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CARSHARING: NICHE MARKET OR NEW PATHWAY?

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ABSTRACT

The premise of carsharing is simple. Households access, as needed, a fleet of shared-use vehicles. Individuals gain the benefit of private car use without the costs and responsibilities of ownership, and society gains large economic, environmental, and social benefits as a result of more efficient vehicle usage. But will these benefits be realized? The answer is unknown due to limited international experience and a virtual absence of credible analysis. It may be, however, that the more important benefits of carsharing are its indirect and unforeseen consequences. It may be that carsharing is best seen as facilitating intermodal travel and as the precursor of a new mode filling the gap between transit and private cars.

INTRODUCTION

Three major system innovations have transformed transportation in the past two centuries, with profound and far-reaching impacts. First came the widespread adoption of inter-urban railroads in the mid 1800s, several decades later came the introduction of electric urban rail, and then automobiles in the early 1900s. Railroads transformed the nature of business; electric rail transformed collections of neighborhoods into metropolitan regions; and the automobile transformed lifestyles. These innovations not only shaped transportation, but also much of our society. The next transportation era will reflect the integration of information and communication technologies into lifestyles and modal choices. The catalysts of these three earlier transportation transformations were the steam engine, electricity, and internal combustion engine (respectively); the catalyst for the coming era of "smart transportation" will be electronic and wireless communication systems.

So far, the application of smart technologies has been aimed primarily at enhancing existing services and activities (the aborted automated highway program in the USA being the notable exception); very few have envisioned a true transformation of business or personal interactions. It seems inevitable, though, that entirely new services will soon emerge that begin transforming business and lifestyles. On the business side, the transforming innovation is likely to be e-commerce; on the passenger side, it is less clear.

The Enduring Prominence of Motor Vehicles

In the modern world of rapid change, it is remarkable how profoundly the motor vehicle has revolutionized society. Providing large mobility benefits, motor vehicles have become deeply entrenched, continuing to increase their share of travel, even in countries with high fuel and vehicle taxes, dense land use patterns, and high quality transit services (ECMT/OECD, 1995). Indeed, private vehicles (cars and light

trucks) now account for around 80% of all motorized passenger travel in virtually all OECD countries.[1] Cars are becoming so dominant in many countries that most travelers no longer reflect on their mode choice, using private vehicle for all metropolitan trips.

The sweeping transformation of travel, from collective conveyances to private vehicles, generates large benefits but also large costs. Although the relative magnitude of these costs and benefits are uncertain, it is axiomatic that transportation services and activities can always be conducted more efficiently. Certainly travelers can be more fully informed of options, services can be priced more correctly, and transaction costs can be reduced so that travelers will satisfy their travel desires more efficiently.[2] But they are not: information about alternative modes and services is *not* readily available to travelers in most regions; collective transport is not well matched to traveler needs; and private vehicles are usually not efficiently matched to societal needs.

The result is an extravagant use of resources to move individuals. In most cases, individuals are transported in vehicles with 10-20 times greater mass than the person being transported and a footprint at least 100 times larger. With dramatically improved information and computing capabilities, the design and management of our transportation system is clearly ripe for transformation.

It is becoming increasingly obvious that the technical barriers to delivering more and better traveler information, facilitating intermodal connections, and creating institutions to provide appropriate vehicles and services are not great. Technically speaking, it will soon be possible to provide more access at less cost. But doing so -- using new information technologies -- implies a sweeping transformation of transportation institutions and behavior. How does one embark on such a path? Is carsharing a first step or is it just another transportation alternative? Can the current evolution in European carsharing, toward partnership management and mobility packages, provide a model for new transportation and travel planning services? This paper presents a brief history of carsharing and describes a possible larger transportation alternative (that we label "new mobility"), which evolves from carsharing principles, experience, and models. New mobility is a fundamentally new approach that focuses on clustering of intermodal and conventional technologies, smart communication technologies, partnership management, and market incentives, to create economically attractive alternatives to the private auto.

Enter Carsharing?

The premise of carsharing is simple. Broadly speaking, individuals potentially gain the benefits of private car use without the costs and responsibilities of ownership, while society potentially benefits from

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1. A notable exception is Japan, with only about 60% of motorized passenger travel by car. Important qualifications are that total motorized travel is much greater in some countries than others, and that non-motorized travel is significant in some. In the US, for instance, about 10% of trips (not total travel) are nonmotorized, versus about 40% in many European countries. Another difference is that much of the non-car travel in the US is by air, while in Europe it tends to be by bus and rail transit.
2. The explanation for this suboptimal state is complex, with economic, political, sociological, and psychological elements. These explanations relate to the large role of the public sector; imposition of many oft-conflicting social goals; the political strength of various interest groups such as road builders and taxi and transit operators; and the complexity of travel choices. The complexity of choices and the apparently erratic and unpredictable behavior of travelers is explained by the limited cognition of humans, the derived demand of most travel, and the role of many non-economic and difficult-to-quantify choice criteria, including security, flexibility, comfort, lifestyle aspirations, environmental values, social class issues, and convenience.

more efficient vehicle usage. More specifically, carsharing allows a household to access, as needed, a fleet of shared-use vehicles. Carsharing may be thought of as organized short-term car rental. Generally, participants pay a usage fee each time they use a vehicle. Historically, most carsharing services have been offered to individuals who joined organizations that maintain a fleet of cars and light trucks in a network of locations, while others have been supplied by corporate employers.

Carsharing might take a variety of forms. It might be neighborhood based, catering to residents who use the vehicles for short round trips to pick up goods and travel to social and recreational activities; it might jointly serve individuals commuting to work or school in peak hours and fleets during work hours; it might serve tourists or second-home residents; or it might be a complex multi-nodal regional system serving millions.

As one illustration, consider the traveler returning from work at the end of a day. She rents a shared-use vehicle at a transit station (or other rental site) close to home; she then conducts various errands and drives home. In the morning she drives to the same (or different) transit stop or station where she leaves the vehicle; she then rides a bus or train to a station near her office where she "rents" another vehicle to complete her commute. During the day, the car, rather than sit idle, might be used as a fleet vehicle by her organization and/or for personal use by other employees at the work site. Many variations are possible. Altogether, a single shared-use vehicle could easily be used for six or more distinct trips per day, plus facilitating four or more additional transit trips.

Potential Benefits

The benefits of carsharing could be large. These benefits might include reductions in transport costs, vehicle travel, and space devoted to transportation infrastructure, as well as increases in convenience in some cases -- while still maintaining or even improving accessibility. The benefits result when a person dispenses with one or more owned vehicles. Instead of paying the high fixed cost associated with vehicle ownership -- insurance, registration, and depreciation – one would pay only for actual usage. For individuals who do not use vehicles intensively, carsharing should reduce the cost of travel to them (and society).

The potential benefit of reduced vehicle travel is realized in two ways: travelers gain easier access to transit (using the vehicle for the short trip from home to transit station or from transit station to workplace); and, because fixed costs of vehicle ownership are converted into variable costs, drivers now respond to price signals that more fully reflect the true cost of tripmaking.

The benefit of diminished space is the result of vehicles being used more intensively -- and therefore being less likely to sit unused in parking lots at transit stations, workplaces, and schools.

Convenience can also be enhanced. While carsharing would diminish convenience in many cases, it would enhance convenience in other cases by facilitating inter-modal trips (for instance between cars and rail transit), providing mobility insurance in emergencies, and better satisfying occasional vehicle desires such as carrying goods, pleasure driving in a sports car, or accessing recreational areas with a four-wheel vehicle.

But these many potential benefits are far from being realized on any significant scale. Carsharing still does not account for even 1% of travel in any region. Its success is far from assured. The largest carsharing organization, located in Switzerland, speculates that 6% of Swiss passenger trips could be served by carsharing, but this number is not based on formal analysis. Indeed, no rigorous analysis has yet been

conducted regarding demand, costs, political acceptance, and organizational efficiency of carsharing. Many questions remain. How many people would be willing to share vehicles? At what cost could carsharing services be provided? Will automotive companies embrace or undermine carsharing? In other words, will carsharing ever be more than a niche market? To succeed commercially, how must those carsharing services be configured? Will carsharing ever generate significant economic, environmental, or transportation benefits?

This paper examines the recent history of carsharing, deriving lessons for policymakers and investors. While no definite conclusions can be drawn at this time due to limited experiences and a virtual absence of credible analysis, it may be that the future of carsharing, and the benefits that result from it, may have more to do with indirect and unforeseen consequences than with direct effects. In this larger sense, carsharing perhaps is best seen as the precursor of a new mode filling the gap between transit and private cars, and a service that facilitates intermodal travel.

What has changed in the past few years that makes carsharing more compelling is the emergence of sophisticated low-cost information and communication technologies and services. The integration of these new technologies opens a large vista of transportation opportunities that have barely been visualized. Carsharing, in combination with these information and communication technologies, presents perhaps the first opportunity in decades to create a significant new mode of transport. Or, more importantly, perhaps it might be the first step along a new transportation pathway.

HISTORY OF CARSHARING[3]

Carsharing efforts mostly emerged from individuals who sought the benefits of cars but were ideologically opposed to widespread car use. Many carsharing organizations (CSOs) were initiated in the 1990s, and a few even earlier, mostly in Europe, supported initially by government grants. Most involved shared usage of a few vehicles by a group of individuals. Most found it difficult to make the transition from grassroots, neighborhood-based programs into viable business ventures. They miscalculated the number of vehicles needed, placed too great an emphasis on advanced technology, and/or were ineffective in their marketing. Many failed organizations merged or were acquired by larger organizations.

Those that grew and thrived were more business-like, and integrated advanced information and communication technologies. But even at the end of the decade, their total presence was negligible in all but a handful of locations. The largest CSO had 1200 cars spread across Switzerland, and the next largest about 300 in several cities of Germany. In total, under 300 CSOs were operating several thousand vehicles.

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3. This section is based largely on Shaheen's (1999) Ph.D. dissertation, which includes a chapter on "Carsharing and New Mobility: An International Perspective." An earlier version of that chapter was published as Shaheen et al (1998).

Carsharing in Europe

Most carsharing efforts remain small scale and concentrated in Europe. Until the late 1990s, virtually all CSO start-ups were subsidized with public funding (and a few by corporate subsidies). Most carsharing trips are roundtrips from a neighborhood lot, with reservations made over the phone.

One of the earliest European experiences with carsharing can be traced to a cooperative, known as "Sefage," which originated in Zurich, Switzerland in 1948 (Harms and Truffer, 1998). Membership in "Sefage" was primarily motivated by economics. It attracted individuals who could not afford to purchase a car but who found sharing one appealing. Elsewhere, a series of "public car" experiments were attempted, but failed, including a carsharing initiative known as "Procotip," begun in Montpellier, France in 1971, and another called "Witkar," deployed in Amsterdam in 1973 (Doherty *et al.*, 1987; Muheim and Partner, 1996).

More successful experiences with carsharing began in Europe in the late 1980s (Steininger *et al.*, 1996; Glotz-Richter, 1997). In 1999, approximately 200 CSOs were active in 450 cities throughout Switzerland, Germany, Austria, the Netherlands, Denmark, Sweden, Norway, Great Britain, and Italy, collectively claiming over 130,000 participants (Shaheen, 1999).

The two largest carsharing organizations are Mobility CarSharing Switzerland, with 1,200 cars, and Stadtauto Drive (formerly StattAuto Berlin) with about 300 cars. The Swiss program, begun in 1987, now operates in 800 locations in over 300 communities, with over 27,000 members. Stadtauto Drive, begun in 1988, now has approximately 7,000 members; their current membership size reflects the 1998 merger of StattAuto Berlin and Hamburg.

Both Stadtauto Drive and Mobility are entering a modernization phase, moving from manual "key box" operations to a system of smart card technologies for making automatic and advanced reservations, accessing vehicle keys, securing vehicles from theft, and facilitating billing. The shift to smart cards simplifies vehicle access for customers and eases the administration and management of large systems. However, the large investment required for the new communication and reservation technologies puts pressure on these organizations to continue expanding to generate revenue to pay off these investments.

An alternative model is offered by Lufthansa Airlines and Swissair. Lufthansa instituted an automatic rental system at the Munich and Frankfurt airports in 1993, in which a computer releases a key and starts the billing. By the end of 1994, 12,000 employees at the two German airports had access to this "carpool" system. Lufthansa reportedly saved over $20 million in avoided parking infrastructure costs (Morias, 1994). These cost savings have been used as a justification for corporate subsidies of the program. The system is being technologically enhanced with smart cards and coordinated with local transit operators (BMBF, 1998). Swissair's program, called "CarShare," was introduced in 1993 at the Zurich airport for flight attendants. It is technologically simpler and works in collaboration with Hertz Rent-a-Car (Wagner, 1997). In both cases, these companies sought to enhance employee access and reduce costs.

Volkswagen launched a broader smart carsharing program in Germany in 1997 and now operates two carsharing projects. The first is operated in an apartment complex with several shared vehicles located outside the building, and the second is a business that shares a range of vehicles. Volkswagen has indicated that it believes the carsharing market will grow at a rate of 50 percent per year into a potential market of 2.45 million shared-use vehicles in Europe within the next ten years (Fastlane, 1997).

The most technologically sophisticated carsharing system began operation just outside of Paris in October 1997 and closed two years later. This "Praxitele" program, operated by by Renault, EDF (an electric utility), and CGFTE (a public transit operator) and designed and evaluated by two French research institutes (INRETS and INRIA), began with 50 Renault electric vehicles that were rented and driven between 12 "Praxiparcs" located near transit stations and employment centers (Massot *et al.*, 1999; Parent, 1999). This program has been referred to as "gold plated" due to large investments in information and control technologies (Whitelegg, 1999). A new Praxitele operation is being considered, possibly with 2000 vehicles in the city of Paris.

Carsharing in North America

As of 1999, there were only nine carsharing organizations in North America. They all follow the operational model of most European CSOs: private individuals acquire cars from nearby neighborhood lots and return them to the same lot. None of these CSOs use smart technologies (i.e., smart cards, Internet-based reservations, and vehicle tracking) to facilitate reservations, operations, and key management. Four of them are run as for-profit businesses, and the rest are run as nonprofit cooperatives. In total, as of 1999, these nine CSOs had about 1600 members and operated about 115 vehicles.

Five of the nine North American CSOs are located in Canada. The oldest, Auto-Com in Quebec City, began operations in August 1994 and had 450 members and 34 cars in 1999. This organization began as a nonprofit cooperative, but changed to a for-profit business in 1997. In September 1995, it launched a second for-profit CSO in Montreal, CommunAuto, Inc., which had 550 members and 32 cars by 1999.

Strong interest in carsharing is emerging in a number of US cities. In Seattle, the city and surrounding county offered funding (approximately $500,000 for two years) to launch a for-profit private venture; in Chicago, a project called "ShareCarGo!" is projected to begin operation in fall 1999 with 12-14 vehicles, about 100 members, and 5-6 sites; and in the San Francisco area Hertz will begin a limited program at a rail station with 20-40 vehicles in early 2000.

Better funded efforts to launch carsharing programs in the United States have their roots in "station cars." These are vehicles deployed at passenger rail stations in metropolitan areas and made available to rail commuters. They were initiated by rail transit operators seeking to relieve parking shortages at stations (and desiring to avoid the high cost of building more parking infrastructure), by electric utilities eyeing a potential initial market for battery-powered electric vehicles, and by air quality regulators seeking to reduce vehicle usage and pollution. Most of these programs have struggled with the high cost and low reliability of first-generation electric cars. While shared use is the goal, as of late 1999 none has yet incorporated shared-use practices.

The first station car program with vehicle sharing will likely be an initiative announced in September 1999 by Hertz and BART, the regional rail transit operator in the San Francisco area, with plans to begin service in early 2000. Hertz will take control of 21 existing parking spaces and will use the space more intensively by parking cars bumper-to-bumper and dispatching the vehicles to reverse-commute subscribers. Hertz plans to charge "home end users" and the "corporate work site users" $400 per month, which includes guaranteed parking near the station entrance, cleaning, servicing and maintenance, and refueling for up to 1,000 miles per month.

Two "smart" carsharing research demonstrations launched in 1999 in California provide more evidence of emerging interests and plans in the U.S. The CarLink project in northern California was initiated with 12 compressed natural gas Honda Civics and a variety of state-of-the-art advanced communication and reservation technologies (Shaheen, 1999; Shaheen *et al.*, 1998), under the direction of the University of California, Davis; Intellishare in southern California incorporates 15 Honda EV Plus electric vehicles, smart cards, and on-board computer technologies, under the direction of researchers at University of California, Riverside. The former is used by residents near a rail station and employees of Lawrence Livermore National Lab, and the latter by faculty, staff, and students at the University of California, Riverside.

Carsharing in Asia

Carsharing activities in Asia are more limited. Most prominent is the Car Co-op, launched in Singapore in 1997. It uses an electronic key box and on-board computers. Residents of two neighboring condominiums automatically become members and have access to a fleet of shared cars, including a Mercedes-Benz limousine and several multi-purpose vehicles, as well as sedans. As it expands, the intent is to provide one car for every 40 residents. The developers of the two condominiums are each paying approximately $100,000 towards this operation during the first three years of the program. Members do not pay membership fees during the first years, but pay for usage. For example, it costs $20 per hour to book the limousine. Carsharing lots are also being located near public transit stations, so users can rent vehicles at the end of a transit trip.

Two experimental programs have been created by Honda and Toyota. In October 1997, Honda unveiled its Intelligent Community Vehicle System (ICVS) in a remote site north of Tokyo. It comprises multiple lots from which four different types of electric-powered vehicles can be selected for use, from an electric bicycle to a Smart-sized electric car; includes smart cards to unlock and start a vehicle, combined with advanced information technologies for reservations and billing; and advanced vehicle monitoring and controls to park and fuel the vehicles and move them in platoons without drivers. The ICVSdemonstration has no subscribed or regular users.

In May 1999, three hundred Toyota employees began a one-year experiment of a smart carsharing system called "Crayon." This system employs a suite of advanced electronics, including smart cards; a reservation, location, and recharging management system; automatic vehicle location; a vehicle information and communications system; and a fleet of 35 small electric E-com cars (with plans to increase to 50 cars). Employees, working at Toyota headquarters in central Japan, reserve vehicles and drive them between home and work sites and to the company's heliport. Eight parking sites will provide charging facilities (Toyota, 1999).

LESSONS

Despite its relatively high profile, carsharing has had little influence on traffic. Even the successful Swiss effort generates only a few thousand trips per day (using 1200 vehicles), accounting for less than 0.1% of total trips made by the 6 million residents of Switzerland. What lessons can be deduced from these limited experiences? Is the concept of carsharing inherently limited? Is the early Swiss success, though limited, best

explained by partnership innovations or by the cooperative and environmentally sensitive nature of Swiss people? Does strong latent demand exist that will be tapped when Silicon Valley technology and American entrepreneurship combine with European carsharing know-how to create a new transport pathway? What is the appropriate role for government? While definitive answers will not be available for many years, this paper attempts to document what has been learned and explore what is possible and perhaps desirable.

MARKET POTENTIAL

Carsharing has made only minor inroads. Many initiatives have failed and only a few have flourished; of those that have flourished, none is coming even close to 1% market penetration. The explanations are varied, relating to inconvenience, cost, unavailable vehicles and services, lack of policy attention, and so on. One should respect history, but circumstances can change. The single most critical change is likely to be the availability and exploitation of low cost and easy-to-use information and communication technologies. A secondary shift might be growing public policy support, manifested in a variety of ways.

It is difficult to estimate demand for new technologies and new attributes when customers have no experience with those products and attributes and when those attributes remain somewhat uncertain.[4] Determining the demand for shared cars is especially difficult because it implies some reorganization of a household's travel patterns and lifestyle. People use and view their cars in many different ways that are poorly understood. They value them not only for utilitarian travel, but also for storage, quiet time away from family and work, and office space. How important are these uses and activities, and for whom? How much inconvenience are people willing to accept in return for less cost? Conversely, how much will different people value eliminating the hassle and responsibility of car ownership? Will elderly people in particular come to see the advantage of carsharing? And how much value will be placed on easy access to specialized vehicles?

Central to these market demand issues are cost. But cost is not an exogenous variable. Cost will be determined in part on how the services are packaged, which is highly uncertain at this time. The varied partnership innovations described below suggest that a wild array of tariff schedules are possible for future users.

Market acceptance will likely be a function of traveler attitudes and values, which vary greatly across individuals and cultures. For instance, are there unique attributes of Swiss culture that explain the quicker embrace of carsharing in that country? Is it because Swiss may be more collective and considerate of group members than other cultures, or that they tend to have a strong environmental ethic? Do these attributes explain the quicker embrace of carsharing in Switzerland? Do they indicate that carsharing will face more resistance elsewhere? In the absence of further study, one can only speculate at the answer. But it should be kept in mind that favorable economics and convenience are likely to play an instrumental role.

Several surveys of users have been conducted in Europe and North America by carsharing organizations. Although most of the surveys have small samples, did not use control groups nor travel diaries

4. Some market studies on this subject have been conducted in the United States, but are too tentative to be indicative (Cervero et al., 1994; Cervero et al., 1996). More sophisticated studies are underway at the University of California, Davis (Shaheen, 1999), and in Switzerland (Muheim and Partner, 1998).

to collect travel data, employed simple questionnaires, and only capture the behavior and attitudes of early adopters, they may provide useful insights.

A survey in Switzerland and Germany found that users (which includes some non-car-owners) were between 25 to 40 years of age with above-average education, were more likely to be male, earned a below-average income (in part due to the low average age of participants), and were sensitive to environmental and traffic problems (Muheim and Partner, 1996). In a separate study, Stadtauto Drive reported similar characteristics: 65 percent male; average age of 33; well educated; and modest incomes (US$2,000 per month)(Muheim and Partner, 1996). Muheim and Partner (1996) reported that men have a greater tendency than women to demand a larger, more diverse fleet of vehicles for a wide range of trip purposes (Hauke, 1993).

In a German survey, Baum and Pesch (1994) explored motivations to participate in a carsharing service. Cost was not considered and multiple answers were possible. Convenient neighborhood locations and reliable availability were rated as most important (see Table 1).

Table 1. **Reasons to Participate in Carsharing**

Service Feature	Rating Service Feature Highly
Convenient neighborhood locations (i.e., a short distance to access vehicles)	71.2 %
High probability of vehicle availability	44.7
Low usage tariffs	30.3
Safe and reliable automobiles	28.2
Flexible booking options	22.6
Car-sharing stations available in other cities	< 10
Reduced capital investment (i.e., fixed car costs)	< 10
Low membership fees (e.g., monthly and annual dues)	< 10
Access to mid- and high-priced automobiles	< 10
Well-maintained vehicles	< 10
Mobility information services	< 10

Source: Baum and Pesch, 1994, cited in Muheim and Partner, 1996

In another European study, it was found that the principal reasons for not participating were the unprofessional image of many CSOs, an insufficient variety of products and services, higher costs than transit, a system that was "complicated, impractical and time consuming," and vehicles not readily available near home (Lightfoot, 1997). In Portland, the top two reasons for joining carsharing include the need for an additional vehicle and financial savings (Katzev, 1999).

Mobility CarSharing Switzerland foresees a large suburban market in Switzerland, though this forecast is not based on careful or rigorous analysis. They believe that they can capture 12 percent of drivers,

many of them in semirural areas. In contrast, Baum and Pesch characterize carsharing as a predominantly urban phenomenon in Germany (Muheim and Partner, 1998; Shaheen *et al.*, 1998). They estimate a potential market of 3 percent of the population (approximately 2.45 million people).

Shaheen's (1999) doctoral dissertation on CarLink, the carsharing program in the San Francisco Bay Area (described briefly in the History section above), attempted to answer many of these questions, using social learning and social marketing theories.[5] She identified a sample population in the area that appeared to be well suited to car sharing, and formed two groups, an experimental group that was exposed to a brochure and video and participated in a drive clinic, and a second control group.

Of those who had been contacted about field test participation and then exposed to the series of informational media and the drive clinic (i.e., the experimental group), 54% indicated that they would be interested in participating in a carsharing program – versus only 18% of the control group. Stated preferences and choices always overstate actual participation. In this case, 15% of the experimental group actually joined, compared to none from the control group. The decision to participate was significant, since a monthly fee of $200 was charged.

Clearly, information and experience play an important role in the decision to become a car sharer. We hypothesize that intense marketing of carsharing to a carefully selected target population can elicit up to 15% participation in carsharing with the level of service embodied in the CarLink program. Further work is needed to refine and extrapolate this finding.

From her research, Shaheen developed an early adopter profile, based on individuals who expressed interest in the CarLink field test and those who joined the program (n=139). The profile follows, expressed as rounded-off percentages of people interested in participating in the CarLink program:

- 50% belonged to households of two or three members.
- An equal number of men and women expressed interest, but of those who actually joined, 60% were male.
- 70% were married.
- 90% were 24-64 years (of which 56% percent were 24-40 and 39% 41-64).
- 60% had a Bachelor's or Master's degree.
- 50% lived in a large- or medium-sized city (greater than 50,000).
- 60% had household incomes over $50,000 per year.
- 20% were dissatisfied with their current transportation modes.
- 60% of individuals agreed or strongly agreed that vehicle maintenance is a hassle.
- 20% strongly agreed or agreed that vehicles are enjoyable.
- 60% strongly agreed or agreed that congestion is a serious problem.

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5. Social learning theory emphasizes a continuous interaction among behavior, personal factors, and environmental determinants. The relative influence of each factor is different for various settings and behaviors. A distinguishing feature of social learning theory is that "symbolic, vicarious, and self-regulatory processes assume a prominent role" (Bandura, 1977, p. 12). For instance, an individual might observe another person's behavior, reproduce it, and in replicating it, reinforce the modeled behavior. Social marketing is the application of concepts and techniques used in business to social behaviors. It begins with targeted customers. It focuses on understanding a target audience's needs, wants, and perceptions and is directed at creating a "social" campaign or product (e.g., anti-smoking campaigns and carsharing) (Andreasen, 1995).

- 50% agreed or strongly agreed that the environment is a concern.
- 80% agreed or strongly agreed that they like to experiment with new ways of doing things.

Many of the profile characteristics are comparable to those of early carsharing adopters in Europe. Differences include relatively more male participation, relatively lower incomes, and more urban-based participation in Europe. The lower incomes in Europe are probably due to the lower ages of carsharing members and the difference in urbanization is probably due to the suburban location of the CarLink project.

In summary, the ultimate market for carsharing, and its derivatives and spin-offs, will include those who perceive economic and convenience benefits. This overall market will include many market niches. It might include less affluent people who do not drive much but want access to a vehicle; richer people who value access to specialized vehicles; elderly people who do not want the responsibilities of owning and operating a vehicle; commuters who value inexpensive and/or guaranteed parking spaces at transit locations, shopping areas, and workplaces; and many other target populations that one can only guess at. Will the sum of these niches be substantial? Will mobility packages of the sort described below, made possible by the information technology revolution, dramatically enhance the attractiveness of carsharing and related means of travel and communication? It remains to be tested.

POTENTIAL REDUCTIONS IN TRAVEL

Indirect and nonmarket effects have little influence on the choice behavior of most travelers (the notable exception in this case being the small number of initial car share users who are ideologically motivated). But it is important to determine the magnitude of these indirect and nonmarket effects, because their presence influences government (and sometimes industry) behavior toward carsharing. If nonmarket and indirect effects are large – i.e., the market is seen to be undervaluing the benefits of carsharing -- government, employers, and others will be encouraged to support carsharing initiatives. [6]

Documentation of benefits is poor and may not be generalizable since initial early adopters (i.e., current carsharing practitioners) may not be representative of later participants. With that caveat, we examine initial carsharing activities, since they represent the only empirical evidence.

According to three carsharing surveys conducted between 1990 and 1994 (see Table 2), the magnitude of these nonmarket and indirect benefits could be substantial. They found that approximately 30 percent of carsharing participants sell their cars upon joining. Autodate reports a 39 percent reduction in vehicles (Autodate, 1998) and in Oslo, Norway, 68 percent of individuals reportedly gave up a vehicle after participating in carsharing (Berge, 1997, cited in Klintman, 1998).

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6. The case of Lufthansa illustrates the breadth and importance of indirect benefits, and how they can create new constituencies. In this case, the company saw carsharing as a means of avoiding the substantial cost of providing additional parking infrastructure.

Table 2. **Vehicle-Ownership After Joining CSOs**[7]

PASSENGER CAR-OWNERSHIP BEHAVIOR OF CSO MEMBERS	SHARE OF USERS		
	Wagner (1990)	Hauke (1993)	Baum and Pesch (1994)
Would never buy a car	37.2%	35.7%	12.9%
Forgone the planned purchase of a private car due to carsharing		15.6%	31.5%
Given up a private car because of carsharing	26.2%	42.4%	23.0%
Given up their car independent of carsharing	31.1%		29.7%
Continue to own a private car	5.5%	6.3%	3.0%

Source: *Muheim and Partner*, 1996, which cites: *C. Wagner*, ATG-UMFRAGE 1990. ATG, Stans. German, 1990; *U. Hauke*, Carsharing-Eine Empirische Zielgruppenanalyse unter Einbeziehung Sozialpsychologischer Aspekte zur Ableitung einer Marketing-Konzeption. Hauke, Feldstrasse, 1993; *Baum and Pesch*, 1994.

Reduced car ownership is critical because it generally translates into reduced driving. Various empirical studies find that, upon joining a CSO, users reduced their driving by about 1/3 to walking, biking, and transit. In Germany, Baum and Pesch reported that carsharing reduced private car mileage by 58 percent, from 7,044 km to 4,073 km per year, after membership (Baum and Pesch, 1994), while a Mobility CarSharing Switzerland study (conducted by the former ATG) reported that upon joining a CSO, the quantity of driving dropped 33 to 50 percent for individuals owning private vehicles. Former car owners in the Netherlands reportedly reduced their driving by 37 percent—from 15,907 to 10,095 km annually (Harms and Truffer, 1998).

An anomalous result from the same Netherlands study found that non-car owners, upon joining a CSO, reduced their private vehicle mileage by 29 percent—from 5,394 to 3,800 km. The explanation offered was that non-car owners often borrowed vehicles from friends and family. More plausibly, Muheim and Inderbitzin report that the mobility behavior of individuals in Switzerland, who did not own a car before CSO membership, was not altered significantly (Muheim and Partner, 1996). These investigators found that for this group of customers, carsharing trips often substitute for vehicle trips that were typically made with a borrowed car (Muheim and Inberbitzin, 1992).

Surveys indicate that the reduction in driving was replaced in part by travel on public transport. Baum and Pesch, for instance, report that public transportation use by CSO members in Germany increased by 1,546 km per year, resulting in them using transit for 57% of their total travel, versus 13% for private cars (see Table 3).

7. Note these statistics are between four to eight years old and generally reflect the behavior of early adopters of carsharing.

Table 3. **Change in Modal Travel Before and After Joining a CSO, in Germany**

Transport Mode	Without Carsharing	With Carsharing
Private or borrowed car	60.5%	13.4%
Carsharing	—	24.9%
Car rental	2.9%	3.1%
Taxi	0.8%	1.3%
Public transportation	35.8%	57.3%

Source: Harms and Truffer, 1998, which cites Baum and Pesch, 1994.

These findings seem directionally correct. One would expect the availability of carsharing to have two reinforcing effects: 1) easier access to transit, thereby encouraging travelers to increase transit use; and 2) greater awareness of per-trip costs (the result of paying more costs as a usage fee than occurs with vehicle ownership), thereby discouraging the amount of travel. One would not expect the shift away from cars to be as dramatic in areas with high car ownership, though – in part because households in those areas are likely to own multiple cars and shift some travel to remaining household vehicles, and because those areas are likely to have poorer transit service (as well as less biking infrastructure and greater walking distances). In any case, CSOs provide the promise of significant reductions in car usage and associated adverse effects with increased market penetration. It remains to be seen whether these effects persist as CSO participation extends beyond early adopter groups.

TECHNOLOGY AND OPERATIONS LESSONS

A majority of existing carsharing programs and businesses still manage their services and operations manually. In these cases, users place a vehicle reservation in advance with a human operator, obtain their vehicle key through a self-service, manually controlled key box, and record their own mileage and usage data on forms that are stored in the vehicles, key box, or both. As carsharing programs expand beyond 100 vehicles, manually operated systems become expensive and inconvenient, subject to mistakes in reservations, access and billing, and vulnerable to vandalism and theft.

Automated reservations, key management, and billing are a response to these problems. The larger CSOs, especially in Germany and Switzerland, have started to deploy automatic technologies that facilitate the operation and management of services, offer greater convenience and flexibility for users, and provide additional security for vehicles and key management systems. In California, the two "smart" carsharing demonstration projects are testing and evaluating a variety of state-of-the-art advanced communication and reservation technologies (Shaheen *et al.*, 1998).

These advanced technologies are key to satisfying customers and managing the systems. Individuals need to be assured that vehicles will be available when they want them (and advised when they are not), and effective management processes need to be implemented to handle imbalance problems that result with multi-nodal systems. That is, information and management systems are needed not only for reservations and

billing, but also to assure that vehicles do not agglomerate at a few locations. Management and pricing systems will be needed that manage temporal and spatial peaking.

Below are some early technology lessons, drawn from Wagner and Shaheen (1998):

- smooth interfaces and intermodal interchanges are needed to reduce time and convenience costs associated with transfers between modes, using electronic payment, for example;
- advanced electronic and wireless technology are becoming available that can be used to provide real-time access to information, reservations, ticketing, and billing, and in general lead to greater flexibility, spontaneity, and confidence for the user;
- international standards to allow easy access to vehicles across countries for business and recreational travel is becoming critical, especially in Europe;

While information technology is key to creating large-scale carsharing services, one should remain ever mindful of the many unforeseen problems that are likely to arise. The type of multi-nodal systems being suggested here, with peak pricing and real-time reservations and management, are well within the capabilities of technology, but management structures need to be created that keep costs low and customers happy, even when malfunctions and surprises happen.

ORGANIZATIONAL STRUCTURE AND PARTNERSHIPS

To date, all carsharing organizations, other than those operated by corporations for their employees, began as small local operations, usually with government funding and usually inspired by ideological concerns about car dependence and the negative impacts of cars (Lightfoot, 1997). Few have thrived. Most have disappeared or been absorbed by larger CSOs. It is difficult to transform a small grassroots CSO, founded on principles of democratic decisionmaking, hostility toward cars, and distrust of corporations, into economically viable businesses.

To the extent that these organizations have succeeded and expanded, it is because they have adopted advanced information technologies, behaved entrepreneurially, and sought partners. Some examples of innovative management practices and organizational structures are described below. Central to all the examples is creation of linkages to other transport services and organizations. Carsharing provides much more value to users if they have easy access to other services as well. Many examples abound.

The best example of an innovative umbrella organization to provide information and assist coordination is Autodate, which provides a variety of services to 90,000 individuals in the Netherlands. In addition to supplying conventional information and marketing functions, Autodate also facilitates linkages between private carsharing services and other businesses (e.g., taxi companies and car rental agencies); links carsharing providers to private companies interested in sharing their fleet vehicles; and promotes the use of shared-vehicle management in land development (e.g., establishment of carsharing in new residential areas). As of 1998, Autodate was financed entirely by the Dutch Ministry of Transport, with the expectation that other governmental agencies and private businesses would assume an expanding share of the budget (Harms and Truffer, 1998).

Most large CSOs have partnered with local transit suppliers, and several with rail companies and national car clubs. The Austrian CSO, Easydrive, has partnered with Vienna's municipal transport agency, the Austrian Rail company, and the Austrian Car Club. A German CSO, StadtAuto Bremen, with 1,700 carsharing members and 80 vehicles, launched a transit pass program in June 1998 that links the city's transit pass to the CSO's smart auto card. Members who purchase the card pay an initial fee of 30 Euro, plus fees based on kilometers driven, use, and type of car.

The need to create a smart card that links mobility services is critical. Stadtauto Drive, Germany's largest CSO with more than 7,000 members in Berlin and Hamburg, has its Mobil Card. Carsharing members use this card to access an expanded set of services and discounts. The card provides a 15 percent cost reduction on public transportation, allows users to take taxis without exchanging cash, and can be used to pay for food and beverage home delivery, reserve a bicycle, and even book canoes. In early 1998, Mobil Cards could be used at 46 carsharing lots in Berlin and Potsdam.

The most innovative and largest CSO, Mobility CarSharing Switzerland, recently deployed two new mobility service programs. The first, Zuri Mobil, is a successful mobility package based on a regional public transit offer that also includes carsharing and car rental. The second, Zuger Pass Plus (ZPP), provides a discounted combination of carsharing, public transit, car rental, taxi, bicycle, and other nontransport related services for its customers (similar to a frequent flyer program). ZPP is a partnership of several transportation providers and other businesses. In 1998, another partnership was launched with the Swiss National Rail System (SBB), offering a mobility package to 1.5 million SBB passholders (approximately 35 percent of the country's adult population). This package provides users with special discounts and easy smart-card access to carsharing vehicles, rental cars, and transit (Wagner and Schmeck, 1998). Starting as a pilot project in 2001, Easy-Ride will encompass most Swiss transportation activities, including rail, bus, taxi, carsharing, and car rental by 2005. Easy-Ride will make all services accessible by smart card. This will simplify ticketing and marketing and open new options for intermodal tripmaking. Almost every public transportation company in Switzerland is a partner in a carsharing mobility package. In the future, this relationship promises to grow even stronger.

Linkages with automotive companies may seem problematic at first glance, but several companies are exploring a variety of innovative connections to carsharing. These connections have various motivations and are manifested in very different ways. For instance, when people buy a Mercedes "Smart" car in Switzerland, they can also purchase a mobility package for $400, or $50 per year. This package includes free access to all carsharing vehicles (of Mobility CarSharing) — with no membership fees — at a slightly higher hourly rate and the same mileage rate paid by carsharing members. This package also includes a half-price pass for the Swiss transportation system. This allows the passholder to purchase train and bus tickets for half price throughout the year. In this partnership, "Smart" fits smoothly into a new consumer-oriented mobility package, since this vehicle only carries two persons and is generally too small for long trips. The carsharing service is a good complement for Smart owners, providing individuals and households with an expanded set of mobility options.

Stadtauto Drive of Germany started perhaps the most innovative partnership with a car company (known as Choice). They paid people who leased cars from Audi to make them available to the CSO. Drivers arranged to deliver their leased cars to the local CSO lot when on vacation or not in need of a vehicle. The lessees received payments based on demand for those types of vehicles at those times. The arrangement is intuitively attractive since demand by CSO members is greatest on weekends and during holidays, and many lessees use vehicles mostly for weekday commuting and business and are pleased to receive revenue when

they will not need the vehicle. As of 1999, 100 vehicles were leased. However, later in 1999 Choice learned that Audi would not continue their leasing contract with Choice. Choice is currently seeking a new automotive partner.

A natural linkage is with car rental companies, four of which now participate in some way. Europcar, a large car rental company, owns and operates an Austrian CSO, Easydrive (70 stations and 1050 members in 1999); Hertz has formed partnerships with a number of CSOs, including Mobility CarSharing Switzerland, and is managing a limited carsharing program at a rail transit station in the San Francisco area; Sixt AG, a German car rental company, recently created a new service called Car Express in which authorized users can rent vehicles from self-service stations at any time of the day or week in several German cities; and Budget Rent-a-Car is planning to supply up to 100 vehicles in 2000 to a technologically-sophisticated start-up CSO in Edinburgh.

The most obvious linkage, being pursued by Hertz, is to contract with CSOs to provide vehicles when members need cars for longer periods or when carsharing demand is at a peak. Whether car rental companies can attract a large enough market share to offer carsharing services remains to be seen. The Hertz/BART station car program, mentioned earlier, to begin in early 2000, will provide a good test case in the U.S.

In summary, we conclude that CSOs need to:

- seek partnerships with companies and organizations that can provide complementary transport services and contribute revenue,
- maintain sufficient overall management control to assure efficient and effective use of advanced communication and information technologies,
- maintain a flexible organization to embrace new partnerships and new information and communication technologies.

Partnering with public transportation agencies, employers, car rental companies, automotive suppliers and retailers, retail fuel suppliers, and auto clubs is essential. These partnerships provide carsharing participants with access to a large range of transport services, can generate additional revenue streams, provide related customer services and incentives (similar to frequent flyer programs) and can be an effective form of advertising.

ECONOMICS AND PRICING

The most commercially successful CSO is likely to be one in which the vehicles are used intensively by a large number of customers who drive infrequently. The CSO needs high utilization to keep per-use costs low, but CSOs are economically attractive only to those who are not intensive vehicle users.

An understanding of the economics of CSOs remains somewhat elusive. Economic data are sparse and not well documented due to the proprietary nature of much of these data, the casual organization of many CSOs, and their relative youth. Since virtually all CSO start-ups have been subsidized by governments, and many have failed or been acquired, an economic analysis is not straightforward. The economic data and

findings for users and operators reported here help to parameterize the attributes of a typical CSO in Europe. These numbers should be considered indicative, not definitive.

The largest CSOs, aiming for a balance between high vehicle utilization and high customer convenience (in terms of proximity and availability), claim that they can guarantee their customers over 95 percent vehicle availability. They accomplish this level of availability by providing about one car for every 15-20 members (Muheim and Partner, 1996; Lightfoot, 1997). Based on a study of a moderately large CSO in Dortmund, Germany ("Stadtmobil"), Lightfoot found that a clustering strategy of three vehicles per location provides optimal vehicle availability and easy physical access (Lightfoot, 1997). Optimal is defined here more in terms of consumer convenience than overall economics. As an indication of vehicle utilization, Stadtauto Drive reports that their vehicles average 34,200 km per year, compared to 14,600 km for the average German car. Vehicle trips tend to be of short duration and distance: 77 percent of Stadtauto Drive "rentals" are fewer than 24 hours in length, and 56 percent range between 19 and 100 km. The average occupancy rate of a Stadtauto Drive vehicle is two persons, compared to the German average of 1.3 (Euronet and ICLEI, 1996). Vehicles were used fairly intensively, but individual members tended to be sporadic users, with Stadtauto Drive members driving less than half that of the average driver (4,025 versus 8,758 km per year) (Euronet and ICLEI, 1996).

As an indication of the economic attractiveness of carsharing, Muheim and Partner found that travel expenses of early carsharing members were reduced by about $440 per year and that carsharing is cost effective for users who drive fewer than 9,000 km per year (Muheim and Partner, 1996). Baum and Pesch report the breakeven point for carsharing in Germany at 6,900 km per year (Baum and Pesch, 1994), and Petersen reported a breakeven point for Stadtauto Drive of 18,300 km (Petersen, 1993-1995). These findings are for European CSOs at varying times and situations and are not well documented.

The poor understanding of carsharing economics -- for both users and service providers – is problematic. How do they manage peak demands and assure a high level of service and reliability? Where do they site their facilities? How do they target their marketing and membership campaigns? What mix of work commuters, recreational users, and fleet operators is most desirable? While there is not a uniform answer to these questions – optimal business strategies will vary greatly -- but at this point it is virtually impossible to even arrive at generalizations. In short, the carsharing industry continues to lack the understandings needed to develop successful business models.

SUMMARY OF LESSONS LEARNED

Carsharing clearly has the potential to provide significant economic, social, and environmental benefits. These benefits would be large if carsharing were widely accepted and services were provided efficiently. These are big "ifs".

We conclude that, in general, carsharing is most likely to succeed if CSOs:

- provide a dense network and variety of vehicles,
- serve a diverse mix of users,
- create joint-marketing partnerships,

- design a flexible yet simple rate system, and
- provide for easy emergency access to taxis and long-term car rentals,
- retain independence from government entities to assure firm adherence to business principles.

Carsharing will not be successful everywhere at all times. It is more likely to thrive when environmental consciousness is high; when driving disincentives such as high parking costs and traffic congestion are pervasive; when car ownership costs are rather high; and when alternative modes of transportation are easily accessible.

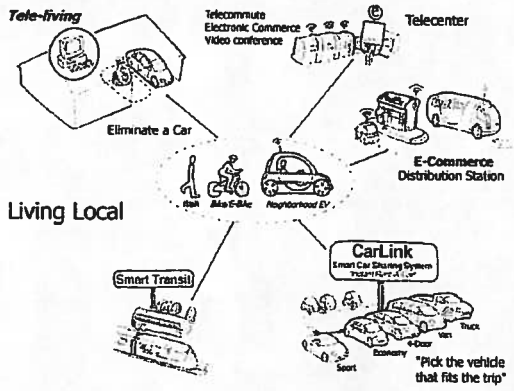
Perhaps most important, but less well documented, is the need for partnership management to offer enhanced products and services and incentives to encourage and maintain customer base. The more expansive CSOs are those that have acquired other CSOs that failed or lacked strong leadership. But to retain customer loyalty, they must improve services and/or reduce costs. Two linked strategies are being followed: (1) coordinate and link with other mobility and nonmobility services (e.g., food providers); and (2) incorporate advanced communication, reservation, and billing technologies in conjunction with significant membership growth. But advanced technologies are expensive and linking with other services is successful only if the customer base is large. Hence, CSOs either remain quite small or grow rather rapidly, at least initially.

TOWARD NEW SERVICES AND NEW FORMS OF MOBILITY

Taking a longer view, CSOs may be the prototype of an entirely new business activity: mobility service companies. As car ownership proliferates and vehicles become more modular and specialized, entrepreneurial companies may see an opportunity to assume the full care and servicing of mobility needs in neighborhoods, work sites, transit stations, and shopping centers, based on a partnership management strategy (Womak, 1994). These new mobility companies might handle insurance, registration, and maintenance, and travel planning services and could substitute vehicles as household situations change. One can imagine a future in which the pioneering CSOs combine their operational expertise with the entrepreneurial capabilities of advanced technology suppliers, and other marketing strategies (e.g., frequent flyer program-based traveler incentives) to create mobility services that enhance our social, economical, and environmental well being.

Taking an even longer view, carsharing might evolve into a wider variety of activities and services, what has been referred to elsewhere as "new" or innovative mobility (Salon et al, 1999) (see Figure 1).

Figure 1. **Conceptual Illustration of a New Mobility System (Salon et al, 1999)**



New mobility is defined as a fundamentally new approach that focuses on intermodal clustering of innovative and conventional technologies to create a coordinated transportation system that could substitute for the traditional private auto. New alternatives include small personal vehicles (Sperling, 1994; Kurani et al, 1995), shared-use vehicles, various telecommunication complements and substitutes (Handy and Mokhtarian, 1996), smart paratransit (Cervero, 1997), telematics (i.e., in-vehicle information services), e-commerce, and travel planning. These options are not entirely new. They have all been experimented with and gained some acceptance in some regions and some markets. But their net impact has been miniscule. We hypothesize that by coupling these options with each other, with conventional cars and transit, and with ever-cheaper and more available communications and information technologies, synergies will arise that create the potential for greatly increased market share by a collective of alternative modes, which can command a market share larger than those attained by carsharing or other alternative modes alone—a sort of "cumulative" mobility market that reinforces use and adoption of other modes and services.

The challenge in devising new service packages is to be respectful of and responsive to the high value placed on personal mobility. Strong synergies and incentives are needed to accomplish a major transportation transformation. These synergies and incentives include building constructive relationships among carsharing, telecommunications technologies, and transit. One can imagine implementing these transportation alternatives together with other community enhancement strategies. The goal is to allow people to match their mode of transport with their specific travel purpose. But no single model fits everywhere.

POLICY STRATEGIES AND INITIATIVES

The evolution of carsharing and other broader intermodal initiatives is difficult to foresee; change will come about in unpredictable and unforeseen ways. Clearly, this evolutionary process will be strongly influenced by government and public policy. Indeed, government is already deeply involved in the transport sector. It provides many transportation services and facilities (road and transit supply, taxi regulation, driver licensing, etc.); intervenes to enhance access by mobility disadvantaged; reduces pollution, traffic congestion,

and other transport-related market externalities; and attempts to facilitate economic growth through transport policy and investments.

In this case, the role of government is probably not to provide services directly – the private sector is far more efficient at this – but to facilitate choice and entrepeneurship, for both users and suppliers. This more indirect role is especially advisable given the dynamic nature and wide availability of information technologies. Government needs to maintain its commitment to basic transit services and respect longstanding social (and legal) contracts with suppliers of infrastructure and services (taxis, airports, etc.). But if entirely new transport services are to emerge, it is difficult to imagine government being flexible, innovative, and efficient enough to launch these services successfully.

At the broadest level, government support could come in a variety of forms. The most direct form would be financial support for system-enhancing technologies, such as "smart" paratransit, carsharing, and even mass transit. Government support for development of key alternative technologies such as small personal vehicles would be another example. At the local level, government, together with technology suppliers and local businesses, could subsidize the start up of demonstrations based on a mobility plan developed by the community. Indirect governmental support for new concepts and programs could come in the form of disincentives for the privately owned vehicle and incentives for using mobility services.

Partnerships between new mobility businesses, such as local carsharing organizations, bicycle retailers, local bus and train operators, telematics, and e-commerce, need to be fostered. These partnerships will create a strong "new mobility" core business community and will facilitate the intermodalism necessary for new services to thrive and to generate customer loyalty. Any city attempting to incorporate the concepts of new mobility into the lives of its residents must start small and systemically. Rarely can any one alternative to the privately owned vehicle succeed alone. Their success in competing with this dominant transportation mode will stem from synergies and incentives that support them all.

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