine your "problem areas" and work on solutions together, such as:

- Improving certain bus routes / establishing new routes
- Establishing a shared database for carpooling
- Defining new vanpooling routes
- Constructing HOV lanes
- Building more / better bikeways
- Creating a region-wide marketing plan to change image

I. Inform your employees and your community through articles in the local newspaper and/or through emails and newsletters about your project, such as:

- "Company X helps to reduce air pollution by offering good alternatives to single car use to its employees."
- "Company X is actively involved in providing the downtown community with improved bus service."
- "Company X acts as the district leader for the downtown area to mitigate traffic problems."
- "Company X was nationally recognized as a *Best Workplace for Commuters*."