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Carlink II: A Commuter Carsharing Pilot Program Final Report

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CARLINK II: A COMMUTER CARSHARING PILOT PROGRAM

FINAL REPORT

Prepared for

California Partners for Advanced Transit and Highways
Memorandum of Understanding 4104

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The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California. This report does not constitute a standard, specification, or regulation.

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EXECUTIVE SUMMARY

CarLink II was a commuter-based carsharing pilot project administered by the Institute of Transportation Studies at the University of California, Davis (ITS-Davis) in conjunction with Caltrans, American Honda Motor Company, and Caltrain. Partners for Advanced Transit and Highways (PATH) researchers conducted the evaluation. Pilot objectives included testing an advanced carsharing system, understanding user response to this service, and testing its long-term sustainability. From July 1, 2001 to June 30, 2002, the CarLink II program was deployed in the field and continued the investigation of commuter-based carsharing originally explored in the 1998 CarLink longitudinal survey and the 1999 CarLink I field test. Lessons learned during the CarLink I field test helped guide the project team's design of the CarLink II project, resulting in several differences and improvements. The table below summarizes the major differences between CarLink I and II.

Differences between CarLink I and II

STUDY CHARACTERISTICS	CARLINK I	CARLINK II
Number of Vehicles	12 Vehicles	19 Vehicles
Primary Transit Partner	BART	Caltrain
Transit Station Location	Dublin/Pleasanton	Palo Alto
Vehicle Type	Compressed natural gas Honda Civics	Ultra-low emission Honda Civics
Homebased Users	Up to 10 households, pay $200 per month.	Up to 16 households, pay $300 per month.
Workbased Commuters	Up to 20 Lawrence Livermore National Laboratory (LLNL) employees pay $60 per carpool ($30 each).	Up to 63 employees of businesses at Stanford Research Park (primarily), share CarLink vehicles to carpool to/from work. Businesses pay $350 per month per vehicle (a combined fee) for Workbased Commuter and Day Use services (in contrast to employees paying for this service independently as in CarLink I).
Workbased Day Users	Employees of LLNL pay $1.50 per hour and $.10 per mile.	Up to 28 employees of Stanford Research Park companies and other nearby businesses have access to vehicles for business and personal use. Employers pay $350 per vehicle per month to subscribe to the combined Workbased Commuter and Day Use services.
Total Users	54	107
Employer	One: LLNL	Six: Several private companies at/nearby Stanford Research Park

Technology	In-vehicle tracking, smart key kiosk at transit station, smart cards, manual key boxes at LLNL, and on-line scheduling system at LLNL	In-vehicle tracking, automated data collection, smart key fob entry, PIN-based vehicle login, on-line reservations, and in-vehicle navigation system
Program Length	Field test designed for limited 10-month duration	Pilot program with planned transition to on-going carsharing service
Research Goals	Document demand for commuter carsharing service and gauge user satisfaction and needs	Continued analysis of commuter carsharing (in a new setting) with greater statistical confidence (i.e., a greater sample size) and new emphasis on technology testing, its impact on cost reduction, and longer-term program sustainability

CarLink I: Key Findings

The original CarLink I field test ran from January to November 1999, and featured 54 individuals sharing 12 natural gas powered Honda Civics. The vehicles were based at the Bay Area Rapid Transit (BART) District station in Dublin-Pleasanton, the eastern terminus of the BART system. The shared cars were equipped with smart technologies including tracking, communication, and reservation systems to facilitate access and logistics. The model incorporated transit-based carsharing for traditional and reverse commute travel patterns, as well as a day-use fleet application, tested at a major employment center—the Lawrence Livermore National Laboratory (LLNL). The CarLink model includes three separate user groups (Homebased Users, Workbased Commuters, and Workbased Day Users), each of which used the vehicles differently and paid fees accordingly. Key CarLink I study findings include:

- Even though CarLink users' commutes took approximately 10 minutes longer on average, they found them less stressful;
- The combination of CarLink, BART, and carpooling resulted in a net commute reduction of approximately 20 vehicle miles (or 32.2 kilometers) per commuter per day (on average) across the fleet;
- CarLink resulted in at least 20 new BART trips each day; and,
- Several Homebased Users stated that if CarLink became a permanent service, they would sell one of their personal cars, which would greatly reduce their transportation costs.

CarLink II: Pilot Program Overview

Building upon the knowledge and experience gained in CarLink I, the CarLink II program reflects several changes to the initial model. Chief among the differences were the decisions to: 1) transition the program to an ongoing service at the end of the pilot phase, and 2) test it in a different location with a new transit provider and business partners. CarLink II launched in Palo

Alto with Caltrain and several businesses located in the Stanford Research Park in summer 2001. The main CarLink II user components were:

- **Homebased Users:** This group paid $300 per month to have access to vehicles on evenings and weekends. They drove a CarLink vehicle to the California Avenue Caltrain station each weekday morning and to home each evening.
- **Workbased Commuters:** Members of this group were employees of Stanford Research Park businesses, who subscribed to CarLink, and drove the vehicles between the Caltrain station and their worksites as part of their daily commute. Their employers paid $50 per month per vehicle for this service.
- **Workbased Day Use:** Registered employees of businesses, which paid $300 per vehicle per month, had access to the vehicles during the day for personal and company trips.
- **Vehicles:** Nineteen 2001 Ultra Low Emission Honda Civics
- **Technology:** CarLink II employed a seamless, customized system that coordinated vehicle tracking, data collection, and reservations. Users reserved vehicles over the Internet and accessed vehicles using smart key fobs.

A total of 107 individuals participated in the CarLink II program: 16 Homebased Users, 28 Day Users, and 63 Workbased Commuters/Day Users. Fifty-three percent of participants were female and 47 percent were male. Sixty-four respondents completed the final questionnaire (a response rate of 60 percent). Respondents included nine Homebased Users (five male, four female); 21 Day Users (9 male, 12 female); and 34 Workbased Commuters (14 male, 20 female).

While the principal goal of the CarLink I field test was to examine response to commuter carsharing, CarLink II focused on commercial potential and technology assessment. The primary tools used to investigate these topics were focus groups, questionnaires, travel diaries, data collected automatically by in-vehicle technology, operational data, and feedback from the CarLink management staff and project partners.

CarLink II Report Overview & Key Findings

This report consists of five chapters and four appendices (survey instruments, travel diary, interim program interviews, and final focus group summaries). Key findings for each chapter are provided below.

Chapter One: U.S. Shared-Use Vehicle Survey Findings: Opportunities and Obstacles for Carsharing & Station Car Growth

This chapter provides original research on the current market for shared-use vehicle services in the U.S. during the timeframe of the CarLink II pilot project. It was also published in *Transportation Research Record*, No. 1841, pp, 90-98 (permission was granted by the Transportation Research Record to publish it in this final report).

Principal findings include:

- In July 2002, there were 18 shared-use vehicle organizations: eleven carsharing organizations; five station car programs; and two carsharing research pilots (both in California). As of July 2002, station car programs claimed approximately 163 members and 121 vehicles, while carsharing programs collectively claimed approximately 12,098 members and operated 455 vehicles. Not surprisingly, the majority of carsharing members (80 percent) live in the 25 most densely populated cities of the nation.

- A few organizations serve the majority of U.S shared-use vehicle program members in multiple regions. For instance, City CarShare, Flexcar, and Zipcar each operate in several cities. In July 2002, these organizations collectively served 92 percent of all U.S. members and deployed 78 percent of the vehicle fleet.

- The reduced number of organizational launches in 2002, amidst continuing market, membership, and fleet expansion, indicates that entry barriers likely exist and could be increasing. The high fixed costs of vehicle lease/purchase, technology development, and insurance also are significant deterrents to a new organization's market entry. In a survey of planned organizations, 75 percent of respondents (n=7) ranked insurance and smart technologies among their top three costs. While insurance was not listed as a major cost or concern in the 2001 survey, by July 2002 researchers found increased insurance costs a major challenge to expansion and sustainability for the vast majority of U.S. organizations.

- Despite promising U.S. shared-use vehicle operational and membership growth rates, the relative small scale of these organizations presents a challenge to: 1) obtaining affordable insurance and 2) covering other high capital costs, including technology, vehicles, and labor. While advanced shared-use vehicle technologies can help organizations to reduce administrative costs and potentially lower insurance premiums, technology deployment has typically required large private investments or public development grants. Second, cooperation among shared-use vehicle organizations could also accelerate the development of interoperable, customized technologies and continued innovation by creating the scale necessary to attract technology providers. Additionally, a combined insurance-technology cooperative strategy may be even more beneficial—lowering insurance premiums, enhancing customer services and capabilities, and lowering capital costs.

- The potential of new and existing shared-use vehicle service organizations to continue expanding and serving new markets could be greatly enhanced through supportive public-private partnerships. Policymakers and transit operators, for instance, should continue to explore the social and environmental benefits of shared-use vehicle services through grant making, preferential parking, supportive policies (e.g., employer pre-tax credits), and outreach/marketing. Strong public-private partnerships are needed to facilitate the on-going development and sustainability of viable U.S. shared-use vehicle programs.

Chapter Two: A Framework for Testing Innovative Transportation Solutions: A Case Study of CarLink—A Commuter Carsharing Program

This chapter outlines the CarLink model, technology, and early lessons learned. It also provides an overview of CarLink II operational understanding, a synopsis of the pilot program transition, and offers recommendations for future model development.

- The CarLink II pilot program built upon six key operational lessons learned from CarLink I:

    1. Streamlining Technology: Several technology shortcomings (i.e., key management and vehicle tracking systems) contributed to delays and necessitated program modification. Technology should be integrated and customized to facilitate carsharing use. A stand-alone "smartcard" approach should be developed and tested in which fixed key box lots are not needed. In this way, participants could access vehicles with smartcards alone.

    2. Limited Compressed Natural Gas (CNG) Infrastructure: During CarLink I, two CNG issues constrained operations: a limited number of CNG refueling sites and slow CNG refueling pumps at Lawrence Livermore National Laboratory. The CNG component of CarLink I restricted vehicle range and participation. Also, users did not refuel vehicles as frequently as agreed. Use of CNG vehicles in the CarLink I field test distracted from the shared-use vehicle evaluation. In the future, this model should be tested with internal combustion engine (ICE) vehicles and fuel cards.

    3. Guaranteed Parking: Guaranteed parking at the Dublin-Pleasanton BART station was a huge program incentive, as parking at this station filled up prior to 7AM at the time of the program. In the future, carsharing programs should be sited in locations where parking is costly and limited.

    4. Vehicle Cleanliness: During CarLink I, participants and operations staff cleaned and washed cars. Nevertheless, vehicle cleanliness continued to be a chronic program issue. Consider hiring a third party to clean vehicles more frequently.

    5. Employer Participation: Day Use participation in CarLink II was limited. In the future, test an employer-focused carsharing service with multiple companies located in a congested corridor with transit access and parking constraints.

    6. Program Duration: CarLink I was a short-term demonstration project (i.e., 10 months), which limited understanding of user adoption and behavior because of its short timeframe. In the future, deploy CarLink as a pilot program with the potential to transition to an ongoing operation after the research phase ends.

CarLink II user satisfaction highlights include:

- CarLink Staff: Thirty-nine percent of respondents to the final questionnaire were very satisfied, and 45 percent were satisfied with the CarLink II staff. No respondents were dissatisfied or very dissatisfied. During the interim program interviews, participants also expressed satisfaction with CarLink II staff. Indeed, 68 percent of those responding were very satisfied with CarLink II operations personnel. Members reported that when a problem arose that CarLink II staff responded very quickly and kept them well informed of relevant issues.

- Transit Costs: Transit costs (primarily Caltrain) varied for individual members. All CarLink II member companies contributed to the transit fares of their employees. As part of the final questionnaire, 19 percent of respondents were very satisfied, 47 percent were satisfied, and only five percent were dissatisfied with their transit costs. Ten percent of respondents answered not applicable, since many Day Users carpooled, vanpooled, bicycled, or walked to work.

- Member Coordination: CarLink II required all members to coordinate with each other to ensure that vehicles reached designated locations at required times (e.g., Caltrain during AM and PM commute peaks). Approximately eight percent of respondents were very satisfied, and 38 percent were satisfied with this process. Thirty-five percent were neutral, indicating that the majority of participants adjusted easily to schedule coordination. It is important to note that scheduling flexibility was accommodated with additional "pool" vehicles in the CarLink II fleet.

Similar to CarLink I, numerous lessons were amassed during CarLink II. Key findings include:

- Parking Impacts: Building on a principal CarLink I success factor, locations with limited parking were emphasized during the CarLink II site selection in early 2000. At this time, the parking lot at the California Avenue Caltrain station was at close to 90 percent capacity. However, due to the subsequent economic downturn, lot utilization decreased to less than 60 percent by the end of CarLink II (July 2002). This change in parking negatively impacted program recruitment, as guaranteed parking is a significant incentive to carsharing use, particularly when parking is oversubscribed.

- Economic Impacts: CarLink II site selection was conducted in summer 2000. At that time, the California economy had just begun to experience a downward turn, but the extent of this decline was not yet apparent. Earlier, the strong economy had contributed to increased highway congestion, and many transit lots were approaching or exceeding capacity in the Bay Area. Employers were anxious about employee retention, and Palo Alto was concerned about the impact of congestion on quality of life. At this time, there was no reason to believe the economic strength of Silicon Valley would diminish enough to affect CarLink II's longer-term operation. Silicon Valley lost approximately nine percent of its employment from the first quarter of 2001 to the second quarter of 2002 (i.e., the period of CarLink II operations). This impact affected user demand and

willingness to pay during CarLink II, economic viability (i.e., CarLink II was unable to cover its costs), and long-term sustainability (i.e., transition to a third-party operator).

- Participant Recruitment and Retention: Engaging potential participants is challenging. Recruitment remains an ongoing effort due to member attrition (business and individual) due to changes in home, work, or business circumstances. During CarLink II, a wide variety of recruitment strategies were utilized with varying levels of success (e.g., the CarLink II website, brochures/postcards, a video, flyers at stations and in Caltrain bills, flyers on trains, articles/advertisements in local papers, community meetings, carpool lists, a trial offer, etc.). The most effective tools included the trial offer (as noted during the CarLink longitudinal survey as a powerful recruitment device), flyers on trains, recommendations from Stanford Research Park, word of mouth, and e-mail communication. Least effective methods included flyers in the Caltrain bill and at the stations, the carpool list, and the CarLink II video.

Chapter Three: Travel Effects of A Suburban Commuter-Carsharing Service: A CarLink Case Study

This chapter presents market and behavioral data from CarLink II and contrasts results of CarLink I where applicable.

Key demographic variables examined include gender, age, education, income, occupation, and vehicle ownership. Findings include:

- Gender: Men and women were equally represented in CarLink II, which is consistent with the distribution of men and women in the Bay Area. However, in CarLink I, male participants were disproportionately represented. The difference in gender distribution between CarLink I and CarLink II may be explained by the demographic or attitudinal characteristics of employees at the respective worksites.

- Age: CarLink II participants tended to be younger than the general Bay Area population and CarLink I participants. Participants 20 to 40 years of age represented approximately 79 percent of CarLink II members and over 20 percent were between 41 and 64 years of age. The location of CarLink II in Silicon Valley, which tends to have a relatively young employee base, may explain the lower relative age of participants in CarLink II. In contrast, only 41 percent of CarLink I participants were between 20 and 40 years of age, and 59 percent were between 41 and 64 years old. The LLNL worksite in CarLink I may explain the higher relative age of participants (i.e., employment may require more advanced degrees).

- Education: Participants in both CarLink I and II possessed higher levels of education than the general Bay Area population. Fifty-seven percent of CarLink I and 48 percent of CarLink II participants had education levels of a bachelors degree or higher. This compares to 14 percent of Bay Area citizens over the age of 25 with a bachelors degree or higher.

- Income: The household income levels of CarLink participants were also relatively high compared with the Bay Area population. Thirty percent of CarLink I members had household incomes ranging from $80,000 to $99,999, while 16 percent had a household income greater than $100,000. CarLink II members had fewer participants in the $80,000-$99,999 range (19 percent), but more participants earning over $100,000 (47 percent). In CarLink II, the greatest portion of all user groups was in the $100,000 plus income category. However, Homebased Users tended to have a relatively large percentage of members in the lower income groups, and the reverse was true for Workbased Commuters. Workbased Day Users tended to have a more even distribution across the income categories than the other user groups.

- Occupation: With higher education and income levels, CarLink members were primarily employed in the professional/technical category (68 percent in CarLink I and over 64 percent in CarLink II). This is high relative to Bay Area residents. The distribution of occupation types did not vary substantially among user groups in CarLink II relative to CarLink I.

- Vehicles Per Household: CarLink II participants owned or leased an average of 1.75 vehicles per household at the start of the program. Overall, the number of vehicles per household of CarLink II participants was similar to the Bay Area population.

CarLink attitudinal profiles follow:

- Current Modes: CarLink II Workbased Commuter and Day User attitudes were slightly positive towards their current mode. Similarly, the CarLink I field test found that 77 percent were satisfied with their current mode. These results suggest that CarLink participants did not join CarLink because of a general dissatisfaction with their current transportation mode.

- Congestion: Participant's least favorite negative transportation attribute, "Spend too much time in traffic," suggests that traffic congestion may be a predictor of CarLink II participation. CarLink I results also suggested that participants may be more sensitive to congestion than other factors.

- Environmental Concern: CarLink I and II participants expressed concern for the environment. These results indicate that reducing automobile effects on the environment may have been an important motivating factor for joining CarLink.

- Transit: CarLink II participants were comfortable with transit. This tended to be most strongly true for Homebased Users, most likely because of their lower vehicle ownership rates, lower household incomes, and somewhat younger ages.

- Experimentation: Both CarLink I and II members indicted a similar comfort level with respect to experimentation.

- Vehicle Hassle: All the CarLink II user groups tended to disagree that "vehicles are a hassle." This result differs from CarLink I. These results indicate that CarLink II participants may have been motivated more by a desire to get out of traffic (as indicated by their least favorite aspect of their current transport mode) as opposed to a desire to reduce vehicle hassle.

CarLink travel effects follow:

- Commute Mode Change: In CarLink II, solo driving was reduced by 23 percent on average for all members. Similarly, promising modal shifts were obtained for CarLink I (over 43 percent reduction in drive alone for the commute travel). CarLink II showed a slight reduction in carpooling. In CarLink I, carpooling increased by nearly five percent, but this is likely because of carpooling requirements built into the program.

- Commute Vehicle Miles Traveled (VMT) Change: In CarLink II, since the majority of Homebased Users were previously Caltrain riders, this resulted in a slight net VMT increase of 1.2 miles per day per person for this user group. However, the Workbased group (both Workbased Commuters and Day Users) reported a significant decrease of 27.2 VMT per day per person. Similarly, the CarLink I study found that the average reduction in daily commute travel was 18.5 miles as a result of CarLink I participation.

- Non-Commute Travel Changes: Almost half of CarLink II participants indicated that their transit use for non-commute trips did not change, while approximately 24 percent stated that it increased, and over 17 percent responded that it greatly increased. Approximately 27 percent of members reported a decrease in household vehicle usage, as they relied less on their personal vehicles.

- Sold or Postponed Vehicle Purchase: Over half (approximately 52 percent) of CarLink II respondents reported no change in personal vehicle use after they joined CarLink. Eleven percent of Homebased Users and five percent of Workbased Users (Workbased Commuters and Day Users) sold a personal vehicle or put it in storage. No one purchased a personal vehicle, although over 51 percent said they would buy one in the next year in the initial questionnaire (i.e., at the time they joined CarLink II).

- Carpooling Effects: The average number of Workbased Commuters sharing a CarLink II vehicle, including drivers, during commutes between the train station and their work sites was 1.48 in both mornings and evenings.

- Parking Impacts: The overall parking benefit to employers resulted in one parking space serving two CarLink II vehicles on average.

Chapter Four: Applying Integrated ITS Technologies to Carsharing and System Management: A CarLink Case Study

This paper focuses on the role of technology in carsharing system management, lessons learned from CarLink, and technology benefits to this nascent market. It was presented at the *10th World Congress on Intelligent Transportation Systems* hosted in Madrid, Spain in November 2003.

CarLink II technology findings include:

- Technology: Technology was a major aspect of CarLink II operations since it facilitated user convenience, management tools, and program expansion. CarLink II technology included: an in-vehicle navigation system for trip routing, vehicle access for all users, refueling cards for maximum flexibility, and a reservation system for Day Use.

- In-Vehicle Navigation: The in-vehicle navigation system allowed users to route their trips and receive visual and voice instruction. This was not a program requirement but rather an additional feature that provided convenience for some trips. While 13 percent never used the system, over 50 percent reported the system was very satisfying or satisfying to use.

- Vehicle Access: Vehicle access is defined as unlocking the car with a key fob and logging into the CarLink II computerized system with a personal identification number (PIN), which released the ignition immobilizer and attributed trip activity to the user's ID number. Ninety-two percent of users were satisfied with vehicle access at the program's mid point. By the program's end, only 60 percent were satisfied or very satisfied, and nearly 20 percent were dissatisfied with the system. Homebased Users were the most frustrated by the length of time (three seconds) the fob took to unlock the vehicle, and they felt that the location of the smart key reader (rear windshield) was inconvenient if holding a child, groceries, etc.

- Refueling: CarLink II vehicles each included a fuel card and a PIN associated with all user. This system allowed individuals to refuel the cars at their convenience at local stations. At the end of the program, 60 percent of respondents reported that they were very satisfied or satisfied with refueling, and only seven percent were dissatisfied or very dissatisfied. Throughout the program, participants indicated that the vehicles were sufficiently fueled, although this was not always the case. Users also indicated that incentives for individuals who frequently refueled the vehicles (e.g., coupons for free coffee, videos, etc.) would have provided more motivation for refueling consistently.

- Reservation System: At the end of the program, 44 percent of the respondents were satisfied, and only eight percent were dissatisfied with the reservation system. However, during interim program interviews, 28 percent were dissatisfied with the system. This change likely reflects satisfaction with reservation system improvements made during the program's remainder. The primary reason for reservation system dissatisfaction was the lack of a lockout system—guaranteeing that a reserved vehicle would be waiting for the individual that requested it. Vehicle lockout was identified as an area for next generation

technology development, as it was not addressed during the CarLink II pilot program due to cost and time constraints.

- Integrated Carsharing Technology: As part of CarLink II, American Honda Motor Company developed an integrated carsharing system that included: 1) vehicle access (smart key fobs); 2) a reservation system (Internet-based website); and 3) vehicle use and tracking (car location, vehicle miles traveled, fuel levels, user ID number, and time). CarLink II also included a navigational system.

  While the majority of participants were satisfied with the CarLink II technology, the following improvements were recommended:

  - A "lockout" feature for reserved vehicles should be developed;
  - The key fob door-release speed should be increased;
  - The PIN entry screen process should be improved;
  - The vehicle immobilizer should be integrated with the engine control unit to make this feature much more secure;
  - The online reservation page should be modified to improve scrolling and reflect the correct time;
  - The number of steps involved in making an online reservation should be reduced;
  - A means to directly inform the reservation system that a trip is extending past the reserved time period should be developed (e.g., automated phone interface); and
  - Reserved cars that are unused should be converted to "available for use" automatically on the reservation page after a 10 to 15 minute waiting period. (Furthermore, users should be fined if they do not cancel a reservation in advance.)

Chapter Five: CarLink—A Commuter-Carsharing Model: Conditions for Economic Viability

This chapter provides an analysis of CarLink's economic potential, drawing from data and experience from CarLink I and II, with an emphasis on CarLink II. In addition to presenting an economic analysis of the CarLink II experience, this paper explores the economic viability of commuter carsharing under three different market scenarios.

Due to underutilization of fleet vehicles and sub-market pricing during the preliminary implementation, CarLink II was unprofitable for its first year, recording costs of $342,002 and revenues of $70,850. Research expenditures also account for some of the high costs. To obtain meaningful results, the pilot project employed advanced data collection technologies that were substantially more expensive than a commercial operator would require for basic carsharing operations.

The three scenarios explore modifications to the CarLink model in terms of market demand, costs, and revenues.

- **Scenario One: Optimal Market Conditions.** Scenario One assumes a high demand for carsharing services. Modifications to the CarLink II figures are as follows: insurance costs were increased to reflect market rates; in-vehicle technology costs were reduced to

reflect off-the-shelf technologies likely to be employed by commercial carsharing operators; marketing costs were reduced to reflect an emphasis on the most cost-effective recruitment methods; monthly vehicle fuel costs were doubled to account for increased use of vehicles; and salaries were slightly reduced to reflect operations of a typical carsharing organization. All other costs remain the same as in CarLink II. The revenue structure was modified to include short-term rentals on weekends to maximize use of idle vehicles. Homebased User fees remained $300, and business customer fees were increased to $960 per month to reflect willingness-to-pay. This scenario assumes 21 vehicles in Year 1 increasing by five in Year 2 and by another four in Year 3. Carsharing becomes profitable in Year 2 and yields a profit of $98,614 by Year 3.

- **Scenario Two: Sub-Optimal Market Conditions.** Scenario two assumes similar regional economic conditions, but reduced demand for the carsharing service, potentially explained by economic, land-use, or demographic composition of a location. The second scenario starts with just 17 vehicles to reflect slightly reduced demand, increasing by only two each year. All costs and revenue patterns, adjusted for the smaller number of fleet vehicles, remain as described in Scenario One. Economic viability is not achieved. The major shortcoming appears to be a limited demand for commuter carsharing, which does not allow the organization to achieve an economically viable size.

- **Scenario Three: Revenue-Risk Sharing Under Sub-Optimal Market Conditions.** Scenario Three begins with market conditions and fleet growth rates similar to Scenario Two; however, the carsharing operator shares the risk of losses with the transit operator. Since transit will ultimately benefit from increased ridership as a result of carsharing, a transit operator might reasonably assume some of the risks of starting up a carsharing service. In this scenario, the transit operator purchases and maintains the reserve vehicles, whereby reducing initial capital costs for the carsharing operator. Should carsharing prove profitable, the transit operator receives a share of revenues. Under this scenario, profitability is achieved in years two and three.

Scenario Three provides the best option for long-term viability because it is profitable even under sub-optimal market conditions. The CarLink Scenarios One, Two, and Three provide useful lessons for future carsharing programs:

Raise User Fees and Implement Short-Term Rentals: User fees are an important revenue stream. Based on the high costs of vehicle ownership ($500-$550 monthly) and the services provided by CarLink II (e.g., includes insurance, fuel, and cleaning), user fees could be raised to $400 for Homebased Users and to $1000 for business customers based on demand. A combination of flat fees and usage-based fees for short-duration rentals can ensure a predictable income stream and provide attractive user fees for short trip needs. Short-term weekend rentals can maximize use of idle vehicles and increase profits.

Reduce Insurance Costs Through Innovative Techniques: To curb costs, a number of measures can reduce insurance premiums. Driver screening can yield reduction in premiums given good driving records and age limitations. Certain passenger safety-technologies can earn insurance

discounts; high deductibles can reduce monthly premiums; and non-profit insurers provide reasonable rates to non-profit carsharing organizations.

Control Costs by Employing Standard Technology and Capitalize on Economies of Scale: To achieve meaningful results, CarLink II employed an advanced technological system that proved much more costly than that which would be required for a typical car-sharing organization. By employing off-the-shelf technologies, substantial savings can be realized. With the addition of new vehicles, economies of scale begin to materialize—all three scenarios support this assertion.

Use Most Cost-Effective and Proven Marketing Strategies: CarLink II focus groups and surveys yielded that certain marketing techniques were substantially more effective than others in recruiting participants. By targeting funds to these cost-effective strategies, commercial operators can reduce marketing costs.

Employ Public-Private Partnerships to Share Revenues and Risks: The revenue-risk sharing concept assumes that a carsharing service benefits third parties (e.g., transit operators in the case of a commuter carsharing program), and thus the third party might be willing to assume a share of the program risk in exchange for a share of program profits. In Scenario Three, the transit operator purchases and maintains the reserve vehicles, thus reducing initial capital costs for the carsharing operator, and receives a share of profits as an incentive. The scenario analysis (Scenario Three) indicates that the revenue-risk sharing could be feasible in practice.

CarLink II, which linked transit and employers with shared-use vehicles, could provide an economically viable demand-responsive mobility option under specific conditions, provided economic success factors gleaned from these experiences are incorporated into future carsharing models.

Appendix I: CarLink II Survey Instruments

Appendix II: CarLink II Diary

Appendix III: CarLink II Interim Program Interviews

Appendix IV: CarLink II Final Focus Groups Summary

CHAPTER ONE

U.S. SHARED-USE VEHICLE SURVEY FINDINGS: OPPORTUNITIES AND OBSTACLES FOR CARSHARING & STATION CAR GROWTH

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ABSTRACT

Shared-use vehicle services provide members access to a fleet of vehicles for use throughout the day, without the hassles and costs of individual auto ownership. From June 2001 to July 2002, the authors surveyed 17 U.S. shared-use vehicle service organizations on a range of topics, including organizational size, strategic partnerships, pricing strategies, insurance costs, and technology applications. While survey findings demonstrate a decline in the number of organizational starts in the last year, the rate of operational launches into new cities, membership, and fleet size continue to increase. Several growth-oriented organizations in the U.S. are responsible for the majority of this expansion. The authors explore several factors that challenge shared-use vehicle growth, such as high capital investment (or start-up costs), dramatic hikes in insurance rates, and scarcity of cost-effective technologies.

The authors conclude that while early niche market findings are encouraging, the ability of this emerging sector to actualize its total environmental, economic, and social goals may be limited without the collective support of private industry (e.g., automakers, insurance providers, technology producers), public agents (e.g., transit and governmental agencies), and shared-use vehicle programs. Indeed, public-private partnerships and cooperation among shared-use vehicle providers may play a key role in addressing insurance and technology costs and assuring the long-term viability of this market.

Key Words: Shared-Use Vehicles, Shared-Vehicle Organizations, Carsharing, Station Cars, Market Developments, Insurance, and Technology

SECTION 1.0 INTRODUCTION

Travel choices are often limited by lack of connectivity among travel modes, such as transit and highways. Shared-use vehicles (linked to key activity locations and transit) can help to expand the mobility options of individuals who use transit, walk, or cycle, but still require access to a personal vehicle for a trip segment. The principle of shared-use vehicles is simple: Individuals gain the benefits of private car use without the costs and responsibilities of ownership. Instead of owning one or more cars, a household or business accesses a fleet of shared-use vehicles on an as-needed basis. Members typically provide a deposit or monthly fee for access to a vehicle fleet distributed throughout a region or concentrated at a transit station, activity center, or worksite. Members also typically pay an hourly and per mileage fee that reflects their vehicle use. Insurance, maintenance, vehicle repair, and reservations are included in the fixed cost of the service (1, 2).

Many U.S. programs operate similarly to the majority of European carsharing organizations: Individuals access cars from nearby neighborhood lots and return them to the same lot (not typically linked to transit). This European approach, which started as a grassroots, cooperative effort in Switzerland, represents "classical" carsharing (1). In contrast, "station cars" are rooted in the U.S. and serve transit/rail commuters primarily, often using electric vehicles. Station cars typically provide a demand-responsive extension to fixed-route rail services and may not be shared by multiple individuals (1, 2, 3). Increasingly, the carsharing and station cars concepts are "merging" to include both elements: transit linkages that serve commuters and distributed lots for spontaneous users (4, 5). One can envision a shared-use vehicle continuum, ranging from carsharing to station cars, in which several new models fall in between these classifications. (For an in-depth discussion of this classification system, see (4).)

Common goals among shared-use vehicle organizations (as reported in the authors' 2001-2002 survey) include:

- Facilitating more efficient land use (e.g., shared-use vehicles reduce the number of parking spaces needed);
- Providing cost savings since customers pay per use, sharing vehicle leasing costs, maintenance, repair, and insurance;
- Increasing mobility options and connectivity among transportation modes; and
- Reducing pollution, if the vehicle links to an alternative travel mode—e.g., commuters using transit can augment their travel with a shared car—or the fleet consists of "clean fuel" vehicles.

This paper provides an overview of shared-use vehicle system growth and market developments from 1994 to present. From June 2001 to July 2002, the authors conducted a longitudinal survey of all 13 operational carsharing programs and 4 station car programs to monitor trends and developments. Operational organizations were surveyed through a combination of e-mail questionnaires and telephone interviews three times throughout the year. Researchers also updated data from each organization's website, if available, and from press releases and news articles. Researchers designed the initial questionnaire to collect baseline data on a range of issues—organizational size, business costs and financing, operational model, technology

applications, marketing methods, and unexpected costs. A database was created to monitor changes reported in subsequent surveys. The second questionnaire was implemented as a phone interview in March 2002 and focused on new developments and membership. During this phase, several organizations were added and ended, resulting in 17 total programs. The predominant reason for termination was insurance rate increases following 9/11. The final survey, conducted from June to July 2002, focused on membership and cost concerns, primarily insurance and technology. In addition, researchers interviewed insurance providers and technology companies to gain a better understanding of these issues and possible solutions. While a dozen planned shared-vehicle efforts were identified throughout this study, only six developed detailed business plans. Of these organizations, two were not available for comment, and four were surveyed as part of the final survey.

This paper includes two main sections. The first is an overview of market growth for shared-use vehicle programs since 1994, in which the authors discuss the emergence of more growth-oriented organizations, total membership, and vehicle trends. In the second section, the authors discuss several challenges facing organizations and explore opportunities to overcome them. Finally, the authors provide a summary of key observations and conclusions following this survey.

SECTION 1.1 U.S. MARKET DEVELOPMENTS OF SHARED-USE VEHICLE SERVICES

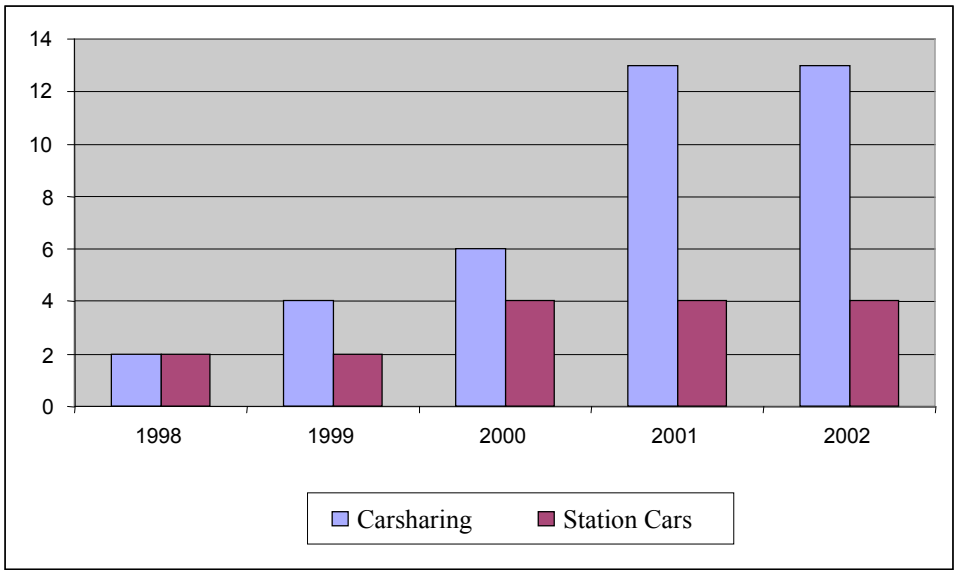
Shared-use vehicle services were largely popularized in Europe in the late-1980s. In its nascent stages, shared-vehicle organizations in the U.S. have sought European guidance. Prior to the 1980s, European carsharing was experimental and limited to small, localized organizations. Two influential carsharing organizations were formed in the late-1980s—StattAuto in Berlin and the Swiss program now called "Mobility CarSharing Switzerland." Mobility CarSharing Switzerland has continued to grow—now claiming over 50,000 members—while StattAuto's growth began to stagnate in the mid- to late-1990s (1). Switzerland's success has been credited to a more business-oriented approach, which has been emulated by many organizations. In North America, carsharing was first successfully established in Canada in 1994 by a cooperative, which later adopted a commercial model (CommunAuto). By 1998, four non-profit organizations had emerged in the U.S. In the mid-1990s, U.S. rail transit operators, seeking to relieve parking shortages at stations, also launched several electric station car programs (1). This section focuses on U.S. shared-vehicle program growth.

Since early U.S. developments, the number of shared-use vehicle organizations has grown to 17: 11 carsharing organizations; four station car programs (two are located in California; the others are in New York and New Jersey); and two research pilots (both in California). Approximately 11 U.S. carsharing deployments are planned. (See Figure 1.1 below.) As of July 2002, station car programs claimed approximately 148 members and 109 vehicles, while carsharing programs collectively claimed approximately 12,195 members and operated 471 vehicles. Not surprisingly, the majority of carsharing members (80 percent) live in the 25 most densely populated cities of the nation.

While survey findings demonstrate a decline in the number of organizational starts between June 2001 to July 2002 (see Figure 1.1 below), the rate of operational launches into new cities (i.e., existing organizations replicate and enter new regions), total membership, and fleet size (Figure 2 below) continue to increase. This indicates several possible trends:

1) An unmet demand for short-term vehicles that supplement existing transportation networks;
2) Emergence of more growth-oriented organizations that can quickly enter new cities; and
3) A change in market forces (e.g., initial fixed costs, such as vehicle leasing, and insurance have increased or start-up grant funding has declined or both).

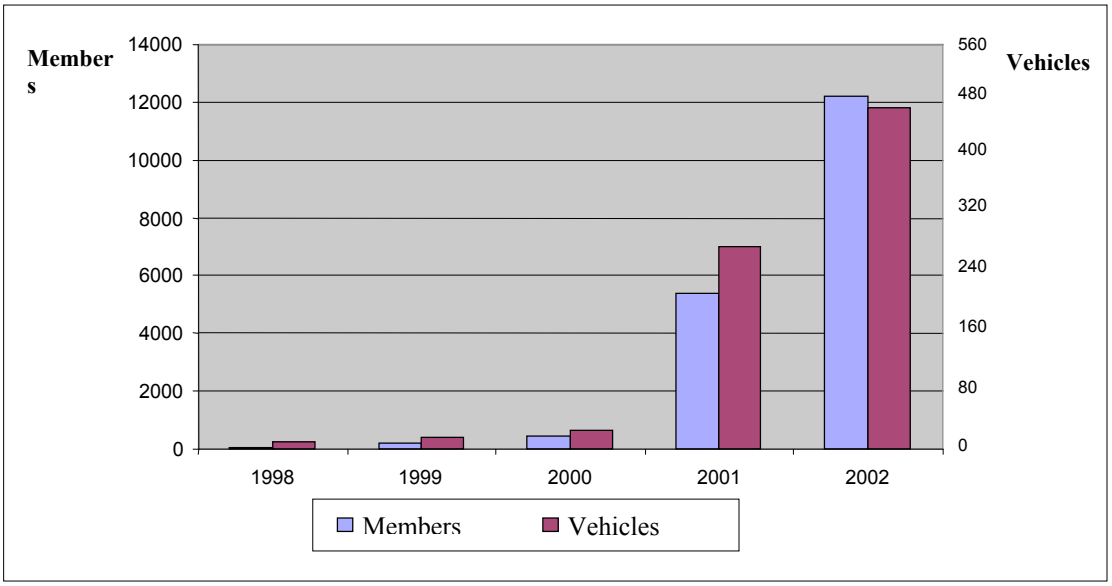
FIGURE 1.1: Growth in Station Car and Carsharing Organizations



As mentioned earlier, a few organizations serve the majority of U.S shared-vehicle program members in multiple regions. For instance, City CarShare, Flexcar, and Zipcar each operate in several cities. Collectively these organizations serve 92 percent of all U.S. members and deploy 78 percent of the vehicle fleet.

Almost exponential growth in U.S. shared-vehicle memberships further demonstrates that existing organizations are developing effective strategies to attract a growing membership base. For instance, carsharing membership grew by approximately 210 percentage points between 1998-1999; 97 percentage points between 1999-2000; 1,174 percentage points the following year; and 127 percentage points to date (between 2001 and July 2002). (See Figure 1.2.) High growth rates between 2000-2001 are due to two organizational launches characterized by large start-up funding, capital investments (i.e., advanced technologies), and rapid growth rates. Total carsharing fleet size reveals a similar trend (see Figure 1.2).

FIGURE 1.2: Growth in Carsharing Membership and Vehicles



Shared-use vehicle programs continue to grow. However, just a few are responsible for most of this expansion. Several growth-oriented organizations have emerged that are pioneering new market segments and diversified rate structures, partnerships with the public and private sectors, and advanced technology applications (6). However, such market developments may be hindered. The majority of survey respondents reported increased insurance costs and scarcity of cost-effective shared-vehicle technologies as their two greatest challenges. In the next section, the authors describe these obstacles and explore possible solutions.

SECTION 1.2 SHARED-USE VEHICLE MARKET GROWTH: OBSTACLES AND OPPORTUNITIES

The reduced number of organizational launches amidst continuing market, membership, and fleet expansion indicates that entry barriers likely exist and could be increasing. The high fixed costs of vehicle lease/purchase, technology development, and insurance also are significant deterrents to a new organization's market entry. Indeed, in a survey of planned organizations 75 percent of respondents (n=7) ranked insurance and smart technologies among their top three costs. While insurance was not listed as a major cost or concern in the 2001 survey, by July 2002 researchers found increased insurance costs a major challenge to expansion and sustainability for the vast majority of U.S. organizations. This section includes a discussion of two main challenges (and opportunities for addressing them): access to affordable insurance and technology.

1.2.1 Insurance Coverage: A Brief History, Current Issues, and Potential Solutions

Since late-2001, U.S. shared-vehicle services have found it more challenging to obtain affordable insurance coverage. The authors interviewed existing and planned organizations to assess the severity of sharp increases on business development. Since station car and shared-vehicle

research programs are more insulated from these difficulties—as their insurance policies are typically supported by agency relationships or partnerships with automakers and rental car companies—this investigation was primarily focused on U.S. carsharing.
Researchers conducted expert interviews with several brokers and underwriters with carsharing experience, as well as a literature review of insurance industry characteristics, underwriting methods, and basic definitions. This discussion focuses largely on the roles of brokers and underwriters. Underwriters determine insurance classifications and corresponding premium prices. Brokers act as intermediaries between shared-vehicle organizations and underwriters. All disclosed past and present carsharing insurers were contacted (n=4); another five were undisclosed and not contacted. Research was partially hindered by the complexities of the insurance industry (e.g., a diverse range of approaches) and confidentiality of insurer-client relationships. Based on these interviews, researchers identified several strategies that could lead to lower insurance rates and attract additional providers. This section includes a discussion of shared-vehicle insurance history, recent changes, and possible strategies.

1.2.1.1 Past Challenges to Recent Market Shifts

Early on, organizations experienced difficulty procuring shared-use vehicle insurance. Most firms were only willing to provide minimum insurance and required members to provide additional coverage—a scheme modeled after rental car insurance policies. Eventually, interest in carsharing by VPSI (a vanpool fleet provider) led to a contact at "Insurance One" (now called HRH of Metropolitan Washington), a brokerage primarily serving vanpool fleets (Dave Brook, unpublished data). Via HRH, many U.S. organizations have acquired coverage. In addition, several smaller organizations have obtained insurance through relationships with local providers, who—according to policyholders—do not have an interest in writing new policies for shared-vehicle services. Currently, there are approximately seven insurance companies actively carrying carsharing policies.

Between 1998 and 2001, insurance premiums were within a range of $1,200 to $2,100 per vehicle/year. However, rates increased dramatically in 2001 across the entire insurance industry, resulting in significant changes for the shared-vehicle market. For 2001, the insurance industry reported a negative 2.7 percent rate of return—the worst in the insurance sector's history. The following factors have each contributed to the insurance industry's tremendous losses: 1) September 11, 2001 terrorist attacks; 2) high catastrophe losses; 3) rising medical costs; 4) high litigation expenses; 5) the Enron debacle; 6) underpricing of insurance services during a soft market in the late-1990s; 7) economic recession; and 8) falling financial markets (7, 8).

Furthermore, several factors in particular contributed to rising automobile insurance costs. These factors include: 1) medical cost inflation; 2) higher jury awards in auto liability cases; 3) increased vehicle repair costs; and, 4) severe fraud problems in several states, such as New York, Florida, and Massachusetts. Furthermore, a recent Georgia Supreme Court decision mandated that insurance companies must compensate car owners for the diminished value of automobiles involved in accidents. This applies even if the vehicle is repaired and fully functional (9). In light of these market forces, insurance companies have become more conservative in selecting markets to insure. Insurers are less likely to take on newer, undefined risks. Of the nine U.S. shared-vehicle insurers, three have terminated coverage. Many insurers are simply unwilling to

insure carsharing at present. Indeed, one broker reported rejections by 250 companies in the last four years (Michael Boylen, unpublished data); another contacted nearly 20 insurance companies before terminating a recent search.

1.2.1.2 Current Status and Market Barriers

During 2001-2002, most shared-vehicle organizations reported a 50 percentage point increase and higher in renewal rates. One organization even terminated operations due to a 500-percentage point increase in premiums. As of July 2002, carsharing organizations reported premiums ranging between $1,200 and $6,000 per vehicle/year, reflecting a one million dollar liability limit and $500 to $1,000 deductibles. (Organizations on the lower end of this spectrum have unique arrangements that are not available to others.) The majority of organizations pay between $4,800 and $6,000 per vehicle/year; this accounts for 20 to 48 percent of an organization's total fixed costs. On the high end, carsharing organizations reported approximately 1.7 collision claims per 10 vehicles/year—resulting in $600 to $900/claim in costs. No liability claims have been reported to date. Costs are also reflected in total staff hours dedicated to obtaining affordable insurance coverage. A few organizations are committing up to 25 percent of high-level staff time to this problem.

At present, shared-vehicle services have not yet been assigned a risk class within the insurance industry. Classification is the process of assigning a proposed party to a group or class of "insureds," with approximately the same expected loss probabilities (10). To develop a premium for a new class of insureds, an underwriter relies on credible historical data to characterize risks across time and factors. Credible data require a large sample size over at least three years. Significant data are generated from 10 years of experience and several millions in premiums (Michael Boylen, unpublished data). When historical data do not exist, the underwriter can use expert judgment to aggregate similar risks and infer applicable ones for a new class (11).

There are several disadvantages associated with an unclassified insurance status. First, policies will vary widely among carriers, who interpret shared-vehicle risks differently, making it difficult for carsharing organizations to predict their premium costs (i.e., there is no standard). Second, in the current market, insurers are less likely to explore new markets, so shared-vehicle organizations have fewer options (and less consumer power due to decreased competition). Finally, premiums are raised to cover unknown risks and the expense of developing a new classification category.

1.2.1.3 Possible Strategies: Lowering Insurance Premiums for Shared-Use Vehicles

Based on the authors' examination, three strategies are recommended for addressing recent insurance hikes experienced throughout the shared-use industry during the past year. They include: 1) developing risk rating factors and actuarial tables for U.S. shared-vehicles, 2) applying advanced technology applications, 3) pursuing captive self-insurance strategy, and 4) investigating usage-based insurance approaches. Each is discussed below.

1.2.1.3.1 Risk-Rating Factors and Actuarial Tables Risk-rating factors provide a means for appropriating and measuring driver and vehicle risk. Thus, they are important to carsharing

providers in calculating risks and corresponding premiums. Actuarial tables summarize risk-rating factors and assign pricing structures for each. Determining accurate rating factors requires the expertise of an actuarial analyst, who applies vehicle and driver statistics in assessing risks. Developing a new class can be time consuming and costly for insurers.

As a first step in lowering premiums, risk-rating factors and actuarial tables must be developed to help carsharing organizations minimize and manage risk exposure. To accomplish this, the authors recommend:

1) Shared-vehicle organizations collaborate in helping underwriters establish standard risk-rating factors through documentation of accurate data on accident history, vehicle and driver profiles, fleet usage patterns, and preventive actions (e.g., theft prevention devices); and
2) Public assistance opportunities should be explored to establish carsharing risk-rating standards.

Based on the authors' review of the literature and interviews, the following rating factors emerged as the most significant in affecting shared-use vehicle premiums (See Table 1.1 below).

TABLE 1.1: Rating Factors for Shared-Use Vehicles

FACTOR	DESCRIPTION & RESEARCH FINDINGS
Unauthorized Drivers	This category was the most common concern among brokers and underwriters. Advanced technologies present a strategy for addressing this concern and minimizing risk exposure.
High Member/Vehicle Ratio	The insurance company takes on the risk of covering multiple drivers on one vehicle policy. Underwriters suggested that screening and continuous monitoring of drivers slightly lowers risk.
Geographical Location of Fleet/Vehicle	Underwriters perceive that shared-vehicle services are offered in metropolitan areas primarily, where risk exposure is generally higher. Underwriters were unclear regarding geographical driving restrictions. One broker recommended that shared-use vehicles be limited to a 50-mile radius of respective lots to reduce risks.
Fleet Scale	The "law of large numbers" means that the scale of the insured contributes to policy profitability, data credibility, and price competition among insurers. All insurers interviewed suggested that carsharing fleet scale and potential market growth are key factors in a decision to offer carsharing insurance. Approximations of ideal fleet size were not provided; however, analogies were drawn to large car rental companies, with fleets ranging between 148,000 and 486,138 vehicles (12).
Driving Records and Personal Driver Profiles	Underwriters were supportive of shared-vehicle efforts to screen drivers and did not want to be responsible for this duty.

Claims History	There was a difference in opinion among insurers regarding how much claims data are need to provide credible evidence for a risk-rating factor (e.g., between 3 and 10 years). Underwriters for a majority of carsharing organizations were unaware of any significant claims in 2001-2002.
Vehicle, Make, Model, and Age	All of these vehicle attributes influence premiums. Car rental risk rates are reduced when cars are between 1-2 years old, as opposed to 3-5 years, or older.
Usage Statistics	The assumption that carsharing vehicles are driven more than average vehicles contributes to higher premium prices. An underwriter for a U.S. carsharing insurance provider (as of July 2002) estimated that the average carsharing vehicle is driven approximately 18,000 miles/year. According to reports, the majority of vehicles are driven between 12,000 and 14,400 miles per year. In comparison, the average operator of a personal vehicle drives nearly 12,000 miles per year and pays $700 in total premiums per car/year (13). Accurate usage statistics would assist insurers in determining the appropriate premium.

At present, the small scale of the carsharing market deters insurers from investing time and resources into analyzing appropriate rating factors for a classification. Data should be aggregated across the carsharing industry to make the model as transparent as possible for insurers in developing risk-rating factors and actuarial tables. Automated vehicle tracking technology could also be used to accurately track and report actual vehicle usage for risk assessment.

1.2.1.3.2 Advanced Technologies A number of vehicle security technologies can also be targeted to lower insurance costs. First, premiums for bodily injury and medical insurance can be decreased by incorporating automated seatbelts into shared-use vehicles. Discounts can account for up to 25 percent of total medical liability premiums (14). Medical liability coverage accounts for up to 60 percent of total insurance premiums (UC PATH shared-use vehicle survey, unpublished data). Second, several anti-theft devices can earn discounts of up to 35 percent off comprehensive coverage, including vehicle immobilizers that prohibit unauthorized users, smart keys that facilitate vehicle access to specified keyholders, and vehicle tracking devices that increase stolen vehicle recovery rates. While anti-theft devices impose a one-time initial cost, they can provide increased security and insurance benefits over several years (14,15). Comprehensive coverage premiums constitute between 10 to 15 percent of total insurance costs in shared-use vehicle programs (UC PATH shared-use vehicle survey, unpublished data). Nevertheless, a cost-benefit analysis should be conducted before investing in anti-theft technologies. Since vehicle type and geographical location are the two major factors used to set comprehensive premiums, comprehensive insurance costs and the feasibility of anti-theft devices can differ based on these factors.

Finally, a vehicle tracking system also allows for automated vehicle usage information and can recognize misuses. Accordingly, insurers could receive automated vehicle-usage data for risk assessment and quoting purposes. Indirectly, vehicle tracking can also positively influence user treatment of vehicles. Despite these benefits, most insurers interviewed were unaware of vehicle

tracking benefits for carsharing and were unable to provide corresponding premium discounts. To summarize, advanced technologies provide another opportunity for shared-vehicle organizations to provide accurate risk-factor data to insurers, which could ultimately lower insurance rates.

1.2.1.3.3 Captive Self-Insurance Strategy Self-insurance is another strategy to reduce high carsharing insurance premiums. This strategy can be advantageous for many small-scale organizations that could not otherwise self-insure and offers an alternative to commercial policies. With self-insurance, the individual/organization assumes financial risk directly, instead of paying an insurance company to cover their risks (16). Another form of self-insurance is a high deductible. Recently, one shared-vehicle organization began insuring their fleet through a high deductible. In this case, the insurance company insures their liability only. The low comprehensive and collisions claims history of U.S. shared-vehicle programs also suggests that they may be good candidates for self-insurance.

Another strategy is to create a "captive" self-insurance pool. This approach would entail four steps. First, shared-vehicle organizations would agree to participate and identify a number of operational standards. Second, organizations would attract private or public (or both) investments to create a "risk retention pool" to cover risks (approximately $4 to $6 million/year, based on current national fleet size), proportional to their fleet size. (Investors would be compensated from the profit pool in a manner negotiated.) Third, an "association captive" (a non-insurer or insurer created/owned by the group to underwrite collective risks) would be established, who would administer claims, primarily those covered by premiums. Fourth, a "reinsurer" would be identified to cover costs from the risk retention pool fund. In exchange for this role, the reinsurer would receive a portion of premiums and residuals. Accordingly, risks would be spread among the pooled funds and reinsurer.

Based on estimates from the principal U.S. shared-vehicle broker and correspondence with underwriters, the following price structures seem reasonable under this scheme:

- Premiums of $2,500 per car/year. This figure is based on four years of experience in brokering for shared-vehicle organizations and inference to vanpools and other fleet applications.
- Approximately 42 percent of premiums collected in this model would cover the following expenses: specific claim losses, claim settlement costs, payments to agents or brokers, taxes, administrative costs, and initial acquisition expenses to establish the association captive.
- Expected losses per year of approximately $750.00/vehicle.
- Seven years is the anticipated timeframe before the premium surplus would sufficiently support the risk pool (and private investors are no longer needed) (Michael Boylen, unpublished data).

There are several potential benefits of the captive self-insurance approach. First, shared-use vehicle service providers would have more influence over their risk-rating structure. The formation of this shared-vehicle pool would facilitate collection of significant historical data after a period of three to ten years. Pooling would also leverage the scale of respective fleets, so

that underwriting is streamlined and more profitable for insurers, resulting in lower premiums. Furthermore, premiums could be lowered if organizations shared insurance overhead, agent commissions, and tax costs. Finally, investment income would be generated from premiums paid to insurance companies on reserves. Also, this approach could empower shared-vehicle providers in determining the nature of their own risk exposure and refining business models to minimize risk (Michael Boylen, unpublished data).

Overall, many organizations reported an interest in self-insurance. However, they expressed concern about generating a risk fund pool and maintaining a competitive edge, while cooperating. Furthermore, the formation of a captive self-insurance scheme would require some level of standardization in business practices. Clearly, such a scheme would benefit from the guidance of an advisory board comprised of shared-use vehicle practitioners and experts, insurers, and other public interest representatives.

1.2.1.3.4 Usage-Based Insurance Usage-based insurance is a concept piloted and copyrighted by Progressive Casualty Insurance Company in July 2000. (An agreement in January 2002 granted an U.K. auto insurer, Norwich Union, exclusive rights to offer usage-based insurance (Progressive Public Relations, unpublished data). This system bases auto insurance rates largely on when, where, and how much a vehicle is driven (17). While driving record, vehicle, and location are still taken into consideration in this model, the customer's rate varies largely due to mileage. Progressive's system, named "Autograph," employs a combination of Global Positioning Systems (GPS) and cellular technology to track vehicle usage. This concept is one that resonates well with the shared-use vehicle model: Carsharing typically aims to assess fees for variable vehicle use, and several large-scale operations have employed automatic vehicle tracking systems to monitor usage.

A number of obstacles hinder the implementation of usage-based insurance; some of these obstacles parallel those facing shared-vehicle organizations working to obtain affordable coverage. From the insurer's perspective, a shift to a new rating-structure is risky without a guaranteed large consumer demand. Also, this new rating system requires deployment of low cost in-vehicle technologies for monitoring usage. Additionally, there are numerous political sensitivities (e.g., privacy) associated with the use of on-board monitoring equipment and mileage as a principal risk-rating factor. If a viable business case is developed for usage-based insurance, the carsharing market should be considered for piloting and marketing this concept.

In the next section, the authors focus on another shared-vehicle challenge—advanced technology—and opportunities for lowering access and cost barriers.

1.2.2 Advanced Technology: Accessing Cost-Effective Systems

Since several U.S. shared-use vehicle organizations have experienced rapid growth in membership and fleet size, this creates a challenge to efficiently managing growth and more complex operations (6). Advanced technologies are key to decreasing administration costs. Interoperability, supported by some degree of standardization among technologies, can further improve customer services (e.g., use of smart cards among providers and transit). Existing technologies already provide solutions for some shared-use vehicle challenges. However,

technological systems tailored to the needs of shared-vehicle providers (e.g., data collection to support insurance approaches, such as usage-based fees) could further enhance overall market growth and operations.

Several organizations have taken an active approach in researching and developing new technologies. Each system has been developed independently, limiting opportunities for interoperability among systems, organizations, and transit services. Since development expenses can easily exceed the budget of a single organization, partnerships among shared-vehicle programs could leverage resources to attain necessary funding and attract technology manufacturers. In addition, technology providers could become potential stakeholders in the shared-use vehicle industry. This section explores challenges to accessing customized technologies, current applications and benefits, and cooperative strategies for enabling the development and distribution of tailored, cost-effective technologies.

1.2.2.1 The Challenges to Accessing Customized Technologies

The majority of shared-use vehicle providers surveyed—especially those with aggressive growth objectives—agreed that advanced technologies are a driving force behind successful operations. Organizations who did not recognize technology as essential typically had more limited growth objectives. The majority of shared-vehicle providers reported that advanced technologies could greatly enhance operations, serving larger and more diverse populations. For example, smart technologies can facilitate one-way rentals (i.e., members are not required to return their vehicles to the same location), increasing market penetration. Furthermore, several providers also noted the advantages of smart chip technologies in linking their services to other shared-vehicle operators and transit systems.

Throughout the survey, many respondents expressed a need for more affordable technologies and lacked sufficient scale to justify system acquisition. Not surprisingly, high technology development costs have deterred most U.S. organizations from developing systems, with just a few exceptions. Such developments have occurred independently through large start-up grants or university-sponsored pilot programs in conjunction with the private sector. Additionally, these efforts are continuously burdened to update their technology. In the next section, the authors describe current technology applications and realized benefits.

1.2.2.2 Current Technology Applications and Realized Benefits

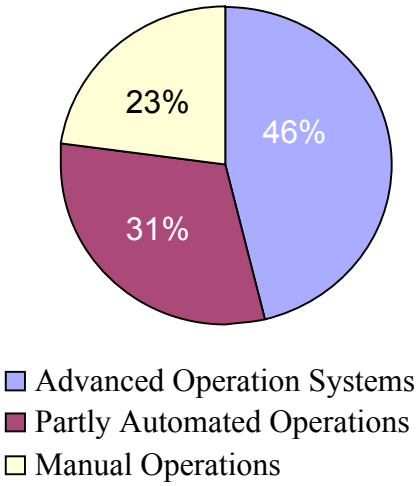
ITS technologies are currently used to improve three main areas of operation: 1) vehicles access (smart cards), 2) reservations, and 3) data collection. Smart cards and key fobs communicate user information to a centralized database that uses member IDs to track participant activities for billing and security purposes. Smart card technologies have the potential to streamline administration and fleet management and link to a variety of transportation services (e.g., carsharing, smart parking, and transit).

Automated reservations via online, voice recognition, or touch-tone telephone systems enable quick and convenient customer scheduling in addition to decreased labor and administration costs. Finally, automated vehicle location technologies are used to track shared-vehicle fleets

over a cellular communications or radio frequency network. Improved member tracking can be used for automated billing and increased security (e.g., vehicle immobilization), hence streamlining management and customer services.

Figure 1.3 (below) illustrates the distribution of carsharing providers employing ITS technologies, ranging from manual operations (e.g., operator phone services, in-vehicle trip logs), to partially automated (e.g., automated reservations via touch-tone telephone or Internet or both), to advanced operations (e.g., smart card access, reservations, billing, automated vehicle location, and cellular/radio frequency communications). As illustrated, 50 percent of U.S. organizations have advanced operations; 29 percent provide partially automated services; and 21 percent offer manual services. All four station car programs employ manual operations at present.

FIGURE 1.3: Technology Levels in U.S. Carsharing Organizations



Although existing technologies can address many challenges of shared-vehicle services, technological systems tailored to the needs of shared-use programs could further enhance market growth and operations (e.g., insurance data collection requirements). City CarShare, for example, is currently developing software that will be licensed at no cost to other non-profit organizations. This open source system will allow license-holders to modify and customize software to their specific needs. Similar to the Linux concept—a free computer operating system available to download and modify—this approach is based on the idea that collective input will accelerate innovations at a lower cost. Furthermore, start-up organizations have recently begun leasing customized technologies and services (e.g., billing) from larger organizations. Both strategies mentioned here support cooperation. In the final section, the authors explore benefits of a cooperative approach to technology development.

1.2.2.3 Cooperation: Leveraging Expertise and Scale to Develop Cost-Effective Technologies

Cooperation among shared-vehicle organizations could be an effective means to decrease technology development costs. There are essentially two possible approaches to furthering cost-

effective, technological advances in shared-use vehicle systems. First, large, business-oriented shared-use vehicle providers invest in researching new technologies and applications. When applicable and feasible technologies are developed, they can be marketed to other shared-vehicle organizations. Second, several shared-use vehicle organizations combine their research investments to implement and develop technology for industry-wide operations.

The first approach partly resembles the current state of the industry. Due to high technology development costs, however, sales to other operations only cover a small portion of initial expenses. As a result, a developed system must prove extremely viable for a particular organization. To date, development has been largely dependent on grant availability. Innovations, even if determined essential, are dependent on subsequent grants or unique opportunities (e.g., private sector investment). To evaluate the second cooperative approach, a more detailed analysis of customized technology systems is discussed below.

Customized technologies that address the specific needs of shared-vehicle programs can provide a powerful tool in improving customer services and streamlining administration. Comprehensive systems with on-board computers and vehicle tracking systems can process and transmit data on vehicle usage and location for administrative and security purposes. Simultaneously, these systems can offer customer-friendly features including phone access; directions and parking information (e.g., through GPS); reminders on low-fuel levels and rental-time limits; and customer-specific features, such as preferred radio station, seating adjustments, and mapping information. Furthermore, advanced on-board computers can be adapted to new customer demands by adding or changing software or hardware. This is crucial when vehicle services target new market segments and a more diverse customer base.

According to industry expert interviews, costs of a customized system, including on-board computers and tracking devices, can range between $500 (when several existing components are incorporated) to $4,000 per vehicle for state-of-the-art system, with highly specified software and hardware components and a high degree of upgrade flexibility. Installation typically does not exceed two labor hours. Due to costs and long development times (i.e., typically over six to twelve months), technology providers are unlikely to design customized systems for small fleets. When interviewed, technology developers reported that fleets of several hundred to one thousand vehicles would be economically viable from a manufacturer’s perspective.

As the combined fleet of U.S. shared-use vehicle operators currently totals 580 vehicles, cooperative efforts would appear beneficial in attracting the technology sector. Large-scale partnerships among shared-vehicle providers could lead to necessary funding and fleet size to attract technology manufacturers. This would also encourage continuous development efforts due to larger, more sustainable industry relationships.

Finally, technology partnerships could lead to a greater degree of technology standardization and facilitate interoperability among different shared-use vehicle organizations. Improved interoperability can enhance customer service. For example, four carsharing organizations located in four different cities in Ontario agreed that the members of a particular organization should have the option to conveniently access the services of another when traveling. To facilitate this partnership, the four organizations share the same insurance carrier, which helped

them overcome challenges related to insurance coverage. To summarize, this agreement positively affected the market since overall carsharing vehicle use and customer satisfaction increased.

SECTION 1.3 CONCLUSION

Despite promising U.S. shared-use vehicle operational and membership growth rates, the relative small scale of these organizations presents a challenge to: 1) obtaining affordable insurance and, 2) covering other high capital costs, including technology, vehicles, and labor. While advanced shared-vehicle technologies can help organizations to reduce administrative costs and potentially lower insurance premiums, technology deployment has typically required large private investments or public development grants.

Strategic cooperation among shared-use vehicle organizations could address these challenges on several levels. First, limited cooperation could help organizations collectively address some insurance issues (e.g., development of risk-rating factors). Furthermore, more involved cooperative efforts could support aggressive strategies, such as captive self-insurance. Second, cooperation among shared-use vehicle organizations could also accelerate the development of interoperable, customized technologies and continued innovation by creating the scale necessary to attract technology providers. Additionally, a combined insurance-technology cooperative strategy may be even more beneficial—lowering insurance premiums, enhancing customer services and capabilities, and lowering capital costs.

Third, cooperation could also manifest highly desirable social and environmental benefits. The potential of new and existing shared-use vehicle service organizations to continue expanding and serving new markets could be greatly enhanced through supportive public-private partnerships. Policymakers and transit operators, for instance, should continue to explore the social and environmental benefits of shared-use vehicle services through grant making, preferential parking, supportive policies (e.g., high occupancy vehicle (HOV) lane access), and outreach/marketing. Strong public-private partnerships are needed to facilitate the on-going development and sustainability of viable U.S. shared-use vehicle programs. Thus, it will be important for the public and private sectors to continue working together to monitor system designs and impacts and to facilitate and encourage collective partnerships among shared-use vehicle organizations particularly where tremendous synergies could be realized, such as insurance policies and customized technologies.

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CHAPTER TWO

A FRAMEWORK FOR TESTING INNOVATIVE TRANSPORTATION SOLUTIONS: A CASE STUDY OF CARLINK—A COMMUTER CARSHARING PROGRAM

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ABSTRACT

Transit accounts for just two percent of total travel in the U.S. One reason for low ridership is limited access; many individuals either live or work too far from a transit station. In developing transit connectivity solutions, researchers often employ a range of study instruments, such as stated-preference surveys, focus groups, and pilot programs. To better understand response to one innovative transit solution, the authors employed a number of research tools, including: a longitudinal survey, field test, and pilot program. The innovation examined was a commuter carsharing model, called CarLink, which linked short-term rental vehicles to transit and employment centers. Over several years, researchers explored user response to the CarLink concept, a field operational test (CarLink I), a pilot program (CarLink II), and a commercial operation (the pilot was turned over to Flexcar in summer 2002). This multi-staged approach provided an opportunity for researchers to learn and adapt as each phase progressed. In this paper, the authors outline the CarLink model, technology, and early lessons learned; describe CarLink II operational understanding; provide a synopsis of the pilot program transition; and offer recommendations for future model development.

Key Words: Carsharing, CarLink, User Response, Operations, Survey, Field Test, Pilot Program, Sustainability

SECTION 2.0 INTRODUCTION

Although public transportation use is growing in the United States, it still accounts for only two percent of total travel (1). In the San Francisco Bay Area, where there is an extensive public transportation network, transit use is higher: twelve percent of commuters used public transportation in 2002 (1). Congestion on freeways and surface streets, coupled with continuing air pollution, requires the examination of more demand-responsive alternatives. According to a nationwide report conducted in 2000, the San Francisco Bay Area averaged 92 hours of delay per person per year during peak commute hours (2). Not surprisingly, transit access is a major impediment to use; transit capacity often exceeds the number of people, living or working, within walking distance—one quarter mile or less—of a station. If existing access methods are augmented (ranging from traditional fixed route transit to more demand-responsive solutions), more individuals could use transit. Increased transit access would assist in reducing congestion during peak travel periods, while also improving overall system efficiency.

Designing innovative solutions that increase transit access and ridership is challenging. This is especially true in the context of altering long-term travel behaviors, particularly single occupancy vehicle use. Furthermore, individuals are reluctant to try unfamiliar ideas, new technologies, or both. Understanding how to change long-held travel patterns is one of the greatest challenges faced by transportation professionals.

There are many complex issues associated with testing and implementing transportation innovations. Significant data about an innovation's impacts are typically needed to justify large-scale deployment costs. There are several methods for gathering these data, such as simulation modeling, stated-preference surveys, and controlled testing. As confirmed by CarLink I, much can be learned from testing a transportation innovation in a real-world setting (3). Field tests and pilot programs provide a framework for investigating complex relationships among system efficiency, user acceptance/impacts, economic viability, and other operational issues.

Usually, field tests operate for a predetermined length of time to evaluate a new concept/ technology. In contrast, pilot programs can extend beyond this initial "proof-of-concept" phase by focusing on program sustainability. Whether instituting a new concept, technology, or regulatory framework, pilot programs can be beneficial to decision makers and participants. Pilots enable new ideas to be tested, modified, and assessed with limited financial risk and no ongoing obligation. At the same time, they can support program continuation and offer a cost-effective alternative to exploring transportation innovations.

From July 1, 2001 to June 30, 2002, a carsharing pilot program, emphasizing transit and employer access—CarLink II—was deployed in the San Francisco Bay Area. Pilot objectives included testing an advanced carsharing system, understanding user response to this service, and testing its long-term sustainability. This paper examines the CarLink technology, participant response, and lessons learned from this multi-stage initiative. The authors first review the CarLink model, technologies, and early lessons learned. Second, CarLink II operational findings are examined. Third, a synopsis of the pilot program transition to a permanent service is discussed. Finally, the authors conclude with opportunities for improving carsharing deployment initiatives based on these findings.

SECTION 2.1 CARLINK PROGRAM AND RESEARCH OVERVIEW

Between 1998 and 2003, researchers deployed a three-phase carsharing research program in the San Francisco Bay Area, CarLink, in conjunction with the California Department of Transportation (Caltrans), American Honda Motor Company, the Bay Area Rapid Transit (BART) District, Caltrain, and Lawrence Livermore National Laboratory. During the first phase, researchers conducted a longitudinal survey that examined CarLink concept response (for more information, see (4)). During the second phase, researchers assessed CarLink I—a demonstration that examined user response and operations in a controlled setting. CarLink I was based at the Dublin-Pleasanton BART station and operated for ten months during 1999 (3). In the final phase, researchers examined the CarLink II pilot program, which ran from July 1, 2001 through June 30, 2002, and was based at the California Avenue Caltrain station in Palo Alto. The research goals of this pilot project included testing advanced carsharing technologies, overall user response, and economic sustainability.

Broadly defined, carsharing allows a group of individuals to share a vehicle fleet, paying for use based on time and miles traveled (e.g., City CarShare, Flexcar, and Zipcar). The most common model is known as neighborhood carsharing, where a few vehicles are deployed in each of several neighborhoods for easy member access. These vehicles are accessed from and returned to the same lot. CarLink tested a commuter carsharing model that provided vehicle access at home and work, as well as a transit linkage on either end of a commute. This section includes a brief overview of the CarLink model, differences between CarLink I and II, and program pricing.

2.1.1 CarLink Model: A Brief Overview

Both CarLink I and II were based on the same commuter carsharing structure, involving three sets of members: Homebased Users, Workbased Commuters, and Workbased Day Users (described below). Both CarLink programs included a single, primary transit station that served as a vehicle transfer point for Workbased Commuters and Homebased Users who commuted via transit. CarLink provided a convenient transit linkage to and from home/work via a shared-use vehicle fleet. This same fleet was also shared by households and employers for tripmaking on evenings and weekends and throughout the workday.

During CarLink I, Homebased Users would drive their CarLink vehicles to a selected transit station each morning, park the car in a designated CarLink space, and ride transit to work. Next, a Workbased Commuter would arrive at the same station via train in the morning, pick up a CarLink car, and drive it to work, parking in a designated CarLink space at their work location. Throughout the day, Workbased Day Users could reserve CarLink vehicles for business and personal errands, returning the cars to a designated work lot after each trip. At the end of the workday, Workbased Commuters drove the CarLink vehicles back to the transit station and would take the train for the remainder of their trip home. After Homebased Users—riding the train for the majority of their commute home— returned to the transit station, they would pick up a CarLink vehicle and drive it home for personal use on evenings and weekends.

As mentioned above, the CarLink II pilot program is based on the same general model as CarLink I. However, lessons gleaned from user feedback and recommendations from the

CarLink I staff and project partners (i.e., Honda, Caltrans, BART District, and LLNL) suggested several changes to improve the model and research focus. Overall, it was decided that more could be learned by adapting the model to a new setting and attempting to create a permanent enterprise. This section describes the CarLink II project components and how they differ from CarLink I. Table 2.1, below, summarizes the major differences between CarLink I and II.

TABLE 2.1: Differences Between CarLink I and II

STUDY CHARACTERISTICS	CARLINK I	CARLINK II
Number of Vehicles	12 Vehicles	19 Vehicles
Primary Transit Partner	BART	Caltrain
Transit Station Location	Dublin/Pleasanton	Palo Alto
Vehicle Type	Compressed natural gas Honda Civics	Ultra-low emission Honda Civics
Homebased Users	Up to 10 households, pay $200 per month.	Up to 16 households, pay $300 per month.
Workbased Commuters	Up to 20 LLNL employees pay $60 per carpool ($30 each).	Up to 63 employees of businesses at Stanford Research Park (primarily), share CarLink vehicles to carpool to/from work. Businesses pay $350 per month per vehicle (a combined fee) for Workbased Commuter and Day Use services (in contrast to employees paying for this service independently as in CarLink I).
Workbased Day Users	Employees of LLNL pay $1.50 per hour and $.10 per mile.	Up to 28 employees of Stanford Research Park companies and other nearby businesses have access to vehicles for business and personal use. Employers pay $350 per vehicle per month to subscribe to the combined Workbased Commuter and Day Use services.
Total Users	54	107
Employer	One: LLNL	Six: Several private companies at/nearby Stanford Research Park
Technology	In-vehicle tracking, smart key kiosk at transit station, smart cards, manual key boxes at LLNL, and on-line scheduling system at LLNL	In-vehicle tracking, automated data collection, smart key fob (or smartcard) entry, PIN-based vehicle login, on-line reservations, and in-vehicle navigation system

Program Length	Field test designed for limited 10-month duration	Pilot program with planned transition to on-going carsharing service
Research Goals	Document demand for commuter carsharing service and gauge user satisfaction and needs	Continued analysis of commuter carsharing (in a new setting) with greater statistical confidence (i.e., a greater sample size) and new emphasis on technology testing, its impact on cost reduction, and longer-term program sustainability

2.1.2 CarLink Economics

Both CarLink I and II required members (or their employers) to pay for vehicle use. Lessons learned from carsharing programs in Japan informed this design decision. There, the program lost participants when fees were implemented for services initially provided for free (5). Thus, CarLink service fees were required to test the economic value of the service. For members, fees covered all operational and vehicle maintenance costs, including fuel and insurance.

The fee structure was determined by a literature review, willingness-to-pay studies through focus groups, discussions with employers, and by estimating operational costs. The fee structure was below "market value" for both the demonstration and the pilot program as this was a new concept and users contributed to the research process. Participants provided feedback on the program and technology, including completing surveys and participating in focus groups and personal interviews.

CarLink I and II consisted of three user groups: Homebased Users, Workbased Commuters, and Day Users. Homebased members paid a monthly fee for car use to commute to and from the station and on evenings and weekends. CarLink I Homebased Users paid $200/month; CarLink II Homebased Users paid $300/month. The payment structure for CarLink I and II differed for the Workbased Commuter and Day Use portions of the model. In CarLink I, employees paid a flat Workbased Commuter fee ($60/month/car), as well as usage fees ($1.50/hour and $0.10/mile) for their personal CarLink vehicle use during the workday. Employers paid for work-related trips. As part of CarLink II, the model was adapted slightly. Under the new structure, employers paid a flat fee of $350/month per car, which covered both the Workbased Commuter and Day Use components. Employers joined CarLink II to provide the carsharing service as an employee benefit. Potential benefits include: 1) promoting employee retention, 2) reducing office parking demand, 3) encouraging transit use, and 4) substituting costly fleet vehicle program operations with CarLink in some cases. Each business had specific, and different, reasons for joining CarLink II.

SECTION 2.2 EARLY LESSONS LEARNED

The CarLink longitudinal survey and CarLink I field test were designed to test the commuter carsharing concept. Proof of concept was the primary goal of CarLink I. Implemented as a demonstration, CarLink I ceased operations at the close of the research project in late 1999. In contrast, CarLink II was a pilot program designed to test integrated carsharing technology and long-term sustainability. Pilots allow for a more realistic evaluation of user response, since members understand that the program may become permanent. For instance, a member might sell a car if she believes the program will continue. This section provides an overview of CarLink longitudinal survey findings and CarLink I field test results, which informed the design of CarLink II.

2.2.1 CarLink Longitudinal Survey

From June to October 1998, researchers collected response data on the CarLink concept from 302 individuals (representing 212 households) in the Bay Area. These attitudinal and belief data measured change in response, which helped to explain the innovation adoption process. The survey consisted of a baseline (or initial survey) and three identical questionnaires that followed each of the informational media developed to explain the CarLink concept: an informational brochure; video; and an interactive trial drive clinic with compressed natural gas (CNG) Honda Civics, smartcards, and a smart carsharing key management kiosk. An experimental group and a control group were recruited for the study to evaluate informational media impacts on CarLink response. Communication objectives emphasized the disadvantages of current modes, the advantages and disadvantages of carsharing, and how the CarLink system works.

Participating households, for both the longitudinal survey and the CarLink I field test, included four groups: 1) current BART commuters, 2) individuals who might use BART when carsharing becomes available, 3) people who do not usually take transit but could take it to work, and 4) individuals who live in neighborhoods with substantial BART ridership. These groups represented potential CarLink participants.

The final sample population consisted of 207 experimental participants (154 households) and 95 control group participants (58 households). A total of 488 individuals (i.e., both experimental and control) received the initial questionnaire. Throughout this study, there were 186 dropouts (58 did not return the first questionnaire, and 128 individuals dropped out after returning the second questionnaire). After the survey was completed, four focus groups were held with study participants in October 1998, to further gauge participant perceptions and overall response to the CarLink concept. The focus groups consisted of three experimental groups with a total of 28 participants and one control group session with nine participants.

Researchers found that CarLink response was influenced by the amount and type of exposure to the concept, as predicted by social marketing and learning theories (for more information on these theories, see (4)). Specifically, participants who only read the CarLink brochure lost interest over time (interest dropped from 45 percent at the time of the initial questionnaire to 33 percent during the final questionnaire), while nearly 78 percent of those who read the brochure, watched the CarLink video, and participated in the drive clinic reported that they would use

CarLink as part of the final questionnaire. In fact, many indicated that they would be interested in joining the CarLink I field test (i.e., 54 percent of the experimental group in contrast to 33 percent of the control) in the final questionnaire.

At the drive clinic, held in September 1998, participants used a smartcard to access a CarLink vehicle and released the immobilizer, which blocked unauthorized users from starting the car, and took a test drive, accompanied by a researcher who documented their observations, questions, and concerns. The drive clinic offered participants a chance to see and try new technologies, as well as to interact with study researchers. Each participant completed a 20-minute exit interview with a researcher on his or her response to the CarLink system and willingness to participate in such a service.

During the exit interview, over 90 percent of participants said "Yes." As a result of the clinic, there was a 21 percent increase in the "Yes" response category. Since control group respondents did not participate in the clinic, there are no corresponding data for them. Thus, it appears that the drive clinic was an effective tool for increasing positive awareness of the CarLink concept. Nevertheless, this response appears to be overstated (i.e., the social desirability effect or tendency of participants to overstate a socially desirable position, especially in the presence of researchers), as there was a 13 percent decrease (from the exit interview) in the experimental group's response during the final questionnaire.

The CarLink program built on the longitudinal survey in three ways. First, researchers included 32 longitudinal survey participants in the CarLink I field test (i.e., 15 percent of the experimental population). Second, understanding about the value of multiple informational media was integrated into CarLink recruitment strategies. Finally, a trial offer was added to the CarLink II program (i.e., an opportunity to try CarLink for a limited period of time prior to subscribing) based on the success of the drive clinic.

2.2.2 CarLink I

The CarLink I field test provided an exploratory test bed for this carsharing model. During the field test, many lessons were learned and success factors identified (3). Shortly after the CarLink longitudinal survey was completed, researchers contacted individuals who indicated that they would be interested in CarLink I field test participation. Individuals were able to enroll in CarLink I, if they had a match with one or more of the following field test requirements, including:

1) Homebased Use, those who could use the Dublin-Pleasanton BART Station to commute to work;
2) Workbased Commuter Use, individuals who work at Lawrence Livermore National Laboratory (LLNL) and could commute via BART; and
3) Day Use, those who work at LLNL.

Researchers were unable to enroll individuals that did not match one of these user groups. Given the restrictive participation requirements, a majority of interested participants did not meet the criteria for program participation. Interestingly, no one from the control group joined the field

test. Thirty-two individuals or 28 percent of experimental respondents, who requested to be contacted about field test participation, became members (or 15 percent of the total experimental population). These individuals (i.e., from the longitudinal survey) represent 60 percent of the field test population. Twenty additional individuals joined the field test (i.e., not from the longitudinal survey), primarily in the Homebased User and Workbased Commuter categories. The field test was deployed in the Dublin-Pleasanton region from January to November 1999. As part of the CarLink I evaluation, several participant feedback tools were employed, including questionnaires, household interviews, and focus groups. A high percentage of users agreed to participate in the study (i.e., 73 percent response rate). This program enrolled 54 participants throughout the 10-month field test with 38 active participants. Active participants drove the vehicles frequently, whereas inactive members did not use the CarLink vehicles (even though they enrolled in the program). The participant pool was limited due to the short project duration, program startup delays, and limited CNG infrastructure (3).

The CarLink II pilot program built upon six key operational lessons learned from CarLink I:

1) Streamlining Technology: Several technology shortcomings (i.e., key management and vehicle tracking systems) contributed to delays and necessitated program modification. Technology should be integrated and customized to facilitate carsharing use. A stand-alone "smartcard" approach should be developed and tested in which fixed key box lots are not needed. In this way, participants could access vehicles with smartcards alone.
2) Limited CNG Infrastructure: During CarLink I, two CNG issues constrained operations: a limited number of CNG refueling sites and slow CNG refueling pumps at LLNL. The CNG component of CarLink I restricted vehicle range and participation. Also, users did not refuel vehicles as frequently as agreed. Use of CNG vehicles in the CarLink I field test distracted from the shared-use vehicle evaluation. In the future, this model should be tested with internal combustion engine (ICE) vehicles and fuel cards.
3) Guaranteed Parking: Guaranteed parking at the Dublin-Pleasanton BART station was a huge program incentive, as parking at this station filled up prior to 7AM at the time of the program. In the future, carsharing programs should be sited in locations where parking is costly and limited.
4) Vehicle Cleanliness: During CarLink I, operations staff and participants cleaned and washed cars. Nevertheless, vehicle cleanliness continued to be a chronic program issue. Consider hiring a third party to clean vehicles more frequently.
5) Employer Participation: Day Use participation in CarLink I was limited. In the future, test an employer-focused carsharing service with multiple companies located in a congested corridor with transit access and parking constraints.
6) Program Duration: CarLink I was a limited demonstration project (i.e., 10 months), which restricted understanding of user adoption and behavior because of its short timeframe. In the future, deploy CarLink as a pilot program with the potential to transition to an ongoing operation after the research phase ends.

SECTION 2.3 CARLINK II USER & OPERATIONAL UNDERSTANDING

During the CarLink I field test, the primary goal was narrowly defined—to study user response to the commuter carsharing concept. In CarLink II, the research goals were broadened to evaluate long-term program sustainability and to test an integrated smart carsharing system. The California Avenue Caltrain station in Palo Alto was selected as the CarLink II transit hub after evaluating a number of potential locations in the San Francisco Bay Area. The criteria for site selection were: 1) located near a congested corridor, 2) significant number of commuters traveling to and from the station, 3) concentration of employers near transit station (i.e., within five to ten miles of station), 4) supportive transit operator, 5) limited bus or shuttle services, 6) transit parking at capacity, and 7) local governmental project support.

All sites evaluated for CarLink II had freeway congestion in both directions and commuters traveling to and from the transit hub. Other locations evaluated included Santa Clara/San Mateo Counties, San Jose, and the Dublin/Pleasanton area (location of CarLink I). Based on the above criteria Palo Alto was selected as the preferred location.

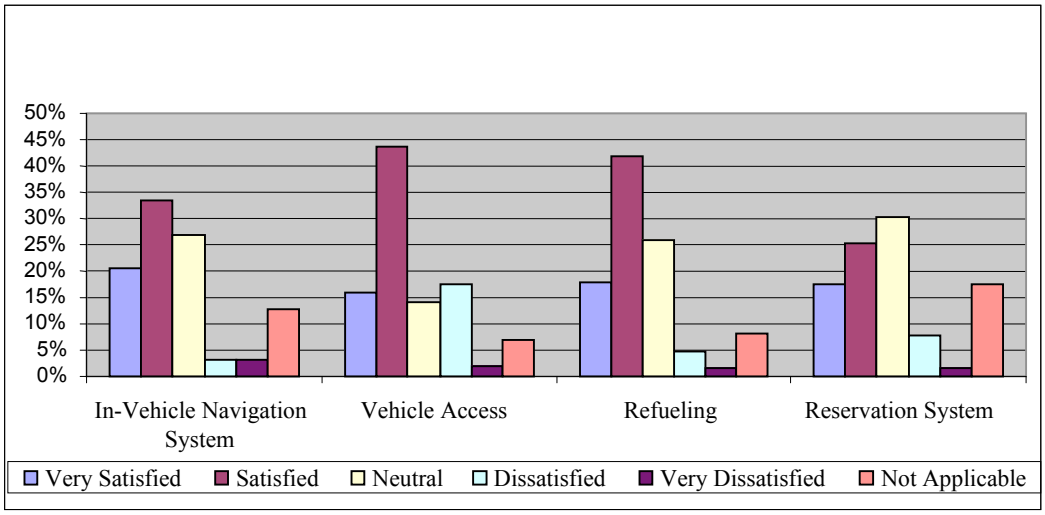
The following section includes an overview of CarLink II user satisfaction and operational lessons learned.

2.3.1 CarLink II User Satisfaction

A total of 107 individuals participated in the CarLink II program: 16 Homebased Users, 28 Day Users, and 63 Workbased Commuters/Day Users. Fifty-three percent of participants were female and 47 percent male. Sixty-four respondents completed the final questionnaire (a response rate of 60 percent). Respondents included nine Homebased users (five male, four female), 21 Day Users (9 male, 12 female), and 34 Workbased Commuters (14 male, 20 female).

Technology was a major aspect of CarLink II operations since it facilitated user convenience, management tools, and program expansion. The CarLink II technology included: an in-vehicle navigation system for trip routing, refueling cards for maximum flexibility, and a reservation system for Day Use. Figure 1, below, provides user satisfaction data on four key program areas: 1) in-vehicle navigation, 2) vehicle access, 3) refueling, and 4) reservations.

FIGURE 2.1: Satisfaction with CarLink II Features



2.3.1.1 In-Vehicle Navigation System

The in-vehicle navigation system allowed users to route their trips and receive visual and voice instruction. This was not a program requirement, but an additional feature that provided convenience for some trips. Many users did not use it regularly, since their trips from the train to home or work were identical each day. While 13 percent never used the system, over 50 percent of respondents reported that the system was very satisfying or satisfying to use. It is interesting to note that system use increased during the second half of the pilot program, particularly among Homebased Users.

2.3.1.2 Vehicle Access

Vehicle access is defined as unlocking the car with a key fob and logging into the CarLink II computerized system with a personal identification number (PIN), which released the ignition immobilizer and attributed trip activity to the user's ID number. Ninety-two percent of users were satisfied with vehicle access at the program's mid point. By the program's end, only 60 percent were satisfied or very satisfied, and nearly 20 percent were dissatisfied with the system. Homebased Users were the most frustrated by the length of time (three seconds) the fob took to unlock the vehicle, and they felt that the location of the smart key reader (rear windshield) was inconvenient if holding a child, groceries, etc.

2.3.1.3 Refueling

CarLink II vehicles each included a fuel card and a PIN associated with each user. This system allowed individuals to refuel the cars at their convenience at local stations. Members were required to refuel a vehicle if the fuel level fell below 1/4 tank or a $10 fine was imposed. At the end of the program, 60 percent of respondents reported that they were very satisfied or satisfied with refueling, and only seven percent were dissatisfied or very dissatisfied. Throughout the

program, participants indicated that the vehicles were sufficiently fueled, although this was not always the case. Homebased Users tended to fuel more frequently since they used the cars more often and for longer trips. Users also indicated that incentives for individuals who frequently refueled the vehicles (e.g., coupons for free coffee, videos, etc.) would have provided more motivation for refueling consistently.

2.3.1.4 Reservation System

The reservation system allowed Day Users to reserve vehicles from any computer from fifteen minutes to one month in advance of appointments. Typically, each employer set aside one vehicle that could not be reserved in advance to provide a system buffer. Since the reservation and access systems did not provide a "lockout" component (i.e., preventing one member from taking a vehicle reserved by another), members were entirely on an "honor system."

At the end of the program, 44 percent of the respondents were satisfied, and only eight percent were dissatisfied with the reservation system. However, during interim program interviews, 28 percent were dissatisfied with the system. This change likely reflects satisfaction with reservation system improvements made during the remainder of the program.

The primary reason for reservation system dissatisfaction was the lack of a lockout system—guaranteeing that a reserved vehicle would be waiting for the individual that requested it. Vehicle lockout was identified as an area for next generation technology development, as it was not addressed during the CarLink II pilot program due to cost and time constraints.

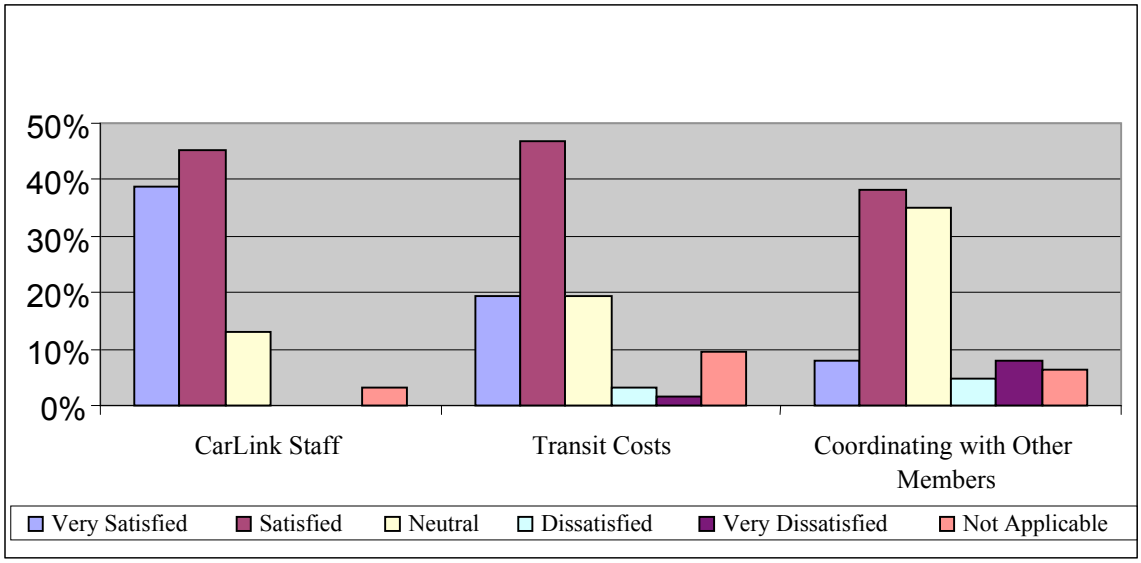
Other reservation system concerns involved the overall reservation process and website format, including:

- Scrolling on the web page was difficult;
- There were too many steps involved in making a reservation;
- All cars should be available to reserve in advance (i.e., not requiring that one of a company's CarLink II fleet vehicles be kept in reserve);
- The reservation page's clock was not always accurate; and
- There was no way to inform the reservation system directly (e.g., automated phone interface) that a Day Use trip was running longer than expected. Instead users had to ask CarLink II staff to check the reservation's page and notify the next scheduled user.

Despite reservation difficulties, many participants who were vocal about reservation concerns, seldom if ever, experienced a problem. However, the perception that a reserved vehicle might not be available became so dominant that many saw this as their most critical CarLink II concern.

In addition to technology, CarLink II staff, transit costs, and member coordination were important elements to gauge user satisfaction. Figure 2.2, below, provides a summary of final questionnaire response to various program features.

FIGURE 2.2: Satisfaction with other CarLink II Features



2.3.1.5 CarLink Staff

A substantial amount of staff time was dedicated to responding to member issues. Thirty-nine percent of respondents to the final questionnaire were very satisfied, and 45 percent were satisfied with the CarLink II staff. No respondents were dissatisfied or very dissatisfied. During the interim program interviews, participants also expressed satisfaction with CarLink II staff; 68 percent of those responding were very satisfied with CarLink II operations personnel. Members reported that CarLink II staff responded very quickly when problems arose and kept them well informed of relevant issues.

2.3.1.6 Transit Costs

Transit costs (primarily Caltrain) varied for individual members. All CarLink II member companies contributed to the transit fares of their employees. As part of the final questionnaire, 19 percent of respondents were very satisfied, 47 percent were satisfied, and only five percent were dissatisfied with their transit costs. Ten percent of respondents answered not applicable, since many Day Users carpooled, vanpooled, bicycled, or walked to work.

2.3.1.7 Member Coordination

CarLink II required all members to coordinate with each other to ensure that vehicles reached designated locations at required times (e.g., Caltrain during AM and PM commute peaks). In addition, Workbased Commuters carpooled from the train station to their employment location, and back again. Initially, a significant amount of time went into schedule coordination by CarLink II staff. Approximately eight percent of respondents were very satisfied, and 38 percent were satisfied with this process. Thirty-five percent were neutral, indicating that the majority of participants adjusted easily to schedule coordination. It is important to note that scheduling

flexibility was accommodated with additional (or unassigned) vehicles in the CarLink II fleet. To reduce costs after the transition to Flexcar—the private third party operator—the number of reserve vehicles was reduced.

2.3.2 Lessons Learned from CarLink II Operations

Similar to CarLink I, numerous lessons were gleaned from CarLink II operations. Issues ranging from parking to participant recruitment and retention are described below.

2.3.2.1 Parking Impacts

Since CarLink II was a pilot program, strong emphasis was placed on business membership (i.e., Workbased Commuter and Day Use participation), which could continue beyond the pilot phase. The Stanford Research Park (consisting of 150 companies, located between one and five miles from the California Avenue Caltrain station) viewed the carsharing service as an employee benefit. Building on a principal CarLink I success factor, locations with limited parking were emphasized during the CarLink II site selection process in early 2000. At this time, the parking lot at the California Avenue Caltrain station was close to 90 percent capacity. However, due to the subsequent economic downturn, lot utilization decreased to less than 60 percent by the end of CarLink II (July 2002). This change in parking impacted program recruitment, as guaranteed parking is a substantial incentive to carsharing use, particularly when parking is oversubscribed. Thus, various economic forces can have a notable impact on carsharing program adoption and appeal, particularly in a commuter carsharing program emphasizing transit connectivity. With job loss and less congested roads, there was less demand for transit and carsharing in Palo Alto.

2.3.2.2 Economic Impacts

As mentioned above, CarLink II site selection was conducted in summer 2000. At that time, the California economy had just begun to experience an economic shift, but the extent of this decline was not yet apparent. Earlier, the strong economy had contributed to increased highway congestion, and many transit lots were approaching or exceeding capacity in the Bay Area. Employers were anxious about employee retention, and Palo Alto was concerned about the impact of congestion on quality of life. At this time, there was no reason to believe the economic strength of Silicon Valley would diminish enough to affect CarLink II's longer-term operation. Silicon Valley lost approximately nine percent of its employment from the first quarter of 2001 to the second quarter of 2002 (i.e., the period of CarLink II operations) (6). This impact diminished user demand and willingness to pay during CarLink II, economic viability (i.e., CarLink II was unable to cover its costs), and long-term sustainability (i.e., transition to a third-party operator).

2.3.2.3 Integrated Carsharing Technology

Both CarLink I and II employed advanced carsharing technologies. In CarLink I, however, the two main technologies employed were not integrated together: 1) vehicle reservation and access technology, and 2) the radio-frequency based vehicle tracking system. Several CarLink I technology shortcomings contributed to delays and necessitated program modifications (e.g.,

user data transmission failure). In the future, it was recommended that carsharing technology be integrated (e.g., tracking, reservations, and billing), customized to facilitate vehicle access, and designed to serve multiple lot designs. Furthermore, the Day Use reservation system was not integrated with the vehicle tracking system, meaning that real-time vehicle availability was not reflected on the reservation page. As part of CarLink II, American Honda Motor Company developed an integrated carsharing system that included: 1) vehicle access (smart key fobs); 2) an Internet-based reservation system; and 3) vehicle use and tracking (car location, vehicle miles traveled, fuel levels, user ID number, and time). CarLink II also included a navigational system. While the majority of participants were satisfied with the CarLink II technology, the following improvements were recommended:

- A "lockout" feature for reserved vehicles should be developed;
- The key fob door-release speed should be increased;
- The PIN entry screen process should be improved;
- The vehicle immobilizer should be integrated with the engine control unit to make this feature much more secure;
- The online reservation page should be modified to improve scrolling and reflect the correct time;
- The number of steps involved in making an online reservation should be reduced;
- A means to directly inform the reservation system that a trip is extending past the reserved time period should be developed (e.g., automated phone interface); and
- Reserved cars that are unused should be converted to "available for use" automatically on the reservation page after a 10- to 15- minute waiting period. (Furthermore, users should be fined if they do not cancel a reservation in advance.)

2.3.2.4 Participant Recruitment and Retention

Participant recruitment for a new transportation concept involves creativity and persistence. Engaging potential participants is challenging. Recruitment remains an ongoing effort due to member attrition (businesses and individuals) due to changes in home, work, or employment circumstances.

During CarLink II, a wide variety of recruitment strategies were employed with varying levels of success, including: the CarLink II website, brochure/postcards, a video, flyers at stations and in Caltrain bills, flyers on trains, articles/advertisement in local papers, community meetings, carpool lists, a trial offer, Stanford Research Park management recommendations, e-mail at employment sites, and word of mouth. The most effective tools included the trial offer (as noted during the CarLink longitudinal survey as a powerful recruitment device), flyers on trains, recommendations from Stanford Research Park, word of mouth, and e-mail communication. Least effective methods included flyers in the Caltrain bill and at the stations, the carpool list, and the CarLink II video.

The Palo Alto location presented a challenge for Homebased User recruitment. Two significant barriers were: 1) high levels of multiple car ownership are common in Palo Alto; and 2) transit station parking was not limited throughout the pilot program. The most efficient mechanism for Homebased User recruitment was the "trial" program, which allowed prospective users to try the

system before committing to a monthly payment. The trial offer included one week of service for $25 (versus $300/month for full participation). More than 50 percent of the individuals that participated in the trial joined as regular members. Business recruitment was conducted by working with local community contacts (e.g., City of Palo Alto, Stanford Research Park Management, and a local ridesharing group). In addition, some employees that saw the CarLink vehicles in parking lots or flyers on the trains, contacted CarLink II operations staff to learn more about the program. Once a business joined, their employees had access to the program at no additional cost. The employers were responsible for advertising the program to their staff and encouraging them to participate. Since employers paid a flat fee per car, it was in their interest to recruit as many employees as possible to maximize investment benefits.

In the next section, the 12-month CarLink II pilot transition is discussed.

SECTION 2.4 PILOT TRANSITION

Starting July 1, 2002, Flexcar—the private carsharing operator—began operating the former CarLink II pilot program. It was not possible to overlap personnel and operational protocols into a transitional phase due to funding constraints. As a result, there were two Flexcar operational phases. The first phase, lasting three months, maintained the CarLink II format to provide member consistency and Flexcar assessment time. During the second phase, Flexcar implemented a revised program approach and rates based on their economic assessment. Changes included: 1) fee increases (employer rates doubled to $700/month per car; Homebased User rates increased by $24.75/month to $324.75/month); 2) hourly rentals ($9/hour and 10 free miles or $40/month with five free hours and 50 miles); 3) fewer reserve (or backup) vehicles to reduce costs; and 4) restricted vehicle assignment and schedule adherence (i.e., vehicle must be returned to Caltrain at the same time each day with no flexibility).

Initially, all Workbased employers (four companies with a total of ten cars) and six Homebased Users remained in the program after CarLink II ended (two Homebased Users pursued other options after CarLink II). During Flexcar's first phase, one company reduced their cars from five to three and provided employees with an option of a commuter subsidy or CarLink. About half of the Workbased Commuters and Day Users stayed with the program. However, two member companies left the program when Flexcar fees were raised.

Flexcar also established other programs to coincide with the CarLink II model (i.e., hourly rentals in a few neighborhoods, at a foundation, and a public parking lot near downtown). Of these programs, only one neighborhood lot proved successful. While Flexcar increased fees to cover vehicle and staffing costs, the program was still not viable. In July 2003, the Palo Alto Flexcar program ceased operations due to: 1) downturn in the economy, 2) inability to cover costs, and 3) member schedule fluctuations.

It is interesting to note that City CarShare, another carsharing provider, also entered into the Palo Alto market at the completion of the CarLink II pilot program. City CarShare initially placed two cars in the same downtown lot as Flexcar. These cars were only used occasionally during the first year because they only had two registered members: one corporation and the City of Palo Alto. In fall 2003, City CarShare placed two cars on the Stanford campus. The cars are used by

students, faculty, and staff. City CarShare moved their two neighborhood cars to the University Avenue Caltrain station (downtown Palo Alto) to coincide with the launch of the Stanford program. They are anticipating increased use at the Caltrain location. The City CarShare rates are the same as in San Francisco, $4/hour peak and $2/hour off peak and $0.44/mile. Monitoring City CarShare's results in the Palo Alto region is recommended.

SECTION 2.5 CONCLUSION

An important benefit of field tests and pilot programs is the systematic approach to designing, implementing, and analyzing the operational framework and user response. This information can serve as a foundation for future study (e.g., moving from a field test to a pilot phase), commercialization (e.g. transitioning to an ongoing program), or program modification. The phased research approach of CarLink I and II provided the ability to investigate differences and similarities between the two methodologies.

Field tests are especially useful to investigate: 1) new concepts never tested, and 2) specific attitudes or marketing strategies in a controlled environment. Furthermore, there is no commitment to future operation. Pilot programs generally follow the demonstration phase. Pilots are useful to investigate: 1) long-term sustainability, 2) user response, and 3) beta test commercial products (e.g., the CarLink II technology) in a real-world setting. They are typically more flexible in responding to market conditions.

Both field tests and pilot programs can assist in establishing public policy direction by putting innovative concepts into operation. While pilot programs are operating in the field, they can be used to show decision makers how a program can work and give them the opportunity to experience the idea first-hand, discuss it with participants, and assess results. This experience is valuable to assist in the formation of realistic public policy initiatives that have a higher probability of success (given understanding garnered). Costs can be controlled, while the feasibility of replicating the pilot in other locations can be assessed. Data collected during the research can assist in forming better policies that can yield intended outcomes.

The CarLink II pilot followed the CarLink I field test, which was preceded by a conceptual market survey (4). The process of investigating the commuter carsharing model through the conceptual, field test, pilot and transition phases allowed researchers to gain a thorough understanding of how a project moves from concept to commercialization and what opportunities and obstacles it might face. Each phase has unique benefits, and the lessons learned during each stage inform program modification (e.g., technology); expand participation (e.g., private sector employers); and analyze commercial strategies.

The CarLink program provided researchers an opportunity to evaluate operations, user response, and commercial potential over time. Based on the CarLink program, the authors recommend that a conceptual study of innovative ideas be conducted in advance of program design (e.g., focus groups and surveys) to assess potential demand, response, and willingness-to-pay. Furthermore, the authors would argue that the field test phase be followed by a longer pilot phase (e.g., two years versus one). Finally, the authors recommend that expert advice from a researcher involved in the field test/pilot design coincide with the transition to an ongoing operation (i.e.,

commercialization phase). Results from the CarLink II transition indicate that additional time to adapt the model and study its impacts could have been useful. A twelve-month period is likely not long enough to achieve program sustainability, particularly during an economic decline and when revenue shortfalls are projected during the pilot phase.

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CHAPTER THREE

TRAVEL EFFECTS OF A SUBURBAN COMMUTER-CARSHARING SERVICE: A CARLINK CASE STUDY

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ABSTRACT

Since 1998, carsharing programs (or short-term auto rentals) in the U.S. have experienced exponential membership growth. As of July 2003, 15 carsharing organizations collectively claimed 25,727 members and 784 vehicles. Given this growing demand, decision makers and transit operators are increasingly interested in understanding the potential for carsharing services to increase transit use, reduce auto ownership, and lower vehicle miles traveled. However, to date, there is only limited evidence of potential program effects in the U.S. and Europe. This paper presents the travel effects of CarLink—a commuter carsharing model with explicit links to transit and employment in a suburban environment—in the context of participant demographic and attitudinal market profiles. A variety of research methods (including focus groups, interviews, questionnaires, and travel diaries) captured the following commute travel effects from the CarLink I and II programs:

- Increased commuter rail mode share by 23 percentage points in CarLink I and II;
- Reduced drive-alone mode share by 44 and 23 percentage points in CarLink I and II, respectively;
- Decreased average daily vehicle miles traveled by 23 miles in CarLink II and by 18 miles in CarLink I;
- Increased travel time but reduced stress;
- Reduced vehicle ownership by almost six percent in CarLink II; and
- Reduced parking demand at participating train stations and among member businesses.

The typical CarLink I and II member was more likely to be highly educated, in an upper income bracket, and professionally employed than average Bay Area residents. CarLink I and II members also displayed sensitivity to congestion, willingness to experiment, and environmental concern. The travel results of CarLink I and II are compared to those of neighborhood carsharing models in the U.S. and Europe to suggest the importance of CarLink's explicit transit and employment connections and the value of carsharing in a suburban location.

Key Words: Carsharing, CarLink, Station Cars, User Profile, and Travel Behavior

SECTION 3.0 INTRODUCTION

Automobiles have profoundly influenced travel and land use in the U.S. by providing unprecedented flexibility, convenience, and speed. Despite the myriad benefits offered by private vehicles, there is a recognition of the negative social and environmental effects of car dependence (1, 2), for example, traffic-related deaths, congestion, air and water pollution, and suburban sprawl. To date, implemented strategies to reduce auto use and dependency have largely focused on public transit. Carsharing programs (or short-term auto rentals) represent an intermediate strategy—situated between public transit and private vehicle ownership—for addressing several auto-related concerns. Furthermore, carsharing vehicles have the potential to enhance the existing transportation infrastructure, improving transit access and reducing parking demand at a lower cost than traditional capacity expansion projects.

Carsharing was first conceived in Europe but has gained popularity in the U.S. over the past six years. Once subscribed to a carsharing organization, individuals can receive the benefits of private car use without the costs and responsibilities of ownership. Generally participants pay a fee each time they use a vehicle, which covers the cost of vehicle use, insurance, maintenance, and fuel. Participants in a carsharing organization incur variable costs of auto use, rather than the largely fixed costs of auto ownership. Thus, the carsharing service may encourage reduced auto ownership and use and increased transit use.

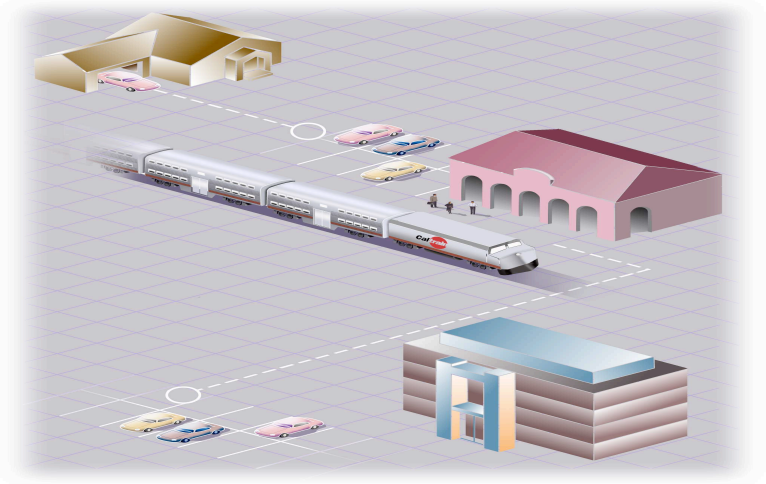
In Europe, StattAuto of Berlin and Mobility CarSharing Switzerland are the two dominant carsharing organizations. The business-oriented Swiss organization boasts over 50,000 members. In the U.S., carsharing developed more recently; carsharing organizations have experienced exponential membership growth, from 1998 to the present. As of July 2003, 15 carsharing organizations collectively claimed 25,727 members and 784 vehicles (3).

In Europe and the U.S., the most common carsharing model is known as “neighborhood carsharing.” Under this model, the carsharing organization maintains a fleet of cars distributed among a network of neighborhood locations for convenient member access. This model is typically located in dense urban areas with strong transit networks. Ideally, members of such a system use transit for most of their trips and carshare only when traveling outside the transit network, when travel times do not coincide with transit schedules or for transporting heavy or bulky items.

The CarLink commuter carsharing model differs from more traditional neighborhood carsharing by providing a formal link to transit and employers in a suburban location. The primary target audience is daily commuters who use the cars frequently for short segments of their commute. The CarLink model includes three user groups: 1) Homebased Users, 2) Workbased Commuters, and 3) Workbased Day Users. Homebased Users drive the cars between their homes and the train station on mornings and evenings, using the train for the line-haul portion of their trip to work. Homebased Users also keep the cars on evenings and weekends for personal use. Workbased Commuters take the train to work in the morning, pick up a shared-use car at the station (left earlier by a Homebased User), and drive the car to work. Day Users can check-out the cars from their work site during the day for personal or work errands. Thus, each car is used by all three

user groups throughout the day. See Figure 3.1, below, for an artist's rendition of CarLink and how each user group interacts with the vehicles and transit.

FIGURE 3.1: The CarLink Model (Consisting of Three User Groups: Homebased Users, Workbased Commuters, and Workbased Day Users)



As demand for carsharing services grows, decision makers and transit operators increasingly need to understand the potential of these services to increase transit use and reduce auto ownership, vehicle miles traveled (VMT), and emissions. However, to date, there is only limited evidence on the potential travel effects of carsharing programs in the U.S. (4, 5, 6). Most of the research focuses on European experience with neighborhood carsharing. These studies indicate significant reductions in auto travel (30 to 70 percent) and auto ownership (10 to 60 percent) (7, 8, 9, 10). However, the methods employed in these studies were limited, and the results may not be generalizable to the U.S. (see literature review below). Only a few studies have been conducted on neighborhood carsharing in the U.S., and these studies suggest that travel benefits may be more modest than those found in Europe (e.g., 5, 6). Nevertheless, research evaluations of U.S. carsharing programs with an explicit transit link (also known as station cars) consistently suggest significant reductions in auto travel (11, 12, 13).

This paper presents the market and travel effects of CarLink I and II from the analysis of a range of before and after instruments (focus groups, interviews, travel diaries, and questionnaires). The results of CarLink I and II are pooled and compared here to: 1) expand the sample and thus the confidence in reported travel effects and 2) explore the relative importance of locational effects (e.g., congestion levels or quality of transit service) and program attributes (e.g., employer demand). The travel results of CarLink I and II are also compared to those of neighborhood carsharing models in the U.S. and Europe to suggest the importance of explicit transit and employment connections in the CarLink model and the value of carsharing in a suburban location.

This paper consists of five main sections. First, the authors present a review of carsharing travel effects in Europe and the U.S. Second, the authors describe the operational models of CarLink I and II. Third, the methods employed in the study are documented. Fourth, study results are examined. Finally, the authors present key study conclusions.

SECTION 3.1 CARSHARING IMPACTS IN EUROPE AND THE UNITED STATES

To date, a number of U.S. carsharing studies have quantified various social and environmental impacts. While a variety of measures have been tracked (e.g., VMT, auto ownership, modal shift), study methods are largely inconsistent. A majority of the information regarding travel impacts comes from European experience (7, 8, 9, 10). Most European studies document impressive VMT reductions, with annual vehicle mileage declining from 30 to 70 percent as a result of carsharing. Vehicle ownership impacts are also notable, ranging from 10 to 60 percent of members selling a vehicle after joining a carsharing program. Although some VMT reductions result from foregone trips, a significant amount of this change is attributed to modal shifts (i.e., members substituting private car use with public transit and non-motorized options).

While European carsharing results are encouraging, the methods employed also vary among studies. First, several rely on data collected only after an individual used carsharing, requiring members to reflect back on prior modal use (versus documenting mode split prior to membership). Not surprisingly, the accuracy of these data is unknown. Second, control groups are seldom used to provide a comparison of behavioral changes for members and non-members over the same time period, controlling for outside factors (e.g., economic downturn). Third, many studies document the behavior of those who are among the first to adopt carsharing (or early adopters). Thus, results may not reflect travel patterns after an individual has fully adjusted to carsharing, as well as evolving market impacts (e.g., new target segments and attrition). Contextually, there are also numerous issues. For example, in Europe, public transit networks are denser, fuel prices are substantially higher, and car ownership rates are lower than those in the U.S. Thus, the degree to which European results can be generalized to the U.S. is questionable.

Several systematic studies have been conducted on U.S. carsharing research demonstrations and just a few on existing programs. These include Purdue University's Mobility Enterprise shared-car experiment of the early 1980s (14) and an evaluation of the Short Term Auto Rental Service in San Francisco (15) around the same time. More recent studies include the San Francisco Bay Area Station Car Program (11); CarLink, a commuter-based carsharing system deployed in the San Francisco Bay Area (12, 13); and Intellishare's campus car study (16). Among operating programs, two-year evaluations of CarSharing Portland and City CarShare have been completed (5, 6).

Evaluation of station car programs (i.e., carsharing with an explicit transit link) conducted thus far have universally supported the proposition that increased transit connectivity can dramatically reduce VMT among program participants. This is not surprising because many of these programs specifically recruit individuals who would otherwise drive to work rather than commute via public transit. CarLink I, a carsharing field test with a central station-car component, yielded a net average commute VMT reduction of approximately 18.5 miles per day. CarLink I also resulted in 20 *new* daily Bay Area Rapid Transit (BART) District trips among

CarLink I commuters (20 participants). Several participants stated that if CarLink I became a permanent service, they would sell one of their personal cars, which could greatly reduce their transportation costs (12). Findings from the San Francisco Bay Area station car demonstration also revealed substantial reductions in commute-related VMT. These findings indicate that personal vehicle mileage declined from 45 percent of total VMT to three percent, with drivers substituting a combination of rail and electric vehicles (11).

Vehicle travel effects are less clear in the case of neighborhood carsharing, largely due to limited samples, length of time studied, modest behavioral changes, or a combination of factors. A study of CarSharing Portland membership behavior after two years of operation indicates that aggregate VMT decreased among members by 7.6 percent. This reduction was largely driven by members who had given up an owned or leased car after joining the carsharing organization. Among this group, VMT was decreased by 25 percent. For members without household vehicle access, VMT increased by 19 percent (5). A similar outcome was observed in a two-year evaluation of City CarShare in San Francisco, which revealed a two percent VMT reduction among members (6). Although modest, it is important to note that this particular measure may underestimate carsharing VMT impacts. Among a comparable group of non-members (a control group), VMT increased by 49 percent over the same period, suggesting that carsharing may have reduced total VMT beyond the modest two percent reduction reported. The authors hypothesize that the influence of carsharing membership on vehicle ownership is likely reflected in reduced VMT among households that either sold or forfeited a car purchase.

Few studies of neighborhood carsharing in the U.S. evaluate the modal shift effects of carsharing, and some study results have been contradictory. For example, CarSharing Portland's two-year study indicates a slight increase in transit use and walking/cycling, while the City CarShare year-two study reports a decline in walking, cycling, and transit usage. In the case of City CarShare, carsharing appears to have largely displaced these travel modes among members (5, 6).

Neighborhood carsharing appears to have a relatively strong effect on vehicle ownership. Most U.S. carsharing studies demonstrate that shared-use vehicles have a mitigating influence on vehicle ownership, motivating members to either sell a vehicle or avoid a vehicle purchase. For instance, CarSharing Portland's two-year study reported that 23 percent of members sold a personal vehicle, and 25 percent were able to avoid purchasing one (5).

The next section presents an overview of the CarLink I field test and CarLink II pilot program.

SECTION 3.2 OVERVIEW OF CARLINK I AND II

The CarLink I field test was launched on January 20, 1999, and ended on November 15, 1999. Fifty-four individuals enrolled in the program and shared 12 natural gas powered Honda Civics. The participants were from San Francisco, Oakland, and East Bay communities. The cars were based in premium parking spaces at the Dublin-Pleasanton BART station. The CarLink I model accommodated traditional and reverse commute travel patterns as well as day-time travel needs of employees at the Lawrence Livermore National Lab (LLNL).

The CarLink I field test combined short-term rental vehicles with communication and reservation technologies (i.e., smart technologies) to facilitate shared-use vehicle access. The ten-month demonstration project was implemented and researched by two teams at the Institute of Transportation Studies at the University of California, Davis. Project partners included the California Department of Transportation (Caltrans), American Honda Motor Company, the BART District, California Partners for Advanced Transit and Highways (PATH), and LLNL. INVERS (a Germany-based smart carsharing technology company) and Teletrac provided the advanced carsharing and vehicle tracking technologies.

The CarLink I model included three separate user structures: a Homebased User lease; transit links for Homebased Users and Workbased Commuters; and shared vehicle access at the LLNL employment site through Day Use. During the field test, each user group paid a distinct fee according to the duration of car use. All user fees included fuel, insurance, and maintenance costs. Roadside assistance and an emergency taxi service were also provided. In addition to vehicle support services, CarLink I implementation staff supported the program by cleaning and occasionally refueling the vehicles, as well as maintaining e-mail and phone contact with users.

Using questionnaires, household interviews, and focus groups, researchers explored CarLink I attitudes and use over time. Although the CarLink I participant sample was small (i.e., 54 enrolled), the results yield valuable lessons. CarLink I findings include operational understanding, participant profiles, behavioral findings, preliminary economic analysis, and directions for future research (13).

The CarLink II pilot program was launched on July 1, 2001, and ended on June 30, 2002, and included 107 members. CarLink II continued the investigation of commuter carsharing as developed in the CarLink I field test. There were five key differences between the CarLink I field test and CarLink II. First, CarLink II was a pilot program that included a transition to an ongoing carsharing organization once the initial pilot stage was completed. Researchers found that many CarLink I users would have remained in the program, sold a household vehicle or forgone a purchase, and increased transit and/or alternative mode use (e.g., carpooling and vanpooling), had the field test been continued (13). Thus, project partners considered a more sustainable program approach to be critical in CarLink II. Second, the size of the CarLink fleet increased from 12 to 19 vehicles, consisting entirely of 2001 Ultra Low Emission Vehicle (ULEV) Honda Civics. CarLink II's larger size enabled researchers to gain a deeper understanding of the model's niche potential with greater statistical significance. A third difference was the program's focus on providing commuter feeder and day use services to *many* companies in the region rather than a single employer. Fourth, the participation of multiple employers and employees required the development of integrated carsharing technologies, which coordinated vehicle tracking, data collection, and reservations. Smart key fobs facilitated instant vehicle access and eliminated the need for multiple "key boxes" at transit stations and work locations. The potential of these technologies to enhance service capabilities and reduce program costs was central to the CarLink II program. Finally, CarLink II was located in the Palo Alto region, south of San Francisco, and its chief transit partner was Caltrain (i.e., a commuter rail system that runs for approximately 75 miles between Gilroy and San Francisco). The notable congestion and growth of the South Bay also rendered it a prime location for exploring

commercial viability. The key differences between CarLink I and CarLink II are also summarized in Table 3.1, below.

TABLE 3.1: Key Differences Between CarLink I and CarLink II

CHARACTERISTICS	CARLINK I	CARLINK II
Community Access	• Limited primarily to employees of a National Laboratory and 10 households • 54 users	• Increased network of users, with several businesses • 107 users
Timeframe	• 10-month field test	• 12-month pilot project, before transitioning to third-party operator (Flexcar)
Vehicles	• 12 Honda Civics fueled with compressed natural gas	• 19 internal combustion engine Honda vehicles
Technology	• Smart key manager • Manual key boxes • On-board vehicle computers • Vehicle tracking units • Manual reservation system (facilitated through web page)	• Smart key fob remote access system (i.e., no key boxes) • On-board vehicle computers • Global Positioning System (GPS) vehicle tracking units • In-vehicle navigation system • Computerized reservation system for Day Use
Transit Partner	• Bay Area Rapid Transit (BART) District	• Caltrain
Location	• Dublin-Pleasanton and Livermore (east of San Francisco)	• Palo Alto and Silicon Valley (south of San Francisco)

As in the CarLink I field test, three distinct categories of users shared the CarLink II vehicles:

- **Homebased Users,** who had access to the vehicles on evenings and weekends, paid $300 per month. These members lived in or near Palo Alto and drove a CarLink vehicle to the Caltrain California Avenue station each weekday morning, before taking a train to work and then home again at night.
- **Workbased Commuters** were employees of Stanford Research Park businesses, who used the CarLink vehicles that Homebased Users parked at Caltrain in the morning, to commute to and from the California Avenue station and work sites. Employers paid approximately $50 per month per vehicle for employee access to vehicles. Employers were encouraged to promote carpooling among Workbased Commuters. This aspect of the program was very successful.
- **Workbased Day Users** were employed by business subscribers of the Stanford Research Park (i.e., the same companies that employed the Workbased Commuters) and used the vehicles for personal and business trips throughout the day. Day Use was provided as a

subscription package to employers for $300 per vehicle per month. Employers paid a total of $350 per month per car for the Day Use and Workbased Commuter components.

Again, all user fees included maintenance, insurance, and fuel costs. Roadside assistance and emergency taxi services were also provided. The CarLink implementation staff also supported the program by cleaning the vehicles, as well as maintaining e-mail and phone contact with users.

During site selection, the CarLink II team worked with the Stanford Research Park to recruit employer participants. Stanford Research Park has over 700 acres and 10 million square feet of developed facilities, 162 buildings, 150 companies, and 23,000 employees. As its name suggests, the Stanford Research Park primarily houses research companies, whose type and size varies widely. Companies include high-tech law firms, software companies, pharmaceutical research companies, and several "dot coms."

The companies most interested and suited to CarLink II participation included those with regular work schedules (in contrast to "dot coms") and ranged in size between 100 to 600 employees. CarLink II included six employers, located throughout or nearby the Stanford Research Park.

The following section provides an overview of the CarLink II research methodology and data collection methodology.

SECTION 3.3 RESEARCH AND DATA COLLECTION METHODOLOGY

The CarLink II evaluation built upon the research of the CarLink I longitudinal survey and field test (13, 17). As in the CarLink I field test, the CarLink II research investigates the perceptions and attitudes of carsharing participants through focus groups, questionnaires, and household interviews, as well as examining changes in travel patterns by comparing travel diaries and automatically collected vehicle data.

Focus groups were the first research instrument employed; two were conducted several months prior to the CarLink II launch to investigate carsharing perceptions and gather feedback on final design details (e.g., costs and recruitment techniques). These focus groups were used to collect rich qualitative data from participant and moderator interactions. They also allowed researchers to monitor the level of emotion or enthusiasm for a subject; these data proved invaluable to the CarLink system design. The focus groups consisted of individuals living in the Palo Alto area (i.e., potential Homebased Users), who were recruited at Caltrain stations and through "cold call" telephone solicitation. Focus groups and interviews were also conducted with program participants mid-way and at the end of the evaluation period.

The second research instrument consisted of a before-and-after questionnaire series. A questionnaire was administered when participants joined CarLink II and at the conclusion of the data collection period or when they left the program. The initial survey instruments addressed each household's pre-CarLink travel patterns as well as basic demographic questions about household characteristics. Researchers compared these responses to participant travel diaries. In addition, respondents also answered a series of psychographic questions related to their opinions

and attitudes about transportation and other items (e.g., environment, advanced technologies, and willingness to try new things).

The third research instrument was a three-day travel diary (i.e., two consecutive weekdays and a weekend day). To evaluate the travel effects of CarLink II (e.g., transit and auto travel, auto ownership, and parking space needs), researchers needed to know how members traveled before and during the program. Before joining CarLink II, all participants were required to complete a travel diary. Subsequently, researchers compared the pre-CarLink travel data to CarLink vehicle usage data collected automatically, as well as travel diaries completed as part of the CarLink II final evaluation.

The response rates for the before-and-after questionnaires and diaries by gender and user groups are presented in Table 3.2, below. The total response rate for the CarLink II questionnaires and diaries was 59.8 percent. Some surveys were returned two to six months after the end of the program and after Flexcar—the third party operator—took over the program. Participants were contacted by telephone to remind them to complete the surveys. Overall response rates for females were seven percent higher than for males.

TABLE 3.2: CarLink II Response Rates by Gender and User Group

USER GROUP	MALE	FEMALE	AVERAGE
Homebased Users (N=9)	62.5%	50.0%	56.3%
Workbased Commuters (N=21)	64.3%	85.7%	75.0%
Workbased Day Users (N=34)	50.0%	57.1%	54.0%
Total Average (N=64)	56.0%	63.2%	59.8%

The distribution of program members and survey respondents by user group are presented in Table 3.3, below. The distribution of Homebased Users is close to equal. However, it appears that Workbased Commuter respondents are somewhat under-represented and Workbased Day User respondents are somewhat over-represented relative to total user group proportions.

TABLE 3.3: Distribution of CarLink II Participants and Survey Respondents[a] by User Group

USER GROUP	PARTICIPANTS (N=107)	RESPONDENTS (N=64)
Homebased Users	15.0%	14.1%
Workbased Commuters	26.2%	32.8%
Workbased Day Users	58.9%	53.1%

[a] Note that all participants completed the initial surveys, but respondents completed both the initial and final surveys.

The CarLink in-vehicle technology provided the fourth study instrument, collecting car usage data automatically. These data could be viewed in real-time (i.e., the fleet manager could monitor vehicles at any time) and were archived to provide usage histories. Data include:

- User ID,
- Start and end times,
- Start and end locations, and
- Fuel level (to an eighth of a tank).

CarLink researchers used these data to calculate total vehicle miles traveled, trip number, fuel used, time of use, and other statistics.

SECTION 3.4 EARLY ADOPTER MARKET PROFILE

In this section, demographic and attitudinal market profiles of CarLink II early adopters are created from data gathered through participant questionnaires described above. The profiles assist in understanding the generalizability of the project and its potential impacts to other locations. For example, commuter carsharing programs may be more or less effective in metropolitan regions depending on land-use patterns, transit systems, and population demographic and attitudinal characteristics. The market profiles for CarLink II are compared to CarLink I whenever possible to help explore any variation in travel effects. The demographic profiles are also compared to U.S. Census data (2000) for the Bay Area to illustrate the similarity between CarLink I and II early adopters and the general Bay Area population.

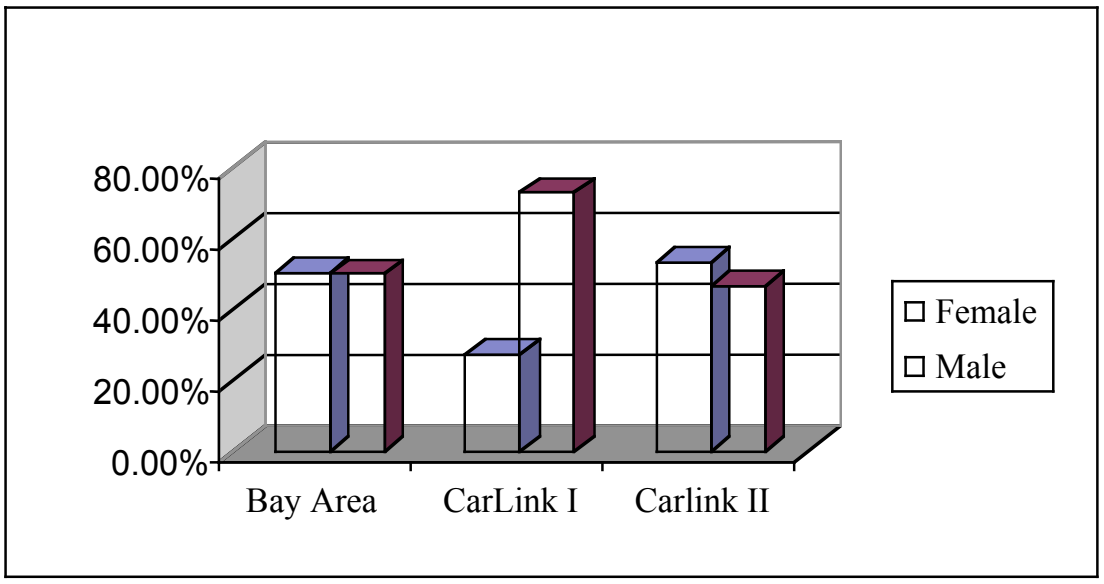
3.4.1 Demographic Profiles

Demographic variables examined include gender, age, education, income, occupation, and vehicle ownership.

3.4.1.1 Gender

Men and women were equally represented in CarLink II, which is consistent with the distribution of men and women in the Bay Area. However, in CarLink I, male participants were disproportionately represented. Figure 3.2, below, presents a comparison of the gender distribution of the CarLink I and II participants and the Bay Area population. Studies of European carsharing have also found that men tend to participate in carsharing more frequently than women (17). The difference in gender distribution between CarLink I and CarLink II may be explained by the demographic or attitudinal characteristics of employees at the respective worksites. The worksite in CarLink I (LLNL) may employ more men than women or female employees may possess less early adopters attributes than male employees.

FIGURE 3.2: Gender of CarLink Members Relative to Bay Area Residents (2000 Census)



3.4.1.2 Age

CarLink II participants tended to be younger than the general Bay Area population and CarLink I participants. The comparison to the Bay Area population excludes those under 20 and over 64 because of CarLink's membership age restrictions. The location of CarLink II in the Silicon Valley, which tends to have a relatively young employee base, may explain the lower relative age of participants in CarLink II. Similarly, the LLNL worksite in CarLink I may explain the higher relative age of participants (i.e., employment may require more advanced degrees). Table 3.4, below, presents a comparison of the age distribution of the CarLink I and II participants and the Bay Area population.

TABLE 3.4: Age of CarLink Members Relative to Bay Area Residents (2000 Census)

AGE [A]	**20-44**	**45-64**
Bay Area	64%	36.0%
AGE	**20-40**	**41-64**
CarLink I (N=54)	40.9%	59.1%
CarLink II (N=107)	79.3%	20.5%

[a] Note that age categories differed from Census to CarLink Data and were collapsed for best consistency.

3.4.1.3 Education, Income, and Occupation

Participants in both CarLink I and II possessed higher levels of education than the general Bay Area population. Fifty-seven percent of CarLink I and 48 percent of CarLink II participants had

completed a bachelors degree or higher. This compares to 14.1 percent of Bay Area citizens over the age of 25 with a bachelors degree or higher.

The household income levels of CarLink participants were also relatively high. Thirty percent of CarLink I members had household incomes ranging from $80,000 to $99,999, while 16 percent had a household income greater than $100,000. CarLink II members had fewer participants in the $80,000-$99,999 range (19 percent), but more participants earning over $100,000 (47 percent). In CarLink II, the greatest portion of all user groups was in the $100,000 plus income category. However, Homebased Users tended to have a relatively large percentage of members in lower income groups, and the reverse was true for Workbased Commuters. Workbased Day Users tended to have a more even distribution across the income categories than the other user groups.

With higher education and income levels, CarLink members were primarily employed in the professional/technical category (68.2 percent in CarLink I and 64.7 percent in CarLink II). This is high relative to Bay Area residents (see Table 3.5 below). The distribution of occupation types did not vary substantially among user groups in CarLink II relative to CarLink I.

TABLE 3.5: Occupation Distribution of CarLink Participants Relative to Bay Area Residents [a]

	Mgr./ Admin.	**Service/ repair**	**Sales/ office**	**Prof./ tech.**	**Prod./ const.**	**Other**
CarLink I (N=43)	18.2%	0.0%	9.1%	68.2%	2.3%	2.3%
CarLink II (N=102)	18.1%	0.0%	11.4%	64.7%	0.0%	5.7%
	Mgr./ Admin.	**Service/ repair**	**Sales/ office**	**Other**		
Bay Area	43.7%	12.8%	25.6%	17.9%		

[a] Note that occupation categories available from the 2000 U.S. Census and the CarLink survey differed.

3.4.1.4 Vehicles Per Household

CarLink II participants owned or leased an average of 1.75 vehicles per household at the start of the program. Overall, the number of vehicles per household of CarLink II participants was similar to the Bay Area population. Figure 3.3, below, presents a comparison of the household vehicle distribution of CarLink II participants and the Bay Area population.

FIGURE 3.3: Distribution of Number of Vehicles per Household for CarLink II

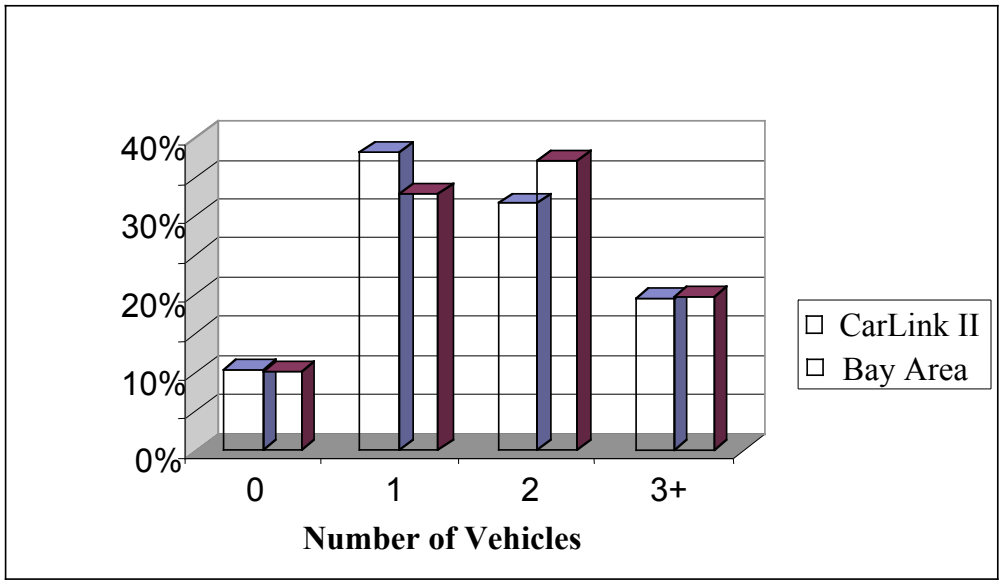
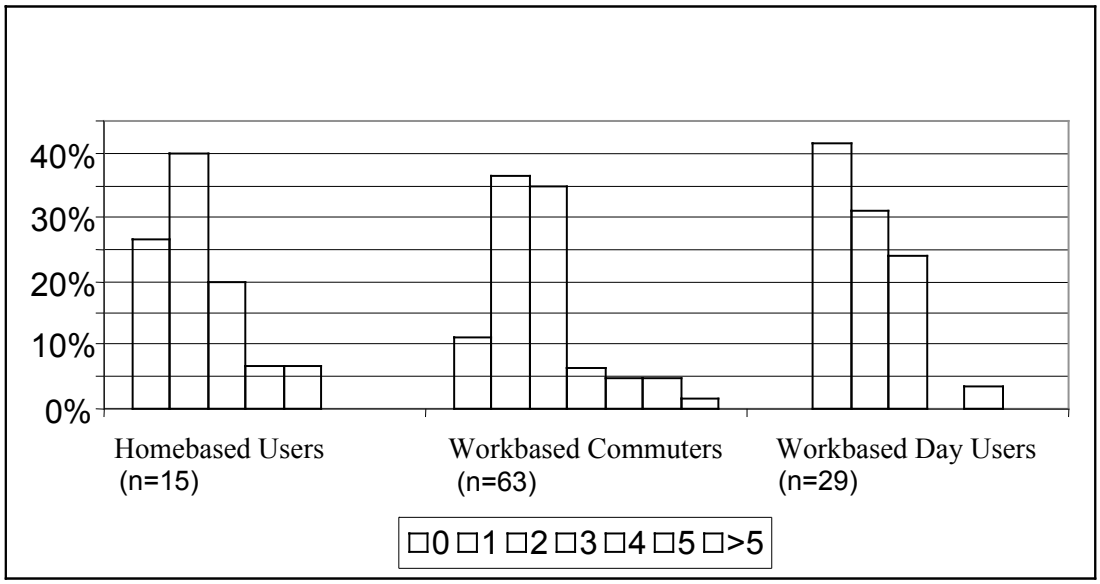


Figure 3.4, below, shows vehicles per household by CarLink II user groups. Participants who belonged to a household without access to a vehicle should be able to significantly improve their mobility. Over a quarter of Homebased Users and a tenth of Workbased Commuters had no vehicle in their household. One third of Homebased Users had household incomes of less than $50,000 (compared to 11 percent of Workbased Commuters). The lower relative incomes of Homebased members help explain their lower car ownership levels and their participation in CarLink II.

FIGURE 3.4: Distribution of Number of Vehicles per Household for CarLink II



3.4.2 Attitudinal Profiles

In this section, the results of the initial questionnaires are summarized to develop an attitudinal profile of early adopters. When possible, comparisons are made to CarLink I participants.

First, participants were asked to rate on a five-point scale how much they agreed or disagreed with ten statements describing attitudes about their current transportation mode. Each question reflected positive and negative modal attributes. A current transportation mode attitudinal scale score was created for each respondent. As a group, Homebased Users were neutral to their current mode. Workbased Commuter and Day User attitudes were slightly positive towards their current mode. Similarly, the CarLink I study found that 77 percent were satisfied with their current mode. These results suggest that CarLink participants did not join CarLink because of a general dissatisfaction with their current transportation mode.

Second, respondents were asked to rank a list of negative attributes for their current (pre-CarLink II) transportation mode. The top four choices for all participants are listed in Table 3.6, below. Participants' least favorite aspect, "Spend too much time in traffic," suggests that traffic congestion may be a predictor of CarLink II participation. CarLink I results also suggested that participants may be more sensitive to congestion than the general population. The second least favorite aspect, commute time (or "it takes too long to get places") was not improved through CarLink II participation—given the additional time required to mode shift (link to transit with CarLink). Average CarLink commute times were longer than non-CarLink I and II commutes. However, there is evidence that CarLink I and II travel times were higher quality and less stressful than non-CarLink travel times.

TABLE 3.6: Participants' Least Favorite Attributes of Transportation Modes before CarLink II (N-107)

Least Favorite	Spend too much time in traffic
Second Least Favorite	It takes too long to get places
Third Least Favorite	It is not flexible enough
Fourth Least Favorite	It is too expensive

Finally, a set of participant attitudinal (or psychographic) questions was included in the questionnaire. Attitudinal scales provide researchers with a means of characterizing participant response to a series of related questions. Responses to these questions were pooled to three measures, experimental, vehicle hassle, and environment. These attitudinal questions and scales were found to be significant (Cronbach's Alpha Score) in Shaheen's (17) analysis of a larger longitudinal carsharing survey (207 respondents).

- **Experimental** is how willing participants are to try new experiences;
- **Vehicle hassle** is how difficult and unpleasant participants find maintaining a private vehicle; and
- **Environment** is the degree to which participants believe that it is important to change behavior to help the environment.

The results allowed for the identification of potentially critical issues to successful recruitment and modal choice. Responses, which are evaluated on the five-point scales—ranging from "Strongly Agree" to "Strongly Disagree"—were assigned a point value (-2 to +2, with 0 being neutral) and averaged over several questions to calculate a respondent rating. The results of the psychographic questions are provided in Table 3.7, below.

TABLE 3.7: Psychographic Scale Scores from CarLink II and I

	EXPERIMENTAL	VEHICLE HASSLE	ENVIRONMENT
CARLINK II			
Homebased User (N=15)	0.94	-0.38	0.98
Workbased Commuter (N=63)	0.64	-0.40	1.03
Workbased Day User (N=29)	0.62	-0.50	1.01
Total Users (N=107)	0.68	-0.43	1.10
CARLINK I			
Total Users (N=44)	0.51	0.40	1.04

The results indicate that CarLink II participants exhibited a tendency to experiment (average score of 0.68). This tended to be most strongly true for Homebased Users, most likely, because of their lower vehicle ownership rates, lower household incomes, and somewhat younger ages. CarLink I participants indicated a similar comfort level with respect to experimentation.

All the CarLink II user groups tended to disagree that "vehicles are a hassle." The score was negative for each user group, and the total score was –0.43 (indicating that CarLink II participants did not perceive vehicles as a hassle). This result differs from the average 0.40 score obtained for vehicle hassle in CarLink I. These results indicate that CarLink II participants may have been motivated more by a desire to get out of traffic (as indicated by their least favorite aspect of their current transport mode) as opposed to a desire to reduce vehicle hassle.

Concern for the environment obtained the highest score (relative to the other attitudinal measures). The average score for CarLink II was 1.04, and the average score for CarLink I was 1.35. These results indicate that reducing automobile effects on the environment may have been an important motivating factor for joining CarLink.

The next section focuses on CarLink II travel impacts. Reference to CarLink I data are made when possible.

SECTION 3.5 CARLINK II TRAVEL EFFECTS

An important difference between CarLink and neighborhood carsharing programs is CarLink's emphasis on the transit commute or linkage. The CarLink model is designed specifically to provide door-to-door connectivity for participants commuting to work via transit. To capture changes in travel due to CarLink, survey methods recorded participants' travel before-and-after joining CarLink. A number of evaluation criteria are analyzed, including mode choice, VMT, travel time, travel stress, household vehicle fleet size, and parking.

3.5.1 Commute Travel

Prior to joining CarLink II, participants used a variety of modes to get to work (see Table 3.8). Many members already took more than one mode to commute (e.g., anyone using Caltrain would use one or more additional modes to travel to the station from home and work), so the total percentages of mode use sum to over 100 percent. Over a third of participants (39.6 percent) used Caltrain as part of their normal commute prior to joining CarLink II, including over half of Homebased Users (56.3 percent). High pre-CarLink Caltrain use is not surprising because much of the recruitment occurred at Caltrain facilities or at businesses with good Caltrain access. However, enough participants were new to Caltrain to show sizable changes in mode choice. This was particularly evident in solo driving, which was reduced by 22.9 percentage points on average for all members. Similarly, promising modal shifts were obtained for CarLink I (a 23.2 percentage point increase in BART use and a 43.5 percentage point reduction in drive alone for the commute travel). CarLink II shows a slight reduction in carpooling. In CarLink I, carpooling increased by 4.6 percentage points, but this is likely because of carpooling requirements built into the program.

TABLE 3.8: Before-and-After Commute Mode Shares for CarLink II Participants

MODES	BEFORE			AFTER			PERCENTAGE POINT CHANGE		
	HB[a] (N=15)	WB[b] (N=92)	All (N=107)	HB (N=8)	WB (N=51)	All (N=59)	HB	WB	All
Drive Alone	37.5%	64.1%	60.2%	12.5%	41.2%	37.3%	-25.0%	-22.9%	-22.9%
Carpool	12.5%	10.9%	11.1%	0.0%	11.8%	10.2%	-12.5%	0.9%	-0.9%
Bus/Shuttle	25.1%	22.8%	23.2%	37.5%	13.7%	15.3%	12.4%	-9.1%	-7.9%
Caltrain	56.3%	35.9%	39.6%	100.0%	56.9%	62.7%	43.7%	21.0%	23.1%
Bike	12.5%	5.4%	6.5%	0.0%	3.9%	3.4%	-12.5%	-1.5%	-3.1%
Walk	43.8%	22.8%	25.9%	50.0%	52.9%	52.5%	6.2%	30.1%	26.6%
Other	6.3%	2.2%	3.7%	12.5%	11.8%	11.9%	6.2%	9.6%	8.2%
CarLink	0.0%	0.0%	0.0%	100.0%	56.9%	62.7%	100.0%	56.9%	62.7%

[a] HB is Homebased User.

[b] WB is Workbased Commuters and Day User.

Changes in commute VMT are shown in Table 3.9, below. VMT includes all miles traveled in a private automobile or in a CarLink II vehicle. Carpool trips were adjusted to avoid double

counting. While on average VMT decreased as members converted from driving solo to taking the train, for some participants VMT rose. Based on interviews and focus groups, researchers learned that increased VMT occurred when a veteran Caltrain user, who had been walking, biking, or taking a shuttle, shifted to a CarLink vehicle to access home or the station. Since the majority of Homebased Users were previously Caltrain riders, this resulted in a slight net VMT increase of 1.2 miles per day per person for this user group. However, the Workbased group (both Workbased Commuters and Day Users) reported a significant decrease of 27.2 VMT per day per person. This reduction in VMT occurred even though some CarLink II employer subscribers had previously operated a shuttle service, and one was within walking distance of the station (less than one mile). In interviews, participants stated that the hassle of getting from the station to the worksite (especially via the shuttles) was often high enough that they used their personal vehicles more than they would have liked. Similarly, the CarLink I study found that the average reduction in daily commute travel was 18.5 miles as a result of CarLink I participation.

TABLE 3.9: Before and After Average Daily Round Trip Commute VMT and Travel Time (Minutes) for CarLink II Participants

	BEFORE	AFTER	CHANGE
VMT	(N=107)	(N=64)	
Homebased Users	10.4	11.6	1.2
Workbased Commuter & Day User	34.4	7.2	-27.2
Total	30.8	7.8	-23
Travel Time (Minutes)	(N=107)	(N=64)	
Homebased Users	71.8	108.3	36.5
Workbased Commuter & Day User	90.2	120.8	30.6
Total	87.4	118.9	31.5

Time is another important factor for commuters. Table 3.9, above, shows that after participants joined CarLink II, their average round trip-commute time increased by over one-half hour. Since most pre-CarLink II commutes did not involve Caltrain, researchers anticipated increased travel times. Time spent waiting for trains tends to increase commute times, regardless of transit mode efficiency. Although commute travel times increased overall, commute stress generally decreased, as indicated in Table 3.10 (below). However, some members mentioned some difficulty in arranging their schedules with other carpool members in the final CarLink II interviews and focus groups. Similarly, in CarLink I, the results of focus groups and in-person interviews with participants indicated that average commute travel times increased, but average commute stress was reduced. CarLink I Workbased Users stated that relaxing during their BART commute was a significant program benefit. Because most Homebased Users commuted via BART prior to CarLink I, they did not generally experience stress reduction.

TABLE 3.10: The Effect of CarLink II Participation on Commute Stress

	HOMEBASED USERS (N=9)	WORKBASED USERS [a] (N=55)	ALL (N=64)
Greatly increased	0.0%	1.8%	1.6%
Increased	12.5%	7.1%	7.8%
No change	25.0%	44.6%	42.2%
Decreased	62.5%	39.3%	42.2%
Greatly decreased	0.0%	7.1%	6.3%

[a] Workbased includes both Workbased Commuters and Day Users

3.5.2 All Travel

This section explores the effect of CarLink II on participant and household travel behavior beyond commute travel. For example, it is possible that exposure to transit in CarLink II may have encouraged its greater use for non-commute travel. In addition, the availability of an extra car in a participant household may have increased auto use.

The issue of total auto and transit use was explored by asking participants to assess how their personal and household travel behavior changed after joining CarLink II. The results are presented in Table 3.11, below. Over half of the participants stated that their drive alone travel decreased or greatly decreased, most likely because of increased commuting by Caltrain. Not surprisingly, one quarter of the Homebased Users indicated that their drive alone travel greatly increased, most likely because of increased access to the CarLink vehicles on evenings and weekends. At the household level, 6.3 percent of all participants indicated that vehicle use increased, 64.6 percent stated that it remained the same, and 27.1 percent said that it increased. Total participant transit use tended to increase (47.6 percent) or stay the same (42.6 percent). Most of the participants indicated that their transit use for non-commute trips did not change (71.2 percent), while 15.3 percent indicated that it increased and 13.6 percent indicated that it decreased.

TABLE 3.11: Change in CarLink II Non-Commute Mode Share

	DRIVE ALONE			TOTAL TRANSIT			NON-COMMUTE TRANSIT			TOTAL HOUSEHOLD VEHICLE USE		
	HB (N=8)	WB[a] (N=48)	All (N=56)	HB (N=8)	WB (N=53)	All (N=61)	HB (N=8)	WB (N=51)	All (N=59)	HB (N=6)	WB (N=42)	All (N=48)
Greatly Increased	25.0%	2.1%	5.4%	25.0%	9.4%	11.5%	12.5%	0.0%	1.7%	0.0%	0.0%	0.0%
Increased	12.5%	2.1%	3.6%	25.0%	37.7%	36.1%	12.5%	13.7%	13.6%	16.7%	4.8%	6.3%
Stayed the Same	25.0%	39.6%	37.5%	25.0%	45.3%	42.6%	37.5%	76.5%	71.2%	33.3%	69.0%	64.6%
Decreased	25.0%	50.0%	46.4%	12.5%	7.5%	8.2%	37.5%	9.8%	13.6%	33.3%	26.2%	27.1%
Greatly Decreased	12.5%	6.3%	7.1%	12.5%	0.0%	1.6%	0.0%	0.0%	0.0%	16.7%	0.0%	2.1%

[a] Workbased includes both Workbased Commuters and Day Users

Like CarLink II, the auto mode share was also reduced in CarLink I. However, in CarLink I, daily bus mode share decreased and walk/bike mode share increased (See Table 3.12 below).

TABLE 3.12: Percentage Point Change in CarLink I Mode Share for All Trip Purposes by User Group

MODE	HOMEBASED USER (N=6)	WORKBASED COMMUTER (N=13)	DAY USER (N=11)
Household Vehicle	-53.7	-49.7	N/A
Carpool	-3.9	+17.2	+4.6
Bus	-8.3	-25.8	-5.4
Bike	-14.3	+1.7	+10.8
Walk	-16.3	+12.7	+5.6
Recreational Public Transit	-24.0	+21.8	N/A
Drive Alone	-13.2	-25.6	-6.5

Note: Questions about "Recreational Public Transit" and "Drive Alone" modes were asked separately. Thus, "Recreational Public Transit" is a subset of "Bus" and, "Drive Alone" is a subset of "Household Vehicle" use.

In sum, these results suggest that the CarLink II program had a positive overall effect on participant transit use including non-commute travel and tended to reduce drive alone and vehicle travel by both the participants and their households.

3.5.3 Household Fleet Size

After joining a commuter carsharing program with direct transit linkages, participants may rely less upon their personal vehicles and thus might reduce their household fleet, lowering household costs and perhaps discouraging unnecessary trips. The final CarLink II questionnaire asked participants about the status of their personal vehicles after joining CarLink. As shown in Table 3.13 (below), over half (52.2 percent) of the respondents reported no change in personal vehicle use after they joined CarLink. Eleven percent of Homebased Users and five percent of Workbased Users (Workbased Commuters and Day Users) sold a personal vehicle or put it in storage. No one purchased a personal vehicle. Although 51.6 percent said they would buy a car in the next year in the initial questionnaire (i.e., at the time they joined CarLink II), only 27.5 percent said so in the final questionnaire. The significant reduction in expected new car purchases may be a result of CarLink II or economic downturn during this period.

In the final CarLink II questionnaire, 44.4 percent of Homebased Users and 11.7 percent of Workbased Users (Workbased Commuters and Day Users) reported that postponing or avoiding the purchase of a car was one of three top CarLink strengths (benefits). These findings may have no direct environmental or VMT benefits, since households may keep their cars longer, but it may represent a significant cost savings, as CarLink allows members to postpone or eliminate such a large purchase.

TABLE 3.13: Use of Personal Vehicle(s) After Joining CarLink II

	HB (N=9)	WB (N=55)	All (N=64)
No change in use of personal vehicles in my household	22.2%	56.7%	52.2%
Family member drives a car more frequently (e.g., "loaned" to a child)	11.1%	6.7%	7.3%
I/We have loaned a vehicle to someone outside our immediate family	0.0%	3.3%	2.9%
I/We have sold or stored one or more of our personal vehicles	11.1%	5.0%	5.8%
I/We have purchased or leased a personal vehicle	0.0%	0.0%	0.0%
I/We did not have a vehicle when I joined CarLink	44.4%	8.3%	13.0%
Other	11.1%	15.0%	14.5%
No response	0.0%	5.0%	4.4%

3.5.4 Carpooling and Parking

In addition to shifting members from single occupancy vehicle travel to transit, carsharing may encourage members to carpool (part of the CarLink I and II design). Carpooling uses vehicles more intensively and thus reduces program costs. Carpooling also helps reduce external costs, such as cold start emissions and parking space use.

Parking use is particularly important to many transit agencies, as each parking space generally has a direct cost (e.g., the space itself, construction, signage, and maintenance), as well as an opportunity cost (e.g., if a potential train rider cannot find a parking space, they often drive all the way to work).

For businesses seeking to maximize their existing parking spaces, CarLink carpooling can reduce the demand for on-site parking, decreasing costs and employee frustration (if parking space is limited). For some CarLink II employer subscribers, encouraging CarLink carpooling to reduce parking demand was a stated goal. CarLink management did not require members to carpool, leaving this decision to the businesses. The overall average number of Workbased Commuters in a CarLink II vehicle, including drivers, during commutes between the train station and the work sites was 1.48 in both mornings and evenings. During the final CarLink II interviews and focus groups, researchers learned that the composition of individual carpools (i.e., specific persons in each car) varied between morning and evening. Overall the parking benefit to employers resulted in approximately one parking space serving two CarLink II vehicles on average. The impact on individual businesses varied. At some businesses, carpooling was not a goal. Thus, CarLink II may not have reduced parking demand. However, in focus groups with employees of businesses with more restricted parking, respondents said that they tended to carpool everyday, meaning each CarLink II vehicle freed up at least one space.

SECTION 3.6 CONCLUSION

CarLink is a commuter carsharing model with an explicit transit and employer connection. The three CarLink user groups, Homebased Commuters, Workbased Commuters, and Day Users, each gain access to a car on an as needed basis, without the costs and hassles of ownership. The CarLink I field test and CarLink pilot program were designed to gain a stronger understanding of the long-term sustainability, technological needs, and user impacts of this model. In this paper, the authors focus on the demographic and attitudinal characteristics of CarLink users, as well as travel effects.

A typical CarLink II member was similar to the average San Francisco Bay Area resident with respect to gender and household vehicle occupancy distribution. On the other hand, CarLink I and II participants were more likely to be highly educated, in a higher income bracket, professionally employed, and younger than the average Bay Area resident. This may be a function of the location of the project (Silicon Valley) and the types of companies that joined as members (high tech firms). The demographic profile of commuter carsharing participants in other locations may be different than those in CarLink I and II. For example, age and gender distribution varied between the CarLink I and II field tests. However, demographic attributes tended to vary in similar ways from the Bay Area average with respect to education, income, and

employment for both CarLink I and II. Studies of neighborhood carsharing in Portland and San Francisco have also found that members tended to be highly educated and professionally employed (5,6).

Participants in CarLink I and II were also apt to share similar attitudes. CarLink I and II members indicated sensitivity to congestion levels, willingness to experiment, and concern for the environment. On the other hand, CarLink II members did not typically view vehicle maintenance as a "hassle," while CarLink I members did.

The CarLink projects employed a number of systematic methods (i.e., questionnaires, travel diaries, and automatic vehicle data) to record participants' travel before and after joining CarLink. The survey analyses indicate that CarLink I and II produced a significant reduction in participant auto travel, which was measured against three key criteria: modal choice, VMT, and household vehicle ownership.

The CarLink II mode choice results indicated a significant shift from single occupancy vehicle travel to transit for participants. This was particularly true with respect to commute drive-alone trips, which were reduced between 25.0 to 23.9 percentage points across user groups, even though many participants still used personal vehicles to access transit on their non-CarLink terminus. Somewhat lower reductions in commute drive-alone trips (ranging from 6.5 to 26.6 percentage points across user groups) were found in CarLink I. In contrast, results of neighborhood carsharing studies indicate small but conflicting results with respect to modal shifts. The CarSharing Portland study (5) showed a small shift from auto mode to transit, walking, and cycling modes, while the City CarShare study (6) indicated a small decline in transit, walking, and cycling. In CarLink I and II, transit use for the commute trip increased by 23.2 and 23.1 percentage points, respectively.

The VMT results for CarLink II show that roundtrip commutes were reduced by an average of 23 vehicle miles per day (while increasing travel times by 15 minutes each way), as members shifted to Caltrain. VMT reductions were also obtained for CarLink I (18.5 miles per day) (12) and for a station-car program in San Francisco (42 percent) (11). In CarLink I and II, reductions in commute VMT were not offset by increases in non-commute travel. For example, over 50 percent of CarLink II members stated that single-occupancy vehicle use decreased or greatly decreased, while almost half saw transit use increase. Across their entire households, nearly 30 percent of member households saw an overall decrease in vehicle use. It appears that the CarLink model encourages members to plan trips more carefully. During interviews, participants said that CarLink led to more trip-chaining during their commutes and the elimination of some unnecessary trips.

Reductions in VMT for CarLink I and II are comparable to the low end of the VMT reductions found in European neighborhood carsharing studies, which ranged from 30 to 70 percent (7, 8, 9, 10). It is important to note, however, that auto travel reductions in the CarLink studies may be somewhat underestimated because the programs included many members who had previously used Caltrain and therefore had little to risk by joining CarLink. A commuter carsharing program with a longer operating history would likely be able to recruit more risk-averse users by

emphasizing stress reductions due to less traffic; this could lead to greater reductions in vehicle trips and VMT.

The vehicle ownership results for CarLink II indicate that a relatively modest number of members (5.8 percent) sold or stored their vehicle after joining the program. Some CarLink I members also indicated that they sold a vehicle after joining CarLink. The Portland and San Francisco neighborhood carsharing studies (4, 5 ,6) suggest that between 12 to 30 percent of members sold a vehicle after joining the organization. In Europe, neighborhood carsharing studies indicate that 10 to 60 percent of members sold a vehicle after joining a service.

Early U.S. results indicate that neighborhood carsharing in urban environments tend to increase auto travel among members without access to vehicles and reduce auto travel among those who owned or leased a vehicle prior to joining the organization. CarLink results (from two suburban programs) show reductions in auto ownership levels that are at least half of those found in the neighborhood carsharing organizations in Portland and San Francisco. These results suggest that the higher quality transit and pedestrian environment of the urban location of the neighborhood carsharing services facilitates auto ownership reductions. However, travel reductions (i.e., reductions in drive alone mode choice and VMT) obtained from the CarLink and station car approaches are significantly larger than those obtained from early U.S. neighborhood carsharing data. These auto ownership and modal choice results suggest that changes in auto ownership may be the key variable causing auto travel reduction in neighborhood carsharing, while the strong transit link may be the critical variable driving auto travel reduction in the CarLink model. It is unclear, however, whether the market niche for the suburban commuter carsharing model could be as extensive as neighborhood carsharing. Thus, total system-wide travel effects are unclear and require future research.

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CHAPTER FOUR

APPLYING INTEGRATED ITS TECHNOLOGIES TO CARSHARING SYSTEM MANAGEMENT: A CARLINK CASE STUDY

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ABSTRACT

Carsharing is the short-term use of a shared vehicle fleet by authorized members. Since 1998, U.S. carsharing services have experienced exponential growth. At present, there are 13 carsharing organizations. Over the past three years, electronic and wireless technologies have been developed that can facilitate carsharing system management in the U.S., improve customer services, and reduce program costs. This paper examines the U.S. carsharing market; the role of advanced technology in program management, including CarLink lessons learned; and technology benefits to this nascent market.

Key Words: CarSharing, CarLink, Technology, User Satisfaction

SECTION 4.0 INTRODUCTION

In the U.S., the private auto accounts for over ninety-eight percent of urban passenger miles (1). This reflects a lack of competitive options to the personal vehicle, including limited transit access. To foster and enhance the range of available travel choices, more economically sustainable transportation options must be explored. Advanced technologies can play a key role in enabling the development and management of innovative mobility services, improving customer satisfaction, and reducing overall costs. This paper examines the role of technology in supporting one such alternative, carsharing.

Carsharing enables its users to reserve a vehicle for short time periods, during which the car can be driven to any destination. Typically, vehicles (including cars, minivans, and light-duty trucks) are picked up and returned to one of several designated lots throughout a community, including neighborhoods, transit stations, and employment sites. Users gain the benefits of a private car without the costs and responsibilities of ownership (2). Since the mid-1990s, interest in carsharing as an alternative mobility solution has grown significantly throughout Europe, North America, and Asia. Increasingly, U.S. carsharing organizations are integrating advanced technologies into their services to facilitate reservations and billing, vehicle tracking, and overall system management (3).

The use of advanced technologies also creates opportunities for new carsharing applications, such as one-way rentals (i.e., users can return a vehicle to a location different from the pick-up lot). At present, carsharing technologies require high initial investment for development and remain costly at low volumes. In the future, access to affordable technologies could become less challenging as a result of increased carsharing growth. If the market continues to expand, costs could be lowered due to scale and availability of preinstalled in-vehicle components to which customized carsharing telematics could be added.

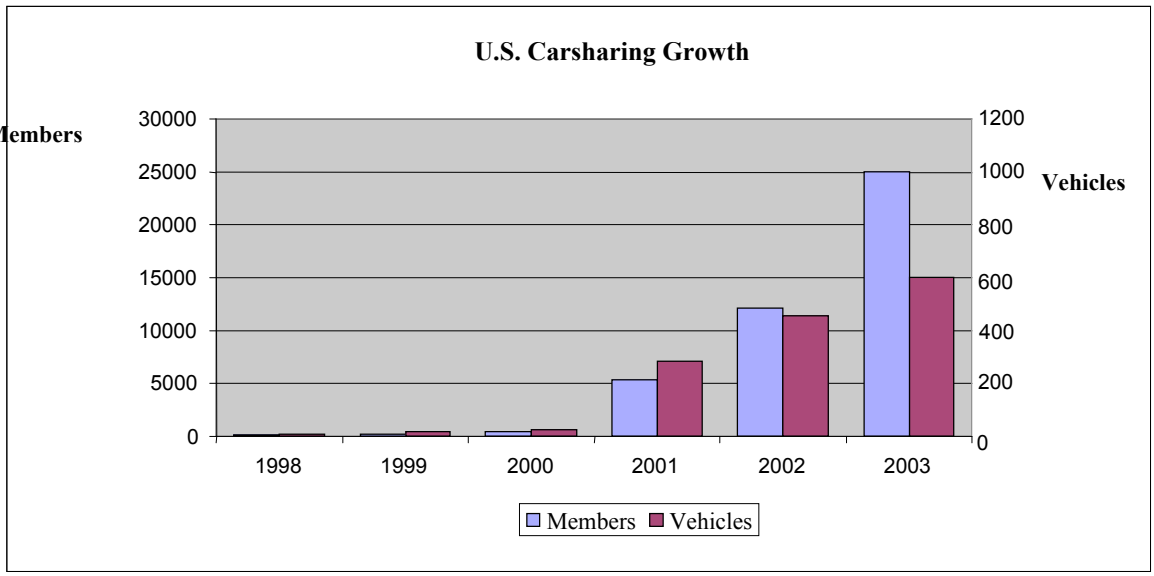
From August 2001 to July 2002, a carsharing pilot program, emphasizing transit and employer access—CarLink II—was deployed in the San Francisco Bay Area. Pilot objectives included testing an advanced carsharing system, user response to this technology, and its role in facilitating system management and cost reduction. This paper examines the CarLink technology, user response, and lessons learned from this initiative. The authors first provide a background overview of the current U.S. carsharing market. Next, the CarLink model, technologies, and findings are presented. Finally, the relationship among system management, costs, and technology is discussed in the conclusion.

SECTION 4.1 U.S. CARSHARING MARKET DEVELOPMENTS

Since the first U.S. carsharing organization was established in 1998, the carsharing industry has experienced exponential membership growth. From 2001 to 2003, the authors periodically surveyed carsharing organizations on a range of topics, including business model, size, market segmentation, insurance, and technology to assess developments. As of July 2003, 13 U.S. carsharing organizations were operational. Another nine programs were planned. Collectively, existing organizations served approximately 25,000 members and deployed more than 600 vehicles. Between August 2002 to July 2003, membership in carsharing programs grew by 110

percent; the number of vehicles increased by 35 percent. The three largest carsharing organizations: Flexcar and Zipcar—both for-profit businesses—and City Carshare, a non-profit organization, accounted for 95 percent of U.S. membership and 91 percent of the total fleet. As such, these organizations had an extensive impact on overall growth.

FIGURE 4.1: U.S. Carsharing Membership and Vehicle Fleet Growth



As a result of growth and regulatory incentives that award additional credits for placement of clean-fuel vehicles into carsharing programs (e.g., the California Zero Emission Vehicle Mandate, see (4) for more information), automakers and technology providers have expressed an increased interest in shared-use vehicle services. In the future, decreasing electronic and wireless technology costs could support increased market growth and the ongoing development of carsharing technologies, such as customized hardware and software systems.

During the author's latest survey of U.S. carsharing organizations (August 2002 to July 2003), several additional trends were identified. In addition to ongoing neighborhood carsharing expansion, there is an emerging trend towards the business carsharing market. At present, corporate carsharing services include: 1) the augmentation or substitution of company fleets with carsharing vehicles; and 2) fleet management services in which the carsharing organization administers an existing commercial fleet of vehicles owned or leased by a corporation.

Another trend represents a secondary market expansion (or business operation outside the core carsharing market) into what we call "carsharing support systems." At present, this includes two key areas: 1) licensing of carsharing technologies—software or hardware—to other shared-use vehicle service providers, government, or corporate fleets; and 2) contracting of back-office management support (e.g., reservations and billing) to other carsharing organizations.

Other market updates include funding, insurance, fixed program costs, and revenue generation. In the recent survey, smaller non-profit organizations identified decreased public funding

opportunities as a primary obstacle to sustainability. High insurance costs continue to adversely affect market growth—posing an entry barrier to planned start-ups—across carsharing programs. While high premiums were recognized as a concern, the majority of organizations surveyed reported that securing an insurance carrier was not as significant a challenge in contrast to one year ago. A possible explanation for this is continued market growth (i.e., doubling in membership since August 2002), which might have led to increased familiarity with this innovative service among insurers. It is also interesting to note that difficulties in identifying affordable insurance can translate into a competitive advantage for organizations that obtain lower rates. High fixed costs due to vehicle leasing/purchase and program management, however, continue to mark an ongoing market barrier. Finally, difficulties in revenue generation were reported in a few cases, largely attributed to overall economic downturn. The next section includes a description of the CarLink model, technology, and lessons learned.

SECTION 4.2 CARLINK II: BUSINESS MODEL, TECHNOLOGY, AND FINDINGS

Between 1998 and 2003, researchers deployed a three-phase carsharing research program in the San Francisco Bay Area, called CarLink, in conjunction with the California Department of Transportation (Caltrans), California's Partners for Advanced Transit and Highways (PATH), the Institute of Transportation Studies-Davis (ITS-Davis), Honda Motor Company, the Bay Area Rapid Transit (BART) District, Caltrain, and Lawrence Livermore National Laboratory (LLNL). During the first phase, researchers conducted a longitudinal survey that examined CarLink concept response (for more information, see (5)). During the second phase, researchers assessed CarLink I—a field test that examined user response and operations in a controlled setting. CarLink I was based at the Dublin/Pleasanton BART station and operated for ten months during 1999 (6). In the final phase, researchers evaluated the CarLink II pilot program, which ran from July 2001 through June 2002, and was based at the California Avenue Caltrain station in Palo Alto. The research goals of this pilot project included testing advanced carsharing technologies, overall user response, and system economics.

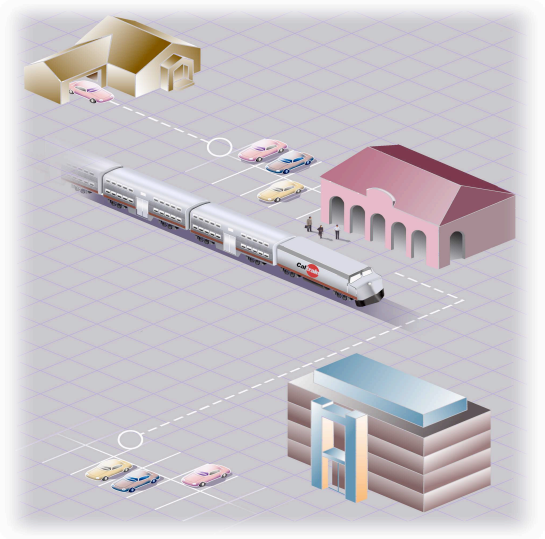
The most common shared-use vehicle model is known as neighborhood carsharing, where vehicles are deployed at many different locations in several neighborhoods for easy member access; these vehicles are accessed from and returned to the same lot. CarLink tested a commuter carsharing model that provides vehicle access at home and work, as well as a transit linkage on either commute end. The following discussion provides an overview of the CarLink model.

SECTION 4.3 CARLINK MODEL: A BRIEF OVERVIEW

Both CarLink I and II were based on the same commuter carsharing structure, involving three sets of members: Homebased Users, Workbased Commuters, and Workbased Day Users. Both CarLink programs included a single, primary transit station that served as a vehicle transfer point for Workbased Commuters and Homebased Users who commuted via transit. CarLink provided a convenient transit linkage to and from home/work via a shared-use vehicle fleet. This same fleet was also shared by households and employers for trip-making on evenings and weekends and throughout the workday.

Each morning, Homebased Users would drive their CarLink vehicles to a selected transit station, park the car in a designated CarLink space, and ride transit to work. Next, a Workbased Commuter would arrive at the same station via train in the morning; pick up a CarLink car; and drive it to work, parking in a designated CarLink space at their work location. Throughout the day, Workbased Day Users could reserve CarLink vehicles for business and personal errands, returning the cars to a designated work lot after each trip. At the end of the workday, Workbased Commuters drove the CarLink vehicles back to the transit station and would take the train for the remainder of their trip home. After returning Homebased Users—riding the train for the majority of their commute home—arrived at the transit station, they would pick up a CarLink vehicle and drive it home for personal use on evenings and weekends. See Figure 2, below, for a graphic representation of the CarLink model.

FIGURE 4.2: The CarLink Model (Consisting of Three User Groups: Homebased Users, Workbased Commuters, and Workbased Day Users)



As mentioned above, the CarLink II pilot program is based on the same general model as CarLink I. However, lessons gleaned from user feedback and recommendations from the CarLink I staff and project partners (i.e., Honda, Caltrans, BART District, and LLNL) suggested several changes to improve the model and research focus. Overall, it was decided that more could be learned by adapting the model to a new setting and attempting to create a permanent enterprise. This section describes the CarLink II project components and how they differ from CarLink I. Table 4.1, below, summarizes the major differences between CarLink I and II.

TABLE 4.1: Differences between CarLink I and II

STUDY CHARACTERISTICS	CARLINK I	CARLINK II
Number of Vehicles	12 Vehicles	19 Vehicles
Primary Transit Partner	BART	Caltrain
Transit Station Location	Dublin/Pleasanton	Palo Alto
Vehicle Type	Compressed natural gas Honda Civics	Ultra-low emission Honda Civics
Homebased Users	Up to 10 households, pay $200 per month.	Up to 16 households, pay $300 per month.
Workbased Commuters	Up to 20 Lawrence Livermore National Laboratory (LLNL) employees pay $60 per carpool ($30 each).	Up to 63 employees of businesses at Stanford Research Park (primarily), share CarLink vehicles to carpool to/from work. Businesses pay $350 per month per vehicle (a combined fee) for Workbased Commuter and Day Use services (in contrast to employees paying for this service independently as in CarLink I).
Workbased Day Users	Employees of LLNL pay $1.50 per hour and $.10 per mile.	Up to 28 employees of Stanford Research Park companies and other nearby businesses have access to vehicles for business and personal use. Employers pay $350 per vehicle per month to subscribe to the combined Workbased Commuter and Day Use services.
Total Users	54	107
Employer	One: LLNL	Six: Several private companies at/nearby Stanford Research Park
Technology	In-vehicle tracking, smart key kiosk at transit station, smart cards, manual key boxes at LLNL, and on-line scheduling system at LLNL	In-vehicle tracking, automated data collection, smart key fob entry, PIN-based vehicle login, on-line reservations, and in-vehicle navigation system
Program Length	Field test designed for limited 10-month duration	Pilot program with planned transition to on-going carsharing service
Research Goals	Document demand for commuter carsharing service and gauge user satisfaction and needs	Continued analysis of commuter carsharing (in a new setting) with greater statistical confidence (i.e., a greater sample size) and new emphasis on technology testing, its impact on cost reduction, and longer-term program sustainability

SECTION 4.4 CARLINK TECHNOLOGY

The CarLink I and II carsharing programs both employed advanced technologies that offered operations staff the ability to access and track vehicles. In CarLink I, however, the two main technologies employed were not integrated: 1) the Car-sharing Organization and Communication System (COCOS) vehicle reservation and access technology, and 2) the radio-frequency based vehicle tracking system, Teletrac. Several CarLink I technology shortcomings contributed to delays and necessitated program modifications (e.g., some Teletrac functions could not be performed as originally envisioned, such as user data transmission). Recommendations included that technology should be integrated (e.g., tracking, reservations, and billing), customized to facilitate vehicle access, and designed to serve multiple lot designs. Furthermore, the Day Use reservation system was not integrated with the vehicle tracking system. As a result, vehicle availability could not be guaranteed.

For CarLink II, Honda R&D, Americas developed an integrated carsharing system that included: 1) vehicle access (smart key fobs); 2) a reservation system (internet-based website); and 3) vehicle use and tracking (car location, vehicle miles traveled, fuel levels, user ID number, and time). CarLink II also included a navigational system to direct users to a destination.

Members accessed vehicles using an electronic key fob, which was held above the key reader or transponder mounted in the back windshield of a CarLink vehicle, to release the door lock. Homebased Users and Workbased Commuters each had their own key fob. Workbased Day Users, at selected employment sites, obtained a key fob at the front desk of their office, prior to and after vehicle use.

The CarLink reservation system was web-based and accessible by a personal computer. CarLink II operations staff was able to monitor the reservation system remotely. The system allowed for reservations to be made in advance (e.g., one month) or at the last minute. The system was designed with a cushion of 15 minutes between reservations.

The vehicle tracking system employed a combination of cellular and Global Positioning System (GPS) technologies. Vehicle tracking enabled CarLink II staff to monitor car location and availability, time of use, user ID, VMT, and fuel levels. Cars were tracked consistently throughout the pilot program. In addition, CarLink II operations staff could remotely monitor real-time vehicle data. Table 4.2, below, offers a comparison between the CarLink I and II technologies.

TABLE 4.2: Comparison of CarLink I and II Technology

TECHNOLOGY FEATURES	CARLINK I	CARLINK II
Vehicle Access and Ignition	• Smart key box at train station • In-vehicle immobilizer that required an initialized key to start car • Manual lock boxes at employment location	• Smart key fob for instant vehicle access • In-vehicle immobilizer that required a personal identification number (PIN) code to start vehicle
Vehicle Tracking	• Teletrac system using Radio Frequency (RF) technology	• Cellular and GPS technology • Ability to locate vehicle and transmit vehicle usage data, including user ID
Data Collection	• RF technology, which did not function reliably in terms of data transmission • Manual trip diary collection was implemented	• User ID • Time in and out of vehicle • VMT • Trip purpose • Fuel level
Reservation System & Billing	• On-line reservation system available only for LLNL employees • Phone call necessary to make reservation changes • Limited reservation system access by CarLink I staff • Billing conducted manually	• Real-time and advanced reservations • Online access from any location • Fully accessible to CarLink II staff • Automated billing
In-Vehicle Navigation	• Not included	GPS-based navigation system

SECTION 4.5 CARLINK II: TECHNOLOGY LESSONS LEARNED

One of the many benefits of demonstration/pilot programs is the opportunity to test new technologies in a "controlled" environment. Since participants know that they are engaging in a study, they are often open to collaborating with researchers and program operators in understanding and modifying technology/service features prior to widespread deployment. For instance, the CarLink II reservation system underwent several revisions. Throughout the CarLink II technology testing, program participants identified practical technology issues, and operations staff worked with technology developers to address them, if at all possible during the pilot phase.

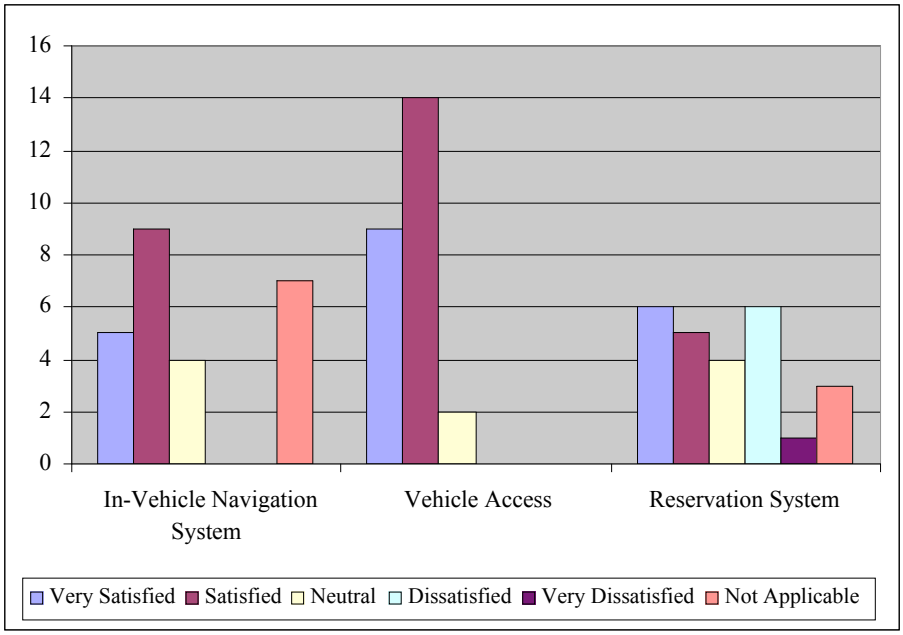
Because the technology was straightforward to operate, the operations staff incorporated training into the initial CarLink II orientation sessions. This proved to be sufficient for most members. A membership manual provided additional details on the reservation system. Not surprisingly, employees from various member companies reacted differently to the technology. More technologically advanced member companies (e.g., software and biotech) were more comfortable with the CarLink II technology and asked more questions, often offering

recommendations for improvement. Employees from other member companies (e.g., a foundation) required more upfront training and were more likely to ask for assistance immediately after a problem occurred, rather than attempting to solve the difficulty themselves. The following sections provide feedback from interim user interviews (six months into the CarLink II program) and final program focus groups and interviews at the end of the 12-month pilot.

4.5.1 CarLink II User Feedback: Interim Interviews

After the first six months of the program, PATH researchers conducted 25 personal interviews with CarLink II participants. Interviewees included Homebased Users, Workbased Commuters, and Workbased Day Users from four participating employment sites (two additional companies joined during the second half of the pilot program). During the interviews, researchers addressed the following CarLink II components: in-vehicle navigation system, vehicle access, and reservation system. Findings are presented in Figure 4.3, below. User satisfaction is measured employing a five-point Likert scale (ranging from very satisfied to very dissatisfied).

FIGURE 4.3: User Satisfaction with CarLink II Features



A discussion of each CarLink II technology component, featured in Figure 4.3, follows:

4.5.1.1 In-Vehicle Navigation

The interviewees found the in-vehicle navigation system satisfying, although many members had never used it. Of those that had, only two used it regularly (one Workbased Commuter and one Homebased User), while the rest only "tried it out" a few times. Since the majority of user trips were on known routes, limited use could be expected.

4.5.1.2 Vehicle Access

Vehicle access is defined as unlocking the car with a key fob and logging into the computerized system with a PIN, which released the ignition immobilizer and attributed the current trip activity to the user's ID number. Fifty-six percent of respondents were satisfied, and 36 percent were very satisfied with the vehicle access system. Two respondents said that the fobs were occasionally difficult to use, and one found the PIN-input keypad difficult to operate. A few interviewees indicated that they at first had difficulties with the keypad screen, but adjusted to its use by the time of the interviews.

4.5.1.3 Reservation System

The reservation system allowed Workbased Users to reserve vehicles in advance for Day Use trips. Generally, one of the CarLink II vehicles could not be reserved in advance to provide an overall system buffer. The reservation and access systems did not provide a "lockout" component (i.e., preventing one member from taking a vehicle reserved by another), so members were entirely on an "honor system."

As shown in Figure 4.3, reaction to the CarLink II reservation system was mixed, with 28 percent of respondents claiming to be dissatisfied or very dissatisfied, while 44 percent said they were satisfied or very satisfied. Dissatisfied members started using the reservation system less often, but most believed that the problems were being resolved and planned to start using it again. The primary reason for reservation system dissatisfaction was the lack of a lockout system—guaranteeing that a reserved vehicle would be waiting for the person who requested it. Vehicle lockout was identified as an area for next generation technology development, as it was not addressed during the CarLink II pilot program due to costs and time requirements. Table 4.3, below, shows how often a reserved vehicle was not available at specified times among those interviewed after they joined the program (essentially during the first six months of the CarLink II pilot).

TABLE 4.3: Number of Times Reserved Vehicle Not Available

FREQUENCY	NUMBER
Never	9
Once	4
Twice	4
Three to Five	1
More than Five	2

While "missing" reserved vehicles was a frequent complaint at one company, most interviewees felt the majority of blame belonged to fellow users (rather than the CarLink II technology). Indeed, some users simply ignored the reservation system. At the time of the interviews (early 2002), most participants felt that CarLink II staff were bringing about changes that would effectively solve this problem (e.g., requiring Workbased Commuters as well as Day Users to

"sign-out" vehicles at the front desk). Other reservation system complaints involved the overall reservation process and website formatting, including:

- Scrolling on the web page was difficult;
- There were too many steps involved in making a reservation;
- All cars should be available to reserve in advance (i.e., not keeping one of the company's CarLink II fleet vehicles in reserve);
- The reservation page's clock was not always accurate; and
- There was no way to inform the reservation system directly (e.g., automated phone interface) that a Day Use trip was running longer than expected—verses asking CarLink II staff to check the reservation's page and notify the next scheduled user.

Despite reservation difficulties, many participants who were vocal about reservation concerns, seldom if ever, actually experienced a problem. However, the perception that a reserved vehicle might not be available became so dominant that many saw this as the most critical CarLink II concern. The next section reflects member feedback from the final focus groups and interviews, conducted at the close of the 12-month program.

4.5.2 CarLink II User Feedback: Final Focus Groups & Interviews

This section provides technology highlights from the two final CarLink II focus groups and an interview session conducted by PATH researchers in May 2002. A total of 22 individuals participated in the focus groups (n=18) and interviews (n=4), including 12 women and 10 men. The sessions generally began with a discussion of participant's transportation methods prior to and during CarLink II enrollment, including likes and dislikes of these modes. The discussion then focused on CarLink II experiences and perceived program strengths and weaknesses. All groups provided suggestions on how to improve the recruitment process among other recommendations. Overall, the focus group participants had a very positive reaction to CarLink II. This section focuses on CarLink II technology feedback exclusively.

Primarily at one CarLink II member company, many users had difficulties with the on-line reservation system. In at least one case, this led to a member dropping out of the program. Some problems were relatively minor, such as difficulty scrolling through the web page. Others were more significant, including inaccurate scheduling clocks. More serious problems occurred when: 1) a member reserved a vehicle, but found that it had already been taken by another user; or 2) individuals reserved a vehicle, but they did not actually use it (preventing other members from taking it). In the latter case, members were unable to use a "reserved" vehicle even though the car was still in the lot (i.e., the reservation page did not automatically "open up" a reservation when a scheduled vehicle was unused). Another problem arose when a vehicle was reserved but was not returned on time. Possible solutions offered by the group included: 1) a lockout system for at least the first ten minutes of a timed reservation, and 2) user fines for individuals who took a vehicle, which has been reserved by someone else.

Focus group and interview participants also noted other CarLink II problems. Nearly everyone reported that the key entry fobs should unlock the vehicles more rapidly (i.e., users were required to hold their key fob over the vehicle reader for several seconds verses just a few), and many

noted occasional problems logging (or entering their PIN) into the message display terminal keypad. Some also said that they would like to access vehicles at different worksites and transit stations. In general, the most serious complaints were vocalized by individuals who had been stranded—either because a vehicle was unavailable or the CarLink II technology had malfunctioned (and refused access). To counter such difficulties, the CarLink II program included a guaranteed ride (either taxi or rental car) and 24-hour, 1-800 roadside assistance. Overall, the majority of complaints focused on convenience and ease of system use.

4.5.3 Summary

Throughout the CarLink II pilot program, technology refinements and feature values were amassed. Benefits were attributed to:

- Enhanced user convenience via online reservations and smart key fob access;
- Streamlined operations and cost savings resulting from automated reservations and billing;
- Vehicle tracking and automated data collection features (e.g., user ID, time of use, VMT, and fuel level) provided valuable logistics understanding and labor savings; and
- Additional cost savings were received from insurance discounts resulting from CarLink II's tracking and ignition immobilization features.

Nevertheless, technology components could be improved, including:

- A "lockout" feature for reserved vehicles should be developed;
- The key fob door-release speed should be increased;
- The PIN entry screen process should be improved;
- The vehicle immobilizer should be integrated with the engine control unit to make this feature much more secure;
- The online reservation page should be modified to improve scrolling and reflect the correct time;
- The number of steps involved in making an online reservation should be reduced;
- All CarLink II company fleet vehicles should be available for use (i.e., none should be kept in reserve, which might be addressed by the vehicle lockout feature);
- A means to directly inform the reservation system that a trip is going over time should be developed (e.g., automated phone interface); and
- Reserved cars that are unused should be converted to "available for use" automatically on the reservation page after a 10- to 15- minute waiting period. (Furthermore, users should be fined, if they do not cancel a reservation in advance.)

SECTION 4.6 CONCLUSION

Advanced technologies can contribute significantly to enhancing the economic sustainability of innovative transportation alternatives and to increasing choice among available travel modes. Carsharing is one such alternative mobility option. The rapid growth of carsharing membership and fleet size, and the expansion/diversification of services aimed at new customer groups (e.g., business customers) indicate an unmet demand for shared-use vehicle services. Thus, advanced

technologies can play an important role in supporting this emerging market, streamlining carsharing operations, increasing customer satisfaction, and enhancing economic viability.

Electronic and wireless technologies can provide automated vehicle usage data, consolidate reservations and billing, and allow real-time vehicle monitoring (e.g., location, fuel level, on-board diagnostics, etc.). Customer satisfaction can be increased through convenient reservations and seamless vehicle access. Primary economic benefits of advanced technologies are reduced management costs, insurance discounts, and expanded market growth (presumably due to increased convenience and customer satisfaction).

The CarLink II pilot program enabled testing of an integrated carsharing system, as well as the evaluation of advanced technology impacts on program logistics and costs. In general, online reservations proved to be efficient from both an operator's and customer's perspective. Key fobs and instant vehicle access (in contrast to a standalone lock box containing vehicle keys) were perceived as convenient. The vehicle immobilization feature (released via entry of a valid user PIN number) represents a cost-efficient means to maximize vehicle security and reduce insurance costs. Vehicle tracking provided valuable system performance data, reduced labor costs due to automated billing, and insurance discounts. Future technology development efforts should include lock-out mechanisms, which restrict user access to reserved vehicles. Based on the CarLink II pilot experience, the lock-out feature appears to be crucial to customer satisfaction and overall system efficiency. Similarly, a web-based vehicle reservation system should be designed to facilitate highly user-friendly reservations and vehicle scheduling changes (e.g., via phone from the road when a scheduled trip goes over time).

To provide comprehensive system data, CarLink II employed advanced, integrated technologies throughout. However, it is advisable for a shared-use vehicle start-up to initially use less advanced, off-the-shelf technologies. Due to the high initial fixed costs of implementing advanced technologies, periodic upgrades should be incorporated based on revenue generation once high initial start-up costs are recuperated. Vehicle tracking services can vary widely in price depending on the degree of tracking activity requested. Basic technologies that facilitate vehicle tracking and capture essential vehicle usage data are available for only a few hundred dollars per vehicle and are easy to install. Economies-of-scale arise when system components serve a larger fleet (e.g., 100 vehicles or more). Hence, advanced technologies are especially profitable for sizable fleets (e.g., when manual administration can be automated and streamlined).

Increased U.S. carsharing growth, as well as regulatory incentives (e.g., the California ZEV mandate), appear to be attracting automakers and technology providers to build closer ties with carsharing organizations. In turn, the shared-use vehicle industry will benefit from more advanced and affordable carsharing technologies. Increasingly, vehicles will be equipped with factory preinstalled and upgradeable technology components, creating a cost-effective interface for a variety of customized carsharing software and hardware systems. Not surprisingly, carsharing hardware/software installation times will decrease and overall quality control will increase with the emergence of factory preinstalled in-vehicle telematics. More widespread availability of vehicle telematics could also lead to greater interoperability among carsharing technologies/providers and between carsharing and public transportation operators. Finally, seamless, intermodal transit linkages could also result in increased carsharing customer

satisfaction and market growth, as well as additional business opportunities (e.g., real-time traveler information services).

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CHAPTER FIVE

CARLINK—A COMMUTER CARSHARING MODEL: CONDITIONS FOR ECONOMIC VIABILITY

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ABSTRACT

At present, only a few alternatives exist to facilitate transit access. To expand the suite of viable modes, more demand-responsive mobility services should be developed. Under specific conditions, short-term rental vehicles linked to transit (or commuter carsharing) can offer a sustainable transportation alternative to private vehicles, particularly in suburban locations where transit connectivity is more limited. From January to November 1999, a commuter carsharing model, called CarLink I, was tested in the East San Francisco Bay Area. Building on CarLink I, the CarLink II pilot program was deployed from July 2001 to June 2002 in the South San Francisco Bay Area with the option of transitioning to a third-party provider. Examination of CarLink I and II economic data and scenario analyses—which explore program modification effects on viability—revealed several economic success factors. In addition to fixed monthly CarLink rates, the introduction of hourly rentals is an important strategy to diversify CarLink income streams and maximize vehicle use, as well as a revenue-risk sharing approach among partner participants (e.g., employers, transit providers). Additional strategies to create more viable commuter carsharing services include raising rates for business customers, lowering insurance rates, controlling costs through technology and scale, and marketing strategies.

Key Words: Carsharing, CarLink, Economics, Scenario Analysis

SECTION 5.0 INTRODUCTION

Given the limited number of demand-responsive modal options, many individuals rely on personal vehicles for the majority of their travel needs. Not surprisingly, high vehicle ownership can result in gridlock during peak travel periods and parking shortages in densely populated regions. To extend the range of flexible and convenient modes, more economically sustainable transportation alternatives should be explored. Options that are competitive with the private auto are more likely to be sustainable.

Shared-use vehicle services, such as carsharing and station cars (i.e., vehicles directly linked to transit), represent one approach to increase the range of available travel modes. Members of a carsharing organization have access to one or more vehicles on an as-needed basis; vehicles are typically "rented" for periods of a few hours or less (1). Carsharing services can provide a viable demand-responsive mobility option under specific economic conditions. Shared-use vehicle services emphasize variable transportation costs, such as fuel, in contrast to fixed auto ownership costs (e.g., purchase or lease of a vehicle).

The CarLink I and II initiatives discussed in this paper represent a commuter carsharing model. CarLink combines direct transit linkages with shared-use vehicle services. CarLink program objectives included increasing transit ridership, testing advanced technologies, and researching program viability (2). Building on CarLink I and CarLink II economic understanding, this paper identifies key factors that might support a more sustainable commuter carsharing operation.

Typically, time, convenience, and economic factors characterize the major concerns of potential carsharing customers. During the CarLink program, the application of shared-use vehicle services to employers as substitutes or augmentations to corporate fleets emerged as a business strategy. In addition, several corporate customers joined the CarLink II program to offer carsharing as an employee benefit (e.g., personal and business trip-making). Use of advanced technologies was found to increase customer satisfaction, decrease labor costs (e.g., when several administrative tasks are automated), and earn insurance discounts. Furthermore, electronic and wireless technologies provide opportunities for new shared-use vehicle services. Such technologies, however, require high initial investment. More economically sustainable operations can be further achieved through diversification of revenue streams and increased vehicle use when a variety of services are offered to different customer groups. Likewise, synergies can be achieved through partnerships among transit agencies, developers and carsharing providers. Additionally, partnerships that include a revenue-risk sharing component can distribute financial risks more adequately among beneficiaries of a carsharing service and can prove mutually advantageous.

Building on CarLink I and II research findings, the authors developed three scenarios to examine economic impacts of various program modifications. Under specific conditions, CarLink could serve as an economically viable demand-responsive mobility option.

This paper is organized into four parts. First, the CarLink I and II business models are presented. Next, a scenario analysis explores business services, short-term rentals, and revenue-risk sharing as key approaches to enhance shared-use vehicle economics. Finally, recommendations for

enhancing program viability are presented based on findings and experience from the CarLink I field test and CarLink II pilot program.

SECTION 5.1 CARLINK: A COMMUTER CARSHARING MODEL

This section includes a description of the CarLink I model and lessons learned, CarLink II's economic structure, actual CarLink II costs, distribution of CarLink II fixed and variable costs, and actual CarLink II revenues.

5.1.1 Description of CarLink I and Lessons Learned

The objectives of CarLink I were to increase transit ridership by attracting new riders, encourage more frequent ridership among existing users, and understand CarLink user response and program logistics (2, 3). Building on CarLink I, the CarLink II pilot program tested integrated carsharing technologies and economic viability (2). Both CarLink programs combined aspects of station car programs (i.e., vehicles directly linked to transit) with traditional carsharing.

CarLink I launched in January 1999, and ended in November 1999. Fifty-four participants from San Francisco and other Bay Area communities shared 12 natural gas powered Honda Civics based at the Dublin-Pleasanton Bay Area Rapid Transit (BART) District station. The program featured three different user groups: Homebased Users, Workbased Commuters, and Workbased Day Users. Homebased Users drove CarLink vehicles to and from the Dublin-Pleasanton BART station, as well as on evenings and weekends. Workbased Commuters used the CarLink vehicles to commute from the transit station to their employment site. Workbased Day Users employed the vehicles for business and personal use during the workweek (3). By servicing three different customer segments, CarLink II facilitated vehicle use throughout the day (4).

CarLink I received revenues from three different user groups. Homebased Users paid a flat monthly fee of $200; Workbased Commuters paid $60 per month; and Day Users were charged $1.50 per hour and $0.10 per mile driven. For each group, user fees included fuel costs, insurance, and maintenance. Although losses were incurred, scenarios were explored under CarLink I that might become economically viable (3, 4). Larger revenues from higher user fees, increased vehicle Day Use, and streamlined administration through advanced technologies were recognized as important to economic viability. If a larger fleet were operated, economy-of-scale effects would potentially materialize. Furthermore, if alternative fuel vehicles were employed, operators might benefit from federal, state, and regional financial incentives (4).

5.1.2 CarLink II Economic Structure

The CarLink II pilot program was operated over 12 months from July 2001 to June 2002 in Palo Alto, California. The program was a joint effort among Caltrans; Caltrain; American Honda Motor Company, Inc.; California Partners for Advanced Transit and Highways (PATH); and the Institute of Transportation Studies-Davis (ITS-Davis). Similar to CarLink I, three user groups drove CarLink II vehicles: Homebased Users, Workbased Commuters, and Workbased Day Users. Homebased Users, largely residents of the Palo Alto area, drove CarLink II vehicles to the California Avenue, Palo Alto Caltrain station to commute, as well as on evenings and weekends.

Workbased Commuters used CarLink II vehicles to commute from the transit station to their respective employment sites in or near the City of Palo Alto. Workbased Day Users employed the vehicles for business and personal trips throughout the day. CarLink II deployed 19 Honda Civics that served up to 94 and on average 77 users. A total of 107 individuals enrolled in the program (16 Homebased Users, 63 Workbased Commuters, and 28 Workbased Day Users); 13 never used the service. Workbased Commuters and Day Users were employees of six corporations participating in the CarLink II program (primarily members of Stanford Research Park).

In the next section CarLink II actual program costs are examined.

5.1.3 Actual CarLink II Costs

In Table 5.1, the authors present 14 categories of operational costs for a 12-month period, including 19 vehicles.

TABLE 5.1: Actual CarLink II Costs

TYPE OF EXPENSE	AMOUNT
Staff	$ 100,000
Technology	$ 67,000
Vehicle Depreciation	$ 40,297
Marketing	$ 31,893
Field Support & Carwash	$ 29,840
Insurance	$ 22,325
Administration	$ 16,609
Office Space	$ 12,000
Vehicle Tracking Services	$ 7,791
Fuel	$ 5,372
Vehicle Licensing	$ 3,800
Accident Repair	$ 3,725
Roadside Assistance	$ 1,350
Guaranteed Ride Service	$ -
TOTAL	**$ 342,002**

Staff Salaries: CarLink II required a full-time administrative assistant in addition to a full-time management position, with respective salaries of $40,000 and $60,000. This resulted in $100,000 in staff salaries, equivalent to $8,333 per month.

Technology: CarLink II employed the following technologies:

- Online reservations,
- Smart key fobs,
- Vehicle ignition immobilizer and release via personal identification number (PIN), and

- Cellular and global positioning satellite (GPS) based vehicle tracking and automated navigation system.

  The integrated CarLink II technologies provided information on vehicle position and fuel levels and collected automated CarLink vehicle usage data (i.e., user ID, time, and vehicle number) when vehicles entered and exited designated CarLink transit and employment lots. CarLink II combined convenient on-line customer reservations with secure and simple vehicle access technologies. Some administrative tasks, such as vehicle reservations, were automated. System costs were $3,000 per vehicle, including installation costs. In addition, two servers were purchased for $10,000 to administer vehicle tracking and collect vehicle usage data. CarLink II technology expenditures totaled $67,000.

Vehicle Depreciation: Researchers calculated the depreciation for each of the 19 CarLink II vehicles by averaging actual and retail values for a 12-month old 2001 Honda Civic LX, with mileage of 3,291 (i.e., the average CarLink II per vehicle mileage). This resulted in $176.75 depreciation per vehicle/month and a cost of $40,297 for all 19 vehicles throughout the program (5).

Marketing: Marketing costs of $31,893 included website development; design and printing of CarLink II brochures, flyers, and postcards; and the costs of creating a recruitment video featuring the program.

Field Support & Carwash: All cars were cleaned three times per month. The costs of $29,840 ($131.88 per vehicle/month) include labor hours for an outside contractor to drive the vehicles to and from a carwash.

Insurance: Due to the short CarLink II pilot program duration, it was possible to obtain insurance at annual premiums of $1,175 per car.

Administration (excluding personnel): Office expenses totaled $16,609. Telephone tolls (1-800 number) and equipment purchases accounted for most administrative costs.

Office Space: CarLink II management and administration were housed in an office facility at ITS-Davis. Office space costs were estimated at approximately $1,000 per month.

Vehicle Tracking Services: The 24-hour cellular tracking service for all deployed vehicles cost $7,791; monthly per vehicle costs were approximately $50.

Fuel: Fuel costs of $23.56 (on average) per vehicle/month resulted in total costs of $5,372.

Vehicle Licensing: One-time licensing fees of $200 per vehicle amounted to a total of $3,800 for the CarLink II fleet.

Accident Repair: Four incidents during the program resulted in accident repair costs of $3,725. Averaged over the number of vehicles deployed, annual repair costs corresponded to $196.05 per vehicle.

Roadside Assistance: Incidents during the program necessitated roadside assistance expenses of $1,350 for the 19 vehicles in the CarLink II fleet.

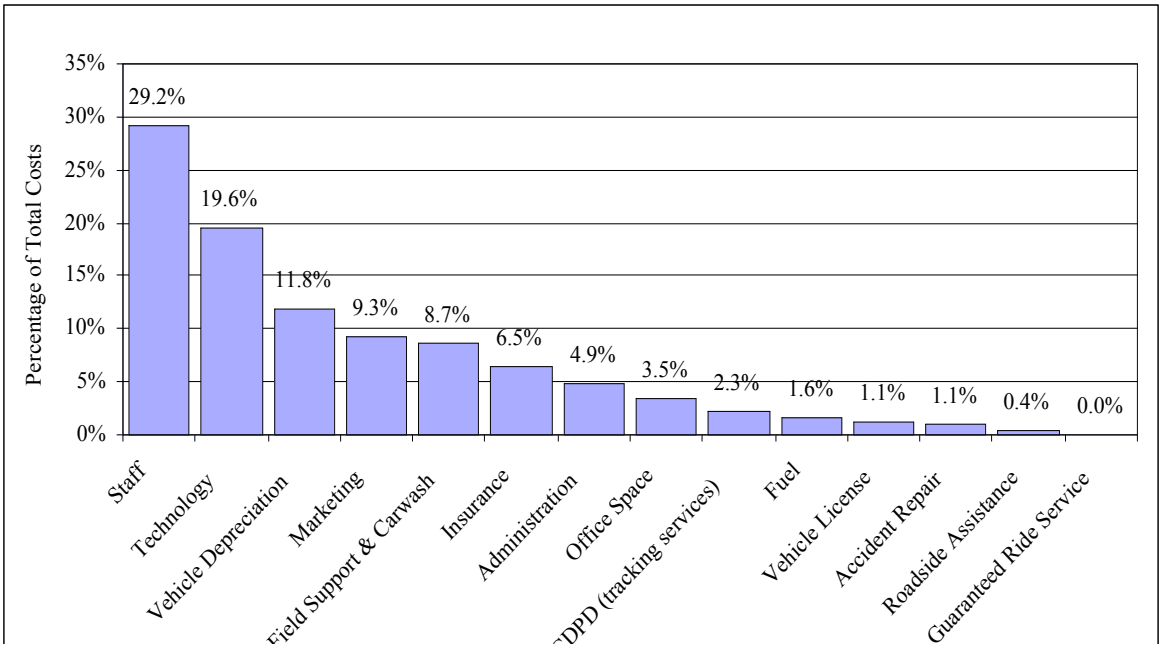
Guaranteed Ride Service: This service option was never requested. Thus, there were no costs incurred during the pilot program.

CarLink II program costs totaled $342,002 during the 12-month pilot program. In the next section, the authors describe the distribution of fixed and variable service costs across 14 operating expense categories.

5.1.3 Distribution of CarLink II Fixed and Variable Costs

Fixed costs included administration, vehicle depreciation, insurance costs, marketing, office space, staff salaries, and technology expenditures. Variable costs consisted of expenses for accident repair, cellular vehicle tracking, field support and car washing, fuel, guaranteed ride services, and roadside assistance. Eighty-six percent of total CarLink II costs were fixed ($293,924), and only 14.1 percent were variable costs ($48,078). Staff salaries represented the single largest cost (29.2 percent of total costs), followed by technology (19.6 percent), vehicle depreciation (11.8 percent), marketing (9.3 percent), and field support and car washing (8.7 percent). See Figure 5.1 below.

FIGURE 5.1: CarLink II Cost Distribution



Interestingly, the CarLink II cost distribution is not representative of the majority of U.S. shared-use vehicle operations. The majority of U.S. operators report vehicle purchase/leasing expenses as their number one cost. Management costs rank second, followed by insurance (20 to 48 percent of operation costs), and technology (1).

The CarLink II costs exceeded program revenues by $271,152. Actual CarLink II pilot program revenues are discussed in the next section.

5.1.5 Actual CarLink II Revenues

American Honda Motor Company, Inc. donated 19 Honda Civics for the CarLink II pilot program. The number of vehicles deployed varied throughout different months of operation. Caltrain provided free parking, reserved exclusively for CarLink II vehicles, at its California Avenue, Palo Alto transit station.

CarLink II had two separate sources of revenues: Homebased Users and business customers, which covered both Workbased Commuter and Workbased Day Use components.

The monthly fees for Homebased Users and business customers included fuel, insurance, and maintenance costs, as well as roadside assistance and a guaranteed ride service for emergencies. Homebased Users paid a flat monthly fee of $300. If 1,000 miles per month were exceeded (the U.S. average vehicle use per month is approximately 500 to 600 miles), $0.25 was charged for every additional mile. Eleven potential customers initially participated in a CarLink II Homebased User trial offer. This trial offer included one week of service for $25 (versus $300/month for full participation). More than 50 percent of individuals that participated in the trial joined as regular members.

Business customers paid a monthly fee of $350 per vehicle, which covered both Workbased Commuter and Day Use. If 1,000 miles per month were exceeded, $0.25 was charged for each additional mile. There were six employer subscribers, and program memberships ranged from four to twelve months. Business subscriptions ranged from one to five vehicles.

The CarLink II program generated total revenues of $70,688. See Table 5.2 below. Revenues from Homebased Users amounted to $17,238 and accounted for 24 percent of total revenues. Homebased User trial revenues were $250. Seventy-five percent of total revenues or $53,200 were collected from business customers. Additional fees (e.g., late vehicle return fees) accounted for $162 (0.2 percent of total revenues). No excess mileage fees materialized in the CarLink II pilot program.

TABLE 5.2: Actual CarLink II Revenues

REVENUE SOURCE	AMOUNT	PERCENTAGE OF TOTAL REVENUES
Employer Subscribers	$ 53,200	75.1%
Homebased Users	$ 17,238	24.3%
Homebased Trial	$ 250	0.4%
Additional Fees	$ 162	0.2%
Excess Mileage Fees	$ -	0.0%
Total	**$ 70,850**	**100%**

In the next section, the authors examine three scenarios—building on CarLink data and experience—to improve the economic viability of a commuter carsharing model.

SECTION 5.2 SCENARIO ANALYSIS: CONDITIONS FOR ECONOMIC VIABILITY

The following three scenarios explore modifications to the CarLink model.

The scenarios model costs and revenues over a period of three years. There are three revenue sources in each scenario: Homebased Users, business customers (including Workbased Commuters and Day Users), and short-term rentals. In the actual CarLink II pilot program late fees and excess mileage fees accounted only for a small fraction of total revenues and are excluded from the scenario analysis. All three scenarios include reserve vehicles (i.e., vehicles kept in reserve to help balance demand, particularly if vehicles are returned later than expected), which serve the purpose of maintaining efficient operations in high capacity situations. Vehicles would not be restricted to one transit station, as in the CarLink II pilot program, but would be placed more dynamically to reflect demand at one or more transit stations. This is critical to balancing vehicle demand and willingness-to-pay. Vehicles stay in the fleet for three years. Depreciation is calculated by the method of accelerated depreciation (i.e., depreciation costs are the highest in early years).

5.2.1 Scenario One: Optimal Market Conditions

Scenario One differs from the actual CarLink II program base case in the following ways. Insurance costs in the model were increased to $255.54 per vehicle/month ($3,071 per vehicle/year) to capture the high insurance rates common to the U.S. carsharing industry (1). This number is based on a weighted average of insurance rates (with respect to number of vehicles) in the carsharing industry (Dave Brook, unpublished data and (1)). Second, in-vehicle technology was set to $500 per vehicle in contrast to $3,000 in CarLink II. This one-time cost for each new vehicle represents the use of basic off-the-shelf technologies, which still allow for vehicle tracking and online reservations, and are more characteristic of the technologies employed in the U.S. carsharing industry (1). By contrast, CarLink II employed state-of-the-art technologies not common to the carsharing industry. Third, marketing costs are approximated at $10,000 for years two and three, as opposed to first-year expenditures of $31,893 as in CarLink II. Marketing expenditures are likely to be larger in the start-up phase than in successive years.

Fourth, monthly fuel costs per vehicle were doubled to $47.12 to account for increased use of the shared-use vehicles. Fifth, staff salaries were adjusted downward from $100,000 to $95,000 to capture operations of a typical carsharing organization (without the pilot program staff research costs as in CarLink II). Three employees are assumed throughout the scenario analysis (i.e., general manager, customer support, fleet manager). This is more reflective of a typical U.S. carsharing service. All other costs, including vehicle depreciation, field support and car washing, administration, office space, vehicle licensing, accident repair, roadside assistance, and the guaranteed ride service remain the same as in the actual program.

The program's revenue structure was adjusted by the introduction of short-term rentals for two hours per day on Saturdays and Sundays (as rationalized in the section "Recommendations" below). Short-term rental charges were approximated at $8.28 per hour, the weighted average of the three leading U.S. carsharing organizations (i.e., City Carshare, Flexcar and Zipcar), which collectively claimed 94 percent of all carsharing members in July 2003 (1, 6). This average figure was calculated using flat per hour charges as well as mileage fees. The scenario analysis assumes a flat per hour rate without mileage fees. Homebased Users pay $300 per month and business customers pay $960. The substantial increase in the employer rate structure (i.e., $350 in CarLink II is increased by $610) is based on actual willingness-to-pay among the largest U.S. carsharing organizations. The rate was calculated by comparing rates charged by carsharing companies for exclusive vehicle access in a business setting and rates charged by rental car companies for comparable (though not identical) fleet services. Homebased Users were found to be highly responsive to price changes and showed limited willingness-to-pay at prices above $300 per month (2). Hence, Homebased User fees in this scenario and the two other scenarios remained unchanged from the actual CarLink II payment structure.

The initial number of vehicles employed in Scenario One is 21. This corresponds to a fleet of 19 vehicles and two reserve vehicles. The actual CarLink II pilot program deployed 17 vehicles with reliance on two back-up vehicles. The reserve vehicles were deployed only a few times in emergency situations. Based on the CarLink II experience, back-up vehicles represent approximately ten percent of the regular fleet size to ensure operational efficiency during peak times or special circumstances. These reserve vehicles generate limited revenues, as their purpose is to maintain vehicle balance. As such, they represent a substantial cost, but are needed to manage a demand-responsive service. In the second year of operations, five vehicles (reflecting increased demand) are added to the fleet, resulting in 26 vehicles in year two. One of the five new vehicles is a reserve vehicle, which fulfills the necessary ten percent ratio of back-up vehicles to the regular fleet. Four more vehicles are added during year three, resulting in a total of 30 vehicles. Growth rates of similar and even larger magnitude have been observed in the U.S. carsharing industry over the past years (1, 6). This scenario achieves near-optimal economic conditions (without outside support).

However, Scenario One relies upon substantial demand and willingness-to-pay across several transit stations.

5.2.2 Scenario Two: Sub-Optimal Market Conditions

In this scenario, the commuter carsharing organization starts with only 17 vehicles (of which two are reserve vehicles) to reflect a slightly reduced carsharing market demand. Multiple factors, such as economic, land use, or demographic composition of a location, can lead to sub-optimal market conditions. The fleet growth pattern described in Scenario One does not materialize. The fleet grows by two vehicles in year two and by another two vehicles in year three. All costs and revenue patterns, adjusted for a smaller vehicle fleet, remain as described in Scenario One. Economic viability is not achieved (see Table 5.3 below). The major shortcoming of Scenario Two appears to be a limited demand for commuter carsharing, which does not allow the organization to achieve an economically viable size.

5.2.3 Scenario Three: Revenue-Risk Sharing Under Sub-Optimal Market Conditions

In this scenario, starting market conditions and fleet growth rates are as in Scenario Two. Without outside support, all costs and revenues would equal the numbers presented in Scenario Two. However, the carsharing organization shares the risk of losses with a transit operator. The rationale behind this model is simple: Since transit ridership increases as a result of commuter carsharing (i.e., due to transit linkages), the transit operator is a key beneficiary of this service. As such, a transit operator might assume some operational expenditure to launch the program and share part of the financial risk. Should the carsharing service prove profitable and exceed expected revenues, resulting profits could be shared with the transit operator. This is what the authors call a “revenue-risk sharing” approach. In essence, this model formalizes a business partnership between the carsharing and transit operators in which risk and revenues are shared.

In Scenario Three, the transit agency bears the cost of operating and maintaining reserve vehicles, thus reducing the high initial capital investment necessary to start the program. Ownership of reserve vehicles does not transfer to the carsharing organization. These vehicles are owned/leased by the transit operator and are made available to the carsharing program as back-up vehicles to meet demand fluctuations, without imposing further costs on the carsharing organization. This results in viable economic conditions for the carsharing organization. Without bearing the cost of the reserve vehicles (now incurred by the transit agency), the commuter carsharing program now generates profits over the three-year period. Due to the revenue-risk sharing partnership, however, a negotiated percentage of the profits is shared with the transit operator (see Table 5.3 below). In Scenario Three, it is assumed that profits beyond the break-even figure are shared by both transit and carsharing operators. The carsharing organization is able to cover its costs and operate under otherwise prohibitive market conditions. The transit operator shares in some of the risk and presumably benefits from increased ridership.

TABLE 5.3: Quantitative Results of Scenario Models

	YEAR ONE	YEAR TWO	YEAR THREE
SCENARIO ONE: Optimal Market Conditions			
Homebased Users	$68,400	$79,200	$90,000
Business Customers	$218,880	$253,440	$288,000
Short-Term Rentals	$37,558	$44,712	$50,077
Total Revenues	**$324,838**	**$377,352**	**$428,077**
Total Costs	**$351,937**	**$310,764**	**$329,463**
Profits	***-$27,099***	**$66,588**	**$98,614**
SCENARIO TWO: Sub-Optimal Market Conditions			
Homebased Users	$54,000	$61,200	$68,400
Business Customers	$172,800	$195,840	$218,880
Short-Term Rentals	$30,404	$35,770	$39,347
Total Revenues	**$257,204**	**$292,810**	**$326,627**
Total Costs	**$316,236**	**$285,025**	**$296,398**
Profits	***-$59,032***	**$7,784**	**$30,229**
SCENARIO THREE: Revenue-Risk Sharing Under Sub-Optimal Market Conditions			
Homebased Users	$54,000	$61,200	$68,400
Business Customers	$172,800	$195,840	$218,880
Short-Term Rentals	$30,404	$35,770	$39,347
Total Revenues	**$257,204**	**$292,810**	**$326,627**
Total Costs	**$299,381**	**$270,180**	**$282,027**
Profits	***-$42,177***	**$22,630**	**$44,600**

Scenario One assumes optimal market conditions (i.e., demand and willingness-to-pay for service) and steady growth. This requires flexibility to move vehicles as needed to match demand at required rates. Substantial profits in year two and year three outweigh initial start-up losses from year one. Economic viability is achieved without outside support.

Scenario Two assumes sub-optimal market conditions (e.g., demand, willingness-to-pay, overall economy, ability to relocate vehicles as needed). Growth is more limited and the program is not economically viable.

Scenario Three is identical to Scenario Two with respect to market conditions. However, a partnership with a transit provider (an example of a key beneficiary of the commuter carsharing model) allows for revenue-risk sharing. The transit operator assumes part of the initial start-up costs. In particular, the costs of operating reserve vehicles necessary for program flexibility is borne by the transit operator. Thus, the carsharing service provider can ensure flexible operations at a relatively low operational cost. However, profits too, are shared as described in year three.

Overall, the program is economically feasible. The revenue-risk sharing approach thus lowers the barrier to entry for potential commuter carsharing programs.

The next section includes recommendations for improving the overall viability of a commuter carsharing model.

SECTION 5.3 RECOMMENDATIONS

When taken together with the CarLink I and II experiences, the scenarios yield several success factors to be considered in future carsharing deployments. The following topic areas are discussed: user fees and short-term rentals, insurance costs, cost control through technology and scale, marketing strategies, and the revenue-risk sharing approach.

5.3.1 User Fees and Short-Term Rentals

User fees and short-term rentals are an important way to increase program revenues. Based on the high costs of vehicle ownership ($500-$550 monthly) and the service provided by CarLink II (i.e., insurance, fuel, and cleaning included), user fees could be raised to $400 for Homebased Users and to $1,000 for business customers based on demand. Based on interviews and focus groups with CarLink participants, Homebased Users are more sensitive to price than business customers (2). Substantial increases in user fees are more likely to adversely affect membership among Homebased Users than among business customers.

The payment structure should reflect the type of carsharing service provided. CarLink II collected flat monthly payments from its two customer groups. Fixed monthly rate structures ensure a predictable income stream and require fewer/less complicated cost calculations. This in turn allows for simpler operations planning. In many cases, it is advisable to introduce usage-based fees for short-duration rentals (combining hourly rates with per-mile charges). This model is already used by several carsharing organizations. More extensive services (e.g., augmenting a business fleet with guaranteed vehicle availability), however, should be based on larger fixed payments, as they typically require some degree of logistic and administrative effort independent of actual usage.

In addition to collecting fees from Homebased Users and business customers, a commuter carsharing operation could explore further possibilities to generate revenues. For example, CarLink II Homebased Users, on average, used their shared-use vehicles for only 3.6 trips (approximately two roundtrips per day) and drove less than 17 miles per day on Saturdays and Sundays. Furthermore, several vehicles were not used during the weekend at all. The fact that some Homebased customers used a shared car as a second vehicle during the week, but did not require the vehicle over the weekend, could account for their low weekend usage. To decrease idle time of shared-use vehicles, the cars could be rented to other carsharing customers when not driven by Homebased Users. Even vehicles driven by Homebased Users for several hours over the weekend had considerable idle periods and could be rented—though to a lesser extent—to other customers. The CarLink II field test data indicates that most Homebased vehicles could be rented for four or more hours per day on Saturdays and Sundays (based on usage patterns of actual participants).

Despite increased revenue generation, addressing key cost factors is essential to ensure program viability. Insurance and technology, discussed in the next two sections, represent such types of expenditures.

5.3.2 Addressing Insurance Costs

Due to the short duration of the CarLink II program, it was possible to obtain insurance at annual premiums of $1,175 per vehicle. This is substantially below the insurance rates reported by most U.S. carsharing operations, which average $3,000 per vehicle/year (David Brook, unpublished data and (1)). The following measures can help reduce insurance costs:

- Driver Screening: The screening of potential carsharing members is required by insurers to guarantee coverage. Typically, a good driving record is necessary and age restrictions apply.
- Employment of Vehicle Safety/Passenger Safety Technologies: Specific technologies can earn insurance discounts by improving vehicle safety and providing accurate vehicle usage data to an insurer.
- Deductibles: High deductibles essentially represent a form of self-insurance. Since many shared-use vehicle organizations only have small claims histories, largely due to driver screening requirements, this strategy can be useful in decreasing monthly premiums.
- Non-Profit Insurance Model: Two non-profit insurers provide affordable coverage for organizations with an IRS 501(c)(3) status (non-profit organizations that are not allowed to lobby for political organizations) (1).

Besides insurance costs, the majority of U.S. carsharing operators indicated that technology represents a substantial cost factor (1).

5.3.3 Controlling Costs Through Technology and Scale

In the CarLink II pilot program, customer satisfaction and operational efficiency were identified as primary benefits of the technology employed. The navigation system proved non-essential for customer satisfaction and operations, while the vehicle tracking system and automated data collection were important for labor cost savings. Online reservations and smart key fobs were equally important for offering customer-friendly services. Furthermore, insurance discounts were granted for vehicle tracking and smart key/PIN vehicle access. Insurers offer discounts of up to 35 percent off comprehensive coverage with the installation of certain anti-theft devices (1).

CarLink II employed and tested an advanced technological system. It is advisable for a shared-use vehicle start-up to employ less advanced, off-the-shelf technologies, however. Due to the high initial fixed costs of implementing advanced technologies, periodic upgrades should be adjusted to revenue generation and increased once high initial start-up costs are recuperated. Basic technologies that facilitate vehicle tracking and capture essential vehicle usage data are available for $500 per vehicle (1). Installation typically does not exceed two labor hours. Tracking services must also be purchased and can vary in price depending on the degree of tracking activity requested (e.g., 24 hours versus 16 hours or less). CarLink II operations staff

paid $50 per vehicle/month for 24-hour cellular tracking. An organization can outsource vehicle tracking server operations for approximately $300/month (7).

As more vehicles are added, economies of scale start to materialize. This is one result of the scenario analysis in all three cases.

The next section describes how a few efficient marketing strategies are sufficient to successfully recruit new carsharing members, while minimizing expenditures.

5.3.4 Marketing Strategies

CarLink II marketing costs totaled $31,893. This included website development; the design and printing of CarLink II brochures, flyers, and postcards; and CarLink II video costs. CarLink II flyers were the most effective recruitment method for Caltrain riders (2). Equally important was the CarLink II website, which enabled potential members to learn about CarLink II and enroll (2). Trial offers can also facilitate recruitment. Eleven potential Homebased Users initially participated in the CarLink II trial offer, which enabled them to use CarLink II vehicles for a one-week period. Four trial offer participants became CarLink II members. The trial offer was found to be a successful and highly effective strategy to attract new customers that initially expressed concerns about joining CarLink II. The first-year CarLink II marketing costs (nearly $32,000) are substantially higher than average annual marketing expenditures for U.S. carsharing organizations (6). Focusing on the most successful methods can reduce marketing costs for advertisement and member recruitment. Finally, partnerships with public organizations, private companies, or both can be beneficial for marketing purposes.

Besides marketing, partnerships should also be explored to share the financial risks of a commuter carsharing start-up.

5.3.5 Revenue-Risk Sharing Approach

A revenue-risk sharing approach could be employed to sustain a commuter carsharing program under sub-optimal market conditions and to reduce financial risk in general. Partnerships are not limited to transit operators and can be extended to any carsharing beneficiary (e.g., housing developers). The concept of revenue-risk sharing is based on the assumption that a carsharing service benefits third parties (e.g., transit operators in the case of a commuter carsharing program); this represents a positive economic externality of carsharing. By assuming part of the financial risk of a carsharing start-up, the beneficiary in essence repays part of this externality. However, by assuming some financial risk, the transit provider or housing developer gains a right to receive a share of surplus revenues, should the carsharing program prove profitable. The scenario analysis presented in this paper (particularly Scenario Three) indicates that the revenue-risk sharing approach could be feasible in practice.

SECTION 5.4 CONCLUSION

CarLink II, which linked transit and employers with shared-use vehicles, could provide an economically viable demand-responsive mobility option under specific conditions. Based on experiences from CarLink I and II and the economic scenario analysis results presented here, the authors have identified several key success factors.

During the CarLink II pilot program, vehicle access and fleet management services provided to business customers were undervalued. When adequately priced, substituting or augmenting corporate fleets can represent a successful business strategy for commuter carsharing vehicle operations. Furthermore, the CarLink II program was too limited in servicing just one transit hub. Carsharing operations that serve multiple transportation hubs may be more viable (i.e., they are more flexible in meeting demand), unless business customer distribution allows for profitable operations around a single transit node. The introduction of short-term (hourly) rentals during times when CarLink vehicles were typically idle (e.g., weekends) can generate substantial additional revenues. During the start-up phase, less cost-intensive, off-the-shelf technologies are sufficient to ensure operational efficiency. In addition, insurance rates can be lowered through driver screening and high deductibles. Cost-effective marketing strategies must identify and concentrate on the most successful types of advertising. Economies of scale materialize when a commuter carsharing program experiences steady membership growth. Finally, a revenue-risk sharing partnership approach with a transit provider or housing developer is advisable under sub-optimal market conditions.

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APPENDIX I

CARLINK II SURVEY INSTRUMENTS

CarLink II Research Program Initial Questionnaire

Instructions: Please read and answer each question. Unless otherwise noted, all questions refer to your travel before you start using CarLink.

The questionnaire should take about 20 minutes to complete. The time you dedicate to this is extremely helpful to our shared-use vehicle research. Thank you for your participation!

Your Current Travel Patterns

In this section, we ask for some information on your current transportation patterns.

1. Please provide your PIN number and your last name (this information will remain completely confidential and is used only by the CarLink research team for data validation purposes):
   PIN Number:_____ Last Name: _____

2. How many persons (including yourself) are in your household? _____

3. How many commuters, including yourself, are in your household? (A commuter is an adult who travels three to five days per week to and from work.) _____

4. How do you usually commute to work?
   Estimate how many miles you travel and how much time you spend one-way going to work using any of the following modes. Please check the appropriate box(es) and provide the time and mileage for each mode for your most common way of commuting. For instance, if five days a week, you drive to a parking lot and meet a carpool, you should check "Drive by myself" and "Carpool." Next, enter the times and mileage for both modes. Please include any waiting times (e.g., for BART, a carpool, etc.) in your estimate.

   Usual Commute to Work: I use this combination _____ days a week:

MODE	YES or NO	MINUTES	MILES
Drive by myself			
Carpool			
Vanpool			
Bus			
Caltrain			
BART			
Shuttle			
Bike			
Walk			
Work at Home			
Other, please specify:			

5. Do you sometimes commute to work by a different method? If yes, please complete the following table for your *other most-common commute method*. (If no, proceed to question 6). Estimate how many miles you travel and how much time you spend commuting to work one-way using each of the following modes. Please provide the time and mileage for each of the modes you use. Please include any waiting times (e.g., for BART, for a carpool, etc.) in your time estimate for the trip.

Other Most Common Commute Method: I use this combination _____ days a week:

MODE	YES or NO	MINUTES	MILES
Drive by myself			
Carpool			
Vanpool			
Bus			
Caltrain			
BART			
Shuttle			
Bike			
Walk			
Work at home			
Other, please specify:			

6. Is it difficult to find parking at your workplace? ____ Yes ____ No

7. How much do you estimate it costs you, on average, for your entire round-trip commute each day? Please calculate costs for each transportation mode used. Please also estimate how much it will cost you each day to commute using CarLink.

   Driving Alone $_____
   (Including car payments, insurance, registration, parking, gas, tolls, wear and tear, etc.)

   Carpooling $_____
   (Including car payments, insurance, registration, parking, tolls, etc.)

   Riding Public Transit $_____
   (Including transit tickets, driving to the station, parking, etc.)

   CarLink $ _____
   (How much do you estimate it will cost each day to commute with CarLink?)

Optional: Do you have any comments on your current travel patterns that you would like to share with us?

_____

_____

_____

Travel and Work

In this section, we hope to learn more about the trips you make during the workday.

1. How many days a week do you leave your workplace and return during the day for personal or company business via a vehicle or public transportation? (Indicate the number of days per week you make these trips.)

____ Not Applicable (I almost never leave my workplace during the day.)
____ Personal Business (lunch, errands, appointments, etc.) _____days per week
____ Company Business (meetings, sales calls, etc.) _____days per week

2. How do you usually complete these personal and company business trips? (Check all that apply)

MODE	PERSONAL BUSINESS	COMPANY BUSINESS
My car		
Company vehicle		
Friend/carpool partner's vehicle		
Bus		
Taxi		
Walking		
Biking		
Other, please specify:		

3. How long do these workday trips usually take on average? _____

4. How often do you choose to drive your vehicle to work because you will need it for errands on the way to work or home (e.g., shopping, picking up passengers, etc.)? (Select one)

____ Never, I always drive my car anyway.
____ Never, I never do errands during my commute.
____ Once a month
____ Once a week
____ A couple of times a week
____ Everyday, I always bring my car to make errands.

5. How often do you drive your vehicle to work because you know you will need it during the workday? (Select one)

____ Never, I always drive my car anyway.
____ Never, I never need a car during the day.
____ Once a month
____ Once a week
____ A couple of times a week
____ Everyday, I always need my car at work.

Optional: Do you have any comments on your work travel patterns that you would like to share with us?

_____
_____
_____

Household Vehicles

The next few questions focus on the motor vehicles in your household.

1. How many operational motor vehicles (including cars, trucks, minivans, and motorcycles) does your household own or lease? _____

2. How do you usually pay for your vehicles?
____ Buy ____ Lease ____ Both

3. Approximately how much does your commute vehicle (the vehicle you most often use to get to work) cost you per month to operate, including purchase/lease cost, depreciation, gasoline, registration, insurance, maintenance, parking, cleaning, and auto clubs (e.g., AAA)?
$_____ per month

4. Consider the next vehicle your household might acquire. How soon do you think your household might buy or lease your next vehicle? _____

5. What do you plan to do with your personal vehicle(s) once you are in CarLink? Will you keep all the vehicles or will you sell one, lend one to someone (such as a licensed child), or put one into storage? (Select one)
____ I will still use all the cars.
____ Someone in my immediate family will be using a car more frequently.
____ I plan to loan a vehicle to someone outside my immediate family.
____ I plan to sell or store one or more of my personal vehicles.

Optional: Do you have any comments on your household vehicles that you would like to share with us?

_____
_____
_____
_____

Your Attitudes and Opinions

Here we ask for your views on various transportation issues.

1. For each of the following statements, please check the one response that best expresses how strongly you disagree or agree. “My current transportation methods (that is, all the different transportation modes I currently use) ...

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
"Are enjoyable to me."					
"Allow me to visit friends when I want."					
"Fit my budget."					
"Allow me to be spontaneous."					
"Help me go everywhere."					
"Say a lot about who I am."					
"Do not make me feel safe."					
"Give me a sense of independence."					
"Are great for my lifestyle needs."					
"Allow me to quickly respond to an emergency."					
"Are comfortable."					
"Give me a sense of freedom."					

2. Please rank the three things you like least about your current transportation methods (for all your trips) in the following table: (Rank 1-3 in order of least favorite thing)

____ It’s too expensive.
____ Parking is a hassle.
____ I waste too much time in traffic.
____ Vehicle maintenance is a hassle.
____ It’s not reliable enough.
____ It takes too long to get places.
____ It’s not environmentally-friendly.
____ It’s not flexible enough.
____ Other, please specify:

3. For each of the following statements, please check the one response that best expresses how strongly you disagree or agree.

“I like to experiment with new ways of doing things.”
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

“I sometimes don’t drive because finding a parking space is difficult and frustrating.”
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

“Transit is too expensive, so I don’t use it much.”
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I would like to reduce my auto use to reduce congestion and improve air quality."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"Once I'm happy with something, I don't want to change it."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I spend too much time dealing with car maintenance."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"Keeping licenses and smog checks current is relatively easy."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I usually do not wait too long for buses and trains."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I am willing to drive an electric or other clean-fuel vehicle to improve air quality if I can afford one."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I use transit (e.g., buses, BART, Caltrain, etc.) when it goes where I want to go."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I'd be willing to ride a bike or take transit to help to improve air quality."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"If friends and neighbors reduced their driving, I would follow their example."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I know transit schedules and routes relatively well."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"It is time to change the way we live to help address environmental problems."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"The benefits of owning a car are higher than the costs."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I would like a job that doesn't require that I continue learning new skills."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"Traffic fumes are a major contributor to global warming, smog, and other environmental problems."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I sometimes do not feel safe while using public transportation."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

4. How long have you wanted to try a different way to commute? _____

5. Was there a particular event or life change that influenced you to try a different way to commute? (Select one)

____ No, there was no particular event or life change.
____ Finding out about CarLink put the idea into my head.
____ Since I changed jobs
____ Since I moved
____ Since our family changed (e.g., childbirth, marriage)
____ Since our car broke down/got rid of a car
____ I have always been looking for a different way to commute.

6. Rank the three greatest strengths of CarLink, by numbering 3 of the following options 1-3:

____ CarLink reduces the time I sit in traffic.
____ With CarLink, parking is easier and less expensive.
____ CarLink fits with my schedule better than buses/shuttles.
____ CarLink will let me run errands during the day.
____ CarLink gives me time to work or relax during my commute.
____ CarLink will save me money.
____ CarLink means I will not have to buy another car.
____ CarLink includes maintenance and licensing.
____ CarLink helps me do my part to reduce congestion and air pollution.
____ Other, please specify:

7. Rank your three most significant concerns regarding CarLink, by numbering 3 of the following options 1-3:

____ Having a CarLink vehicle break down or run out of fuel
____ The costs of being a member
____ Availability of vehicle when I need one
____ It will take me more time to go places.
____ I'm unfamiliar with the transit systems.
____ I won't be able to keep my personal items in the car (tools, sunglasses etc.).
____ I won't be able to be as spontaneous as I might like.
____ I have privacy concerns about the technologies employed in the CarLink system.
____ Dirty vehicles
____ Other, please specify:

8. In a few sentences, could you tell us why you are joining CarLink?

_____
_____
_____

Optional: Do you have any other comments that you would like to share with us?

_____
_____
_____

Cost Issues

An important part of the CarLink II program is determining the appropriate level of fees. Your answers here are not intended to affect the price you pay while using CarLink II.

1. How important are the following CarLink II services in your choice to join the program?

Services	Extremely Important	Important	Somewhat important	Not important
Cleaning				
Insurance				
Maintenance				
Registration				

2. As you know, the CarLink II program employs 2001 Honda Civics as its vehicles. If we used each of the following vehicles instead (comparably equipped to CarLink's Civics), how much more or less would you be willing to pay per month? (Circle an amount)

Ford Focus

LESS					SAME					MORE
-$100	-$50	-$25	-$10	-$5	$0	$5	$10	$25	$50	$100

Honda Accord

LESS					SAME					MORE
-$100	-$50	-$25	-$10	-$5	$0	$5	$10	$25	$50	$100

Toyota Prius (Hybrid-Electric Vehicle)

LESS					SAME					MORE
-$100	-$50	-$25	-$10	-$5	$0	$5	$10	$25	$50	$100

Used Honda Civics (identical to current vehicles but two years older)

LESS					SAME					MORE
-$100	-$50	-$25	-$10	-$5	$0	$5	$10	$25	$50	$100

3. How much more per month would you be willing to pay if there were one sport utility vehicle, one minivan, and one pickup truck, in addition to the current fleet of Honda Civics? (Circle an amount)

SAME					MORE
$0	$5	$10	$15	$20	$25

4. Assuming your monthly cost remains the same, how much would you be willing to pay on a per use basis to use a specialty vehicle? (Select one)

____ $2.50 per hour
____ $5 per hour
____ $10 per hour
____ $5 per use
____ $10 per use

5. Which method of payment would you prefer?
____ Higher monthly rates for a limited number of hours
____ Pay per use

6. What do you think the monthly mileage limit should be for Homebased Users? (Select one)
____ 500 miles per month
____ 750 miles per month
____ 1,000 miles per month
____ 1,250 miles per month
____ There should be no limit
____ There should be a charge for every mile driven

7. Currently, Homebased Users are allowed 1,000 miles per month. How much would you be willing to pay per mile if you exceeded the 1,000 mile monthly limit? (Select one)
____ There should be no extra charge.
____ $.10 per mile
____ $.20 per mile
____ $.30 per mile
____ $.40 per mile
____ $.50 per mile

8. Suppose you are a satisfied CarLink II user after one year and you want to continue using the service. Do you think you would dispose of one of your personal vehicles at that time? (Select one)
____ I think I would still keep all my vehicles.
____ I would probably put a car into storage.
____ I would sell one of my cars.
____ I would loan a vehicle to a friend or family member long-term.
____ Other, please specify:

9. Keeping in mind your response to the last question, what would you be willing to pay per month for access to CarLink II?
$_____

Optional: Do you have any comments on carsharing costs that you would like to share with us?
_____
_____
_____

Information about Yourself

Finally, we would like a little more information about you for our records. All your answers will be kept completely confidential.

1. ____ Female ____ Male

2. Household Composition (check one):
____ Self only
____ Self with spouse/partner
____ Self with spouse/partner and child(ren)
____ Self with child(ren)
____ Self with roommate(s)
____ Other, please specify:

3. What is the last level of school that you completed? (Please select one)
____Grade School ____High School ____College ____Graduate/Professional ____Trade School

4. What is your employment status? (Please select one)
____ Employed full-time ____ Homemaker ____ Other, please specify:
____ Employed part-time ____ Retired
____ Currently unemployed ____ Student

5. Which category best describes your occupation (even if you are unemployed or retired)? (Please select one)
____ Homemaker ____ Sales
____ Manager/administrator ____ Professional/technical
____ Service/repair ____ Production/construction/crafts
____ Clerical/administrative support ____ Other, please specify:

6. What is your age? (Please select one)
____ 24-30 ____ 31-40 ____ 41-50 ____ 51-60 ____ 61-70 ____ 71 or older

7. How many individuals in your household are in each of the age groups below, including yourself? Please circle the number of people for each age category.

Age category:	Number of people in household in each age category:										
0-5 years old	0	1	2	3	4	5	6	7	8	9	10 or more
6-15 years old	0	1	2	3	4	5	6	7	8	9	10 or more
16-18 years old	0	1	2	3	4	5	6	7	8	9	10 or more
19-23 years old	0	1	2	3	4	5	6	7	8	9	10 or more
24-30 years old	0	1	2	3	4	5	6	7	8	9	10 or more
31-40 years old	0	1	2	3	4	5	6	7	8	9	10 or more
41-50 years old	0	1	2	3	4	5	6	7	8	9	10 or more
51-60 years old	0	1	2	3	4	5	6	7	8	9	10 or more
61-70 years old	0	1	2	3	4	5	6	7	8	9	10 or more
71 years old or older	0	1	2	3	4	5	6	7	8	9	10 or more

8. What is your household's annual income (please include all sources of income, not just personal salaries)?

____ Under $10,000
____ $10,000 to $19,999
____ $20,000 to $49,999
____ $50,000 to $79,999
____ $80,000 to $109,999
____ More than $110,000

9. Ethnic Background (check all that apply):

____ African-American
____ Asian-American
____ White/Caucasian
____ Hispanic
____ Pacific-Islander
____ Native-American
____ Other, please specify:

Optional: How did you like taking this questionnaire on-line? Is there anything we should have done differently?

_____
_____
_____

Optional: Are there any other comments you would like to share with us?

_____
_____
_____

Thank you very much for taking the time to complete this questionnaire.

CarLink II Research Program End Questionnaire

We sincerely hope that you enjoyed the first year of the CarLink II program. As you know, we have been conducting carsharing research this year on the CarLink program for the University of California's Partners for Advanced Transit and Highways (PATH). The questionnaires and travel diaries you completed before you started the program have been very helpful, as have the interviews and focus groups that many of you participated in.

This final questionnaire is your last step in providing us with feedback on your CarLink experiences. As one of the first people in the nation able to experience carsharing, you can provide us with invaluable feedback as we continue to study and refine this carsharing model.

Instructions: Please read and answer each question. Unless otherwise noted, all questions refer to your travel during the CarLink program.

The questionnaire should take about 15 minutes to complete. The time you dedicate to this is extremely helpful to our shared-use vehicle research. Thank you for your participation!

1. PIN Number:_____ Last Name:_____

2. What is your usual home-end Caltrain station when you use CarLink?

___ California Avenue	___ Hayward Park	___ Sunnyvale
___ San Francisco (4th and King)	___ Bay Meadows	___ Lawrence
___ 22nd Avenue	___ Hilsdale	___ Santa Clara
___ Paul Avenue	___ Belmont	___ College Park
___ Bayshore	___ San Carlos	___ San Jose Diridon
___ South San Francisco	___ Redwood City	___ Tamien
___ San Bruno	___ Atherton	___ Capitol
___ Milbrae	___ Menlo Park	___ Blossom Hill
___ Broadway	___ Palo Alto	___ Morgan Hill
___ Burlingame	___ San Antonio	___ San Martin
___ San Mateo	___ Mountain View	___ Gilroy

3. What is your usual work-end Caltrain station when you use CarLink?

___ California Avenue	___ Hayward Park	___ Sunnyvale
___ San Francisco (4th and King)	___ Bay Meadows	___ Lawrence
___ 22nd Avenue	___ Hilsdale	___ Santa Clara
___ Paul Avenue	___ Belmont	___ College Park
___ Bayshore	___ San Carlos	___ San Jose Diridon
___ South San Francisco	___ Redwood City	___ Tamien
___ San Bruno	___ Atherton	___ Capitol
___ Milbrae	___ Menlo Park	___ Blossom Hill
___ Broadway	___ Palo Alto	___ Morgan Hill
___ Burlingame	___ San Antonio	___ San Martin
___ San Mateo	___ Mountain View	___ Gilroy

4. How do you usually get to Caltrain from your home?

___ CarLink	___ Bus	___ BART
___ Drive by myself	___ Shuttle	___ Use more than one mode,
___ Carpool	___ Bike	please specify:
___ Vanpool	___ Walk	

5. How do you usually get to work from Caltrain?

___ CarLink	___ Bus	___ BART
___ Drive by myself	___ Shuttle	___ Use more than one mode,
___ Carpool	___ Bike	please specify:
___ Vanpool	___ Walk	

6. How many days a week do you commute with CarLink?

___ One day per week	___ Five days per week
___ Two days per week	___ Six days per week
___ Three days per week	___ Seven days per week
___ Four days per week	

7. How long does it take you (in minutes and miles) to get to your Caltrain station from home, take Caltrain (including wait time), and get to work when using CarLink?

	Home to Caltrain	Caltrain Station to Caltrain Station	Caltrain to Work
Minutes	_____	_____	_____
Miles	_____	_____	_____

8. On days that you do not commute with CarLink, what are the primary reasons? Please check all that apply:

___ Do not have time (e.g. get a late start, day too busy, need to leave early.)
___ Need my own car on the way home or on the way to work.
___ Need a non-CarLink vehicle during work hours.
___ Need to carry heavy/inconvenient items to or from work.
___ Personal work schedule varies some days.
___ Need to drop-off/pick-up somebody or something.
___ Caltrain service is too infrequent.
___ Transit (non-Caltrain) service is too infrequent.
___ Use a different mode to go between the Caltrain station and work (e.g. walk, shuttle, different carpool)
___ Other, please specify:

9. How do you commute to work on days that you do not use CarLink?

___ CarLink	___ Bus	___ BART
___ Drive by myself	___ Shuttle	___ Use more than one mode,
___ Carpool	___ Bike	please specify:
___ Vanpool	___ Walk	

10. How many days per week do you typically carpool when you commute with CarLink?

___ Zero days per week
___ One day per week
___ Two days per week
___ Three days per week
___ Four days per week
___ Five days per week
___ Six days per week
___ Seven days per week

11. *Including yourself*, what is the average number of individuals carpooling in a CarLink vehicle to and from Caltrain?

Morning Commute
___ One person (just you)
___ Two people (you and another)
___ Three people (you and two others)
___ Four people (you and three others)
___ Five people (you and four others)

Evening Commute
___ One person (just you)
___ Two people (you and another)
___ Three people (you and two others)
___ Four people (you and three others)
___ Five people (you and four others)

12. Please estimate your average daily cost for your entire round-trip commute. Please consider all costs for each portion of your commute, not just CarLink.

Daily commute costs with CarLink
(Each day that you use CarLink)
___ $0-$1.99
___ $2-$3.99
___ $4-$5.99
___ $6-$7.99
___ $8-$9.99
___ $10 or more

Daily commute costs without CarLink
(Each day that you do not use CarLink)
___ $0-$1.99
___ $2-$3.99
___ $4-$5.99
___ $6-$7.99
___ $8-$9.99
___ $10 or more

13. How many days a week do you take a CarLink vehicle for a personal or business trip on a workday?

___ One day per week
___ Two days per week
___ Three days per week
___ Four days per week
___ Five days per week
___ Six days per week
___ Seven days per week
___ N/A - I almost never leave my workplace during the day

14. What percentage of these trips is work-related? ____%

15. How soon do you think your household might buy or lease your next vehicle?

___ Within the next six months
___ Between six months and one year from now
___ Between one and two years from now
___ Between two and five years from now
___ More than five years from now or never

16. How have you used your personal vehicle(s) since you joined CarLink?
___ No change in the use of personal vehicles.
___ Family members drive a car more frequently (e.g. “loaned” to a child).
___ I/We have loaned a vehicle to someone outside our immediate family.
___ I/We have sold or stored one or more of our personal vehicles.
___ I/We have purchased or lease a personal vehicle.
___ Other, please specify:

17. Have you been able to avoid or postpone the purchase or lease of a vehicle due to your CarLink membership?
___ Yes, we were going to buy/lease a vehicle but did not because of CarLink.
___ No, we did buy/lease a vehicle.
___ We were not planning on buying/leasing a vehicle.

18. If you continue your CarLink participation, do you think that you would dispose of one of your personal vehicles or postpone the purchase of one?
___ I would still keep all my vehicles.
___ I would put a car into storage.
___ I would sell one of my cars.
___ I would loan a vehicle to a friend or family member long-term.
___ Other, please specify:

Optional: Do you have any comments that you would like to share about changes in your vehicle ownership while enrolled in the CarLink program?

_____
_____
_____

19. For each of the following statements, please check the one response that best expresses how strongly you disagree or agree. "While in CarLink, my transportation methods (that is, all the different transportation modes I used, including carsharing)…

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
"Were enjoyable to me."					
"Allowed me to visit friends when I wanted to."					
"Fit my budget."					
"Allowed me to be spontaneous."					
"Helped me go everywhere."					
"Said a lot about who I am."					
"Did not make me feel safe."					

"Gave me a sense of independence."					
"Were great for my lifestyle needs."					
"Allowed me to quickly respond to an emergency."					
"Were comfortable."					
"Gave me a sense of freedom."					

20. What motivated you to use a CarLink vehicle? Please rank from 1 to 3 the greatest strengths of CarLink.

___ With CarLink, parking is easier and less expensive.
___ CarLink gives me time to work or relax during my commute.
___ CarLink fits into my schedule better than buses/shuttles.
___ CarLink takes care of maintenance, insurance, and registration.
___ CarLink is flexible.
___ CarLink saves me money.
___ I do not need to use my personal car as much.
___ CarLink is good in bad weather (e.g. too hot, too cold).
___ I like the CarLink vehicles themselves.
___ I like sharing with other people.
___ CarLink lets me run errands during the day.
___ CarLink reduces the time I sit in traffic.
___ CarLink means I can avoid or postpone buying a car.
___ CarLink helps me do my part to reduce air pollution.
___ Other, please specify:

21. What do you dislike about CarLink? Please rank from 1 to 3 your most significant concerns or problems with CarLink:

___ Having a CarLink vehicle break down
___ The costs of being a member
___ Availability of a vehicle when I need one
___ It takes more time to go places.
___ I'm not able to keep personal items in the car (tools, sunglasses).
___ I'm not as spontaneous as I like to be.
___ I have privacy concerns about the CarLink technologies.
___ Difficulties with the technology (e.g. fobs, reservations, etc)
___ I would like a different type of vehicle.
___ Having to refuel the CarLink vehicles
___ Other users are not always responsible.
___ Transit is inconvenient (please specify)
___ CarLink requires that I change my work schedule.
___ CarLink vehicles are not clean/have odors.
___ Other, please specify:

22. How would you rate your satisfaction with the following CarLink items?

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied	N/A
Vehicle Access (i.e., using key fob, entering ID number)						
In -Vehicle Mapping/ Navigation System						
On-Line Vehicle Reservation System						
CarLink Staff						
Vehicle Type (i.e., Honda Civic)						
Vehicle Refueling						
Transit Costs						
Transit Safety						
Coordinating with Other Members						
Frequency of Transit						

23. How can the CarLink program be improved?

_____

_____

_____

24. How has your commute stress changed since you joined CarLink?

___ My stress has greatly increased.
___ My stress has increased.
___ There has been no change.
___ My stress has decreased.
___ My stress has greatly decreased.

25. How has your morning commute time to work changed since you joined CarLink?

___ Over 60 minutes shorter
___ 45 to 60 minutes shorter
___ 30 to 45 minutes shorter
___ 15 to 30 minutes shorter
___ Up to 15 minutes shorter
___ Stayed about the same
___ Up to 15 minutes longer
___ 15-30 minutes longer
___ 30-45 minutes longer
___ 45-60 minutes longer
___ Over 60 minutes longer

26. How often do you refuel a CarLink vehicle?

___ Everyday
___ More than once a week
___ Once a week
___ A few times a month
___ Once a month
___ Less than once a month
___ Never

27. How often do you reserve a vehicle?

___ Everyday
___ More than once a week
___ Once a week
___ A few times a month
___ Once a month
___ Less than once a month
___ Never

28. Have you ever reserved a vehicle and not found one waiting?

___ No, never
___ Once
___ Twice
___ 3 to 5 times
___ More than 5 times

29. What types of vehicles do you think should be available in the CarLink program? Please check all appropriate answers.

___ No other vehicles are needed
___ Motorcycle
___ Pickup Truck
___ Bicycle
___ Sport Utility Vehicle
___ Electric-Assist Bicycle
___ Minivan
___ Electric Scooter
___ Sports Car or Convertible
___ Electric/Alternative-Fueled Vehicle

30. How has your overall travel increased or decreased, since you joined CarLink, for each of the following modes?

	Greatly Increased	Increased	Stayed the Same	Decreased	Greatly Decreased	N/A
Driving Alone						
Overall Transit Use						
Non-Commute Transit Use						
Carpooling						
Biking						
Walking						
Vehicle Use by Everyone in your Household						

Optional: Do you have any comments about the changes you reported in your travel behavior for the modes listed above?

_____
_____
_____

31. Considering all the costs included in the CarLink program (e.g. fuel, maintenance, insurance, administration, etc.), how much do you think it would be fair to charge on a monthly basis for the AM and PM commute between the California Avenue Caltrain station and a nearby employment site?
    $_____

32. Considering all the costs included in the CarLink program (e.g. fuel, maintenance, insurance, administration, etc.), how much do you think it would be fair to charge on a monthly basis for Home-based Use, including AM and PM commute to/from Caltrain, evening, and weekend use?
    $_____

33. How much would it be fair to charge users who do not want to pay a monthly fee for the following trips:

Per Day: A commute trip of two miles each way $_____
Per Day: A commute trip of ten miles each way $_____
Per Trip: A three mile round trip for two hours $_____
Per Trip: A one mile round trip for one hour $_____
Per Trip: A twenty mile round trip for one hour $_____
Per Trip: A thirty mile round trip for four hours $_____

34. What would it take to convince your friends and neighbors to join CarLink?

_____
_____
_____

35. What are your overall thoughts about CarLink?

_____
_____
_____

36. Do you plan to continue to use CarLink?_____

Why or why not? If no, what will you do to get around?

_____
_____
_____

37. If CarLink expanded to different stations would you be interested in becoming a Homebased or Workbased member?

___ Yes, a Homebased Member
___ Yes, a Workbased member
___ Yes, both a Homebased and a Workbased member
___ No

Thank you very much for taking the time to complete this questionnaire.

CarLink II Research Program Initial Questionnaire

Instructions: Please read and answer each question. Unless otherwise noted, all questions refer to your travel before your household started using CarLink.

The questionnaire should take about 20 minutes to finish. The time you dedicate to this, even though you are not the primary CarLink II user of your household, is extremely helpful to our shared-use vehicle research. You will help us to understand how carsharing can affect an entire household. Thank you for your participation!

Your Current Travel Patterns

In this section, we ask for some information on your current transportation patterns.

1. Please provide your last name (this information will remain completely confidential and is used only by the CarLink research team for data validation purposes):
   Last Name: _____

2. How many persons (including yourself) are in your household? _____

3. How many commuters, including yourself, are in your household? (A commuter is an adult who travels three to five days per week to and from work.) _____

4. How do you usually commute to work?
   Estimate how many miles you travel and how much time you spend one-way going to work using any of the following modes. Please check the appropriate boxes and provide the time and mileage for each mode for your most common way of commuting. For instance, if five days a week, you drive to a parking lot and meet a carpool, you should check "Drive by myself" and "Carpool." Next, enter the times and mileage for both modes. Please include any waiting times (e.g., for BART, a carpool, etc.) in your estimate.

   Usual Commute to Work: I use this combination _____ days a week:

MODE	YES or NO	MINUTES	MILES
Drive by myself			
Carpool			
Vanpool			
Bus			
Caltrain			
BART			
Shuttle			
Bike			
Walk			
Work at Home			
Other, please specify:			

5. Do you sometimes commute to work by a different method? If yes, please complete the following table for your *other most-common commute method*. (If no, proceed to question 6). Estimate how many miles you travel and how much time you spend commuting to work one-way using each of the following modes. Please provide the time and mileage for each of the modes you use. Please include any waiting times (e.g., for BART, for a carpool, etc.) in your time estimate for the trip.

Other Most Common Commute Method: I use this combination _____ days a week:

MODE	YES or NO	MINUTES	MILES
Drive by myself			
Carpool			
Vanpool			
Bus			
Caltrain			
BART			
Shuttle			
Bike			
Walk			
Work at home			
Other, please specify:			

6. Is it difficult to find parking at your workplace? ____ Yes ____ No

7. How much do you estimate it costs you, on average, for your entire round-trip commute each day? Please calculate costs for each transportation mode used.
   Driving Alone $_____
   (Including car payments, insurance, registration, parking, gas, tolls, wear and tear, etc.)

   Carpooling $_____
   (Including car payments, insurance, registration, parking, tolls, etc.)

   Riding Public Transit $_____
   (Including transit tickets, driving to the station, parking, etc.)

Optional: Do you have any comments on your current travel patterns that you would like to share with us?

_____

_____

_____

Travel and Work

In this section, we hope to learn more about the trips you make during the workday.

1. How many days a week do you leave your workplace and return during the day for personal or company business via a vehicle or public transportation? (Indicate the number of days per week you make these trips.)

____ Not Applicable (I almost never leave my workplace during the day.)
____ Personal Business (lunch, errands, appointments, etc.) _____days per week
____ Company Business (meetings, sales calls, etc.) _____days per week

2. How do you usually complete these personal and company business trips? (Check all that apply)

MODE	PERSONAL BUSINESS	COMPANY BUSINESS
My car		
Company vehicle		
Friend/carpool partner's vehicle		
Bus		
Taxi		
Walking		
Biking		
Other, please specify:		

3. How long do these workday trips usually take on average? _____

4. How often do you choose to drive your vehicle to work because you will need it for errands on the way to work or home (e.g., shopping, picking up passengers, etc.)? (Select one)

____ Never, I always drive my car anyway.
____ Never, I never do errands during my commute.
____ Once a month
____ Once a week
____ A couple of times a week
____ Everyday, I always bring my car to make errands.

5. How often do you drive your vehicle to work because you know you will need it during the workday? (Select one)

____ Never, I always drive my car anyway.
____ Never, I do not need a car during the day.
____ Once a month
____ Once a week
____ A couple of times a week
____ Everyday, I always need my car at work.

Optional: Do you have any comments on your work travel patterns that you would like to share with us?

_____
_____
_____

Household Vehicles

The next few questions focus on the motor vehicles in your household.

1. How many operational motor vehicles (including cars, trucks, minivans, and motorcycles) does your household own or lease? _____

2. How do you usually pay for your vehicles?
   ____ Buy ____ Lease ____ Both

3. Approximately how much does your commute vehicle (the vehicle you most often use to get to work) cost you per month to operate, including purchase/lease cost, depreciation, gasoline, registration, insurance, maintenance, parking, cleaning, and auto clubs (e.g., AAA)?
   $_____ per month

4. Consider the next vehicle your household might acquire. How soon do you think your household might buy or lease your next vehicle? _____

5. What do you plan to do with your personal vehicle(s) once your spouse is in CarLink? Will you keep all the vehicles or will you sell one, lend one to someone (such as a licensed child), or put one into storage? (Select one)
   ____ I will still use all the cars.
   ____ Someone in my immediate family will be using a car more frequently.
   ____ I plan to loan a vehicle to someone outside my immediate family.
   ____ I plan to sell or store one or more of my personal vehicles.

Optional: Do you have any comments on your household vehicles that you would like to share with us?

_____
_____
_____

Your Attitudes and Opinions

Here we ask for your views on various transportation issues.

1. For each of the following statements, please check the one response that best expresses how strongly you disagree or agree. “My current transportation methods (that is, all the different transportation modes I currently use) ...

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
"Are enjoyable to me."					
"Allow me to visit friends when I want."					
"Fit my budget."					
"Allow me to be spontaneous."					
"Help me go everywhere."					
"Say a lot about who I am."					
"Do not make me feel safe."					
"Give me a sense of independence."					
"Are great for my lifestyle needs."					
"Allow me to quickly respond to an emergency."					
"Are comfortable."					
"Give me a sense of freedom."					

2. Please rank the three things you like least about your current transportation methods (for all your trips) in the following table: (Rank 1-3 in order of least favorite thing)
   ____ It’s too expensive.
   ____ Parking is a hassle.
   ____ I waste too much time in traffic.
   ____ Vehicle maintenance is a hassle.
   ____ It’s not reliable enough.
   ____ It takes too long to get places.
   ____ It’s not environmentally-friendly.
   ____ It’s not flexible enough.
   ____ Other, please specify:

3. For each of the following statements, please check the one response that best expresses how strongly you disagree or agree.

“I like to experiment with new ways of doing things.”
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

“I sometimes don’t drive because finding a parking space is difficult and frustrating.”
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

“Transit is too expensive, so I don’t use it much.”
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I would like to reduce my auto use to reduce congestion and improve air quality."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"Once I'm happy with something, I don't want to change it."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I spend too much time dealing with car maintenance."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"Keeping licenses and smog checks current is relatively easy."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I usually do not wait too long for buses and trains."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I am willing to drive an electric or other clean-fuel vehicle to improve air quality if I can afford one."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I use transit (e.g., buses, BART, Caltrain, etc.) when it goes where I want to go."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I'd be willing to ride a bike or take transit to help to improve air quality."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"If friends and neighbors reduced their driving, I would follow their example."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I know transit schedules and routes relatively well."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"It is time to change the way we live to help address environmental problems."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"The benefits of owning a car are higher than the costs."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I would like a job that doesn't require that I continue learning new skills."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"Traffic fumes are a major contributor to global warming, smog, and other environmental problems."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

"I sometimes do not feel safe while using public transportation."
☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Agree Strongly

Optional: Do you have any other comments that you would like to share with us?

_____

_____

_____

Information about Yourself

Finally, we would like a little more information about you for our records. All your answers will be kept completely confidential.

1. ____ Female ____ Male

2. Household Composition (check one):
____ Self only
____ Self with spouse/partner
____ Self with spouse/partner and child(ren)
____ Self with child(ren)
____ Self with roommate(s)
____ Other, please specify:

3. What is the last level of school that you completed? (Please select one)
____Grade School ____High School ____College ____Graduate/Professional ____Trade School

4. What is your employment status? (Please select one)
____ Employed full-time ____ Homemaker ____ Other, please specify:
____ Employed part-time ____ Retired
____ Currently unemployed ____ Student

5. Which category best describes your occupation (even if you are unemployed or retired)? (Please select one)
____ Homemaker ____ Sales
____ Manager/administrator ____ Professional/technical
____ Service/repair ____ Production/construction/crafts
____ Clerical/administrative support ____ Other, please specify:

6. What is your age? (Please select one)
____ 24-30 ____ 31-40 ____ 41-50 ____ 51-60 ____ 61-70 ____ 71 or older

7. How many individuals in your household are in each of the age groups below, including yourself? Please circle the number of people for each age category.

Age category:	Number of people in household in each age category:										
0-5 years old	0	1	2	3	4	5	6	7	8	9	10 or more
6-15 years old	0	1	2	3	4	5	6	7	8	9	10 or more
16-18 years old	0	1	2	3	4	5	6	7	8	9	10 or more
19-23 years old	0	1	2	3	4	5	6	7	8	9	10 or more
24-30 years old	0	1	2	3	4	5	6	7	8	9	10 or more

31-40 years old	0	1	2	3	4	5	6	7	8	9	10 or more
41-50 years old	0	1	2	3	4	5	6	7	8	9	10 or more
51-60 years old	0	1	2	3	4	5	6	7	8	9	10 or more
61-70 years old	0	1	2	3	4	5	6	7	8	9	10 or more
71 years old or older	0	1	2	3	4	5	6	7	8	9	10 or more

8. What is your household's annual income (please include all sources of income, not just personal salaries)?

____ Under $10,000
____ $10,000 to $19,999
____ $20,000 to $49,999
____ $50,000 to $79,999
____ $80,000 to $109,999
____ More than $110,000

9. Ethnic Background (check all that apply):

____ African-American
____ Asian-American
____ White/Caucasian
____ Hispanic
____ Pacific-Islander
____ Native-American
____ Other, please specify:

Optional: How did you like taking this questionnaire on-line? Is there anything we should have done differently?

_____
_____
_____

Optional: Are there any other comments you would like to share with us?

_____
_____
_____

Thank you very much for taking the time to complete this questionnaire.

CarLink II Research Program End Questionnaire

We sincerely hope that your household enjoyed the first year of the CarLink II program. As you know, during this first year we have been conducting carsharing research on the CarLink program for the University of California's Partners for Advanced Transit and Highways (PATH). The questionnaires you completed before you started the program have been very helpful, as have the interviews and focus groups that many of you participated in.

Even though you were not the primary CarLink user, your feedback is extremely helpful to our research at the University of California. You will help us to understand how carsharing can affect an entire household's travel behavior and auto ownership.

Instructions: Please read and answer each question. Unless otherwise noted, all questions refer to your travel during the CarLink program.

This questionnaire should take about 10 minutes to complete. The time you dedicate to this is extremely helpful to our shared-use vehicle research. Thank you for your participation!

1. Last Name:_____

2. How do you usually commute to work?
   Estimate how many miles you travel and how much time you spend one-way going to work using any of the following modes. Please check the appropriate boxes and provide the time and mileage for each mode for your most common way of commuting. For instance, if five days a week, you drive to a parking lot and meet a carpool, you should check "Drive by myself" and "Carpool." Next, enter the times and mileage for both modes. Please include any waiting times (e.g., for BART, a carpool, etc.) in your estimate.

   Usual Commute to Work: I use this combination _____ days a week:

MODE	YES or NO	MINUTES	MILES
Drive by myself			
Carpool			
Vanpool			
Bus			
Caltrain			
BART			
Shuttle			
Bike			
Walk			
Work at Home			
Other, please specify:			

8. Do you sometimes commute to work by a different method? If yes, please complete the following table for your *other most-common commute method*. (If no, proceed to question 6). Estimate how many miles you travel and how much time you spend commuting to work one-way using each of the following modes. Please provide the time and mileage for each of the modes you use. Please include any waiting times (e.g., for BART, for a carpool, etc.) in your time estimate for the trip.

   Other Most Common Commute Method: I use this combination _____ days a week:

MODE	YES or NO	MINUTES	MILES
Drive by myself			
Carpool			
Vanpool			
Bus			
Caltrain			
BART			
Shuttle			
Bike			
Walk			
Work at home			
Other, please specify:			

4. For each of the following statements, please check the one response that best expresses how strongly you disagree or agree. "While my household has been in CarLink, my transportation methods (that is, all the different transportation modes I use, including carsharing)…

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
"Were enjoyable to me."					
"Allowed me to visit friends when I wanted to."					
"Fit my budget."					
"Allowed me to be spontaneous."					
"Helped me go everywhere."					
"Said a lot about who I am."					
"Did not make me feel safe."					
"Gave me a sense of independence."					
"Were great for my lifestyle needs."					

"Allowed me to quickly respond to an emergency."					
"Were comfortable."					
"Gave me a sense of freedom."					

5. How has your travel increased or decreased, since your household joined CarLink, for the following modes?

	Greatly Increased	Increased	Stayed the Same	Decreased	Greatly Decreased	N/A
Driving Alone						
Overall Transit Use						
Non-Commute Transit Use						
Carpooling						
Biking						
Walking						
Vehicle Use by Everyone in your Household						

6. What would it take to convince your friends and neighbors to join CarLink?

_____

_____

_____

7. What are your overall thoughts about CarLink?

_____

_____

_____

Thank you very much for taking the time to complete this questionnaire.

APPENDIX II

TRAVEL DIARY

CarLink II
Trip Diary Memory Jogger

This memory jogger is intended to allow you to jot down notes as you travel to help you remember each trip. For every trip you make, by any mode, no matter how short, please fill out an entry in this log. A trip is defined as travel to a location away from your home, work, school or any previous destination. Each stop you make is a ***separate trip***, even if you stop for a very short time, or are stopping on the route to somewhere else.

Please record your travel for two consecutive weekdays and one weekend day travel. Please complete either Thursday/Friday/Saturday or Sunday/Monday/Tuesday, unless your travel is very atypical on those days (for example, if you are taking an airplane trip).

After you complete this diary, please log on to www.gocarlink.com and fill out the travel diary section, using this jogger as a reference. Once you finish entering your data you may keep or dispose of this jogger.

Thank you very much for your cooperation!

Please feel free to contact me with any questions:

John Wright
jwwright@path.berkeley.edu
(510) 643-5503

Please Note: Your travel must reflect typical weekday and weekend travel days. Please do not use a holiday weekend (e.g., Memorial Day or the 4th of July).

Day/Date	Start Time	Start Odometer	Trip Mode: ☐ Vehicle ☐ Bicycle ☐ Public Transportation ☐ Walk ☐ Carpool/Vanpool ☐ Other
How many passengers?	End Time	End Odometer	

Trip Purpose:
☐ Work/School ☐ Business Related ☐ Shopping ☐ Home
☐ Personal Related ☐ Medical/Dental ☐ Transit Station
☐ Passenger Drop-off/Pick-up ☐ Refueling ☐ Social/Entertainment/Recreational

Did you pay anything for this trip, such as parking, transit fare, tolls (but not gas)? How much?

Day/Date	Start Time	Start Odometer	Trip Mode: ☐ Vehicle ☐ Bicycle ☐ Public Transportation ☐ Walk ☐ Carpool/Vanpool ☐ Other
How many passengers?	End Time	End Odometer	

Trip Purpose:
☐ Work/School ☐ Business Related ☐ Shopping ☐ Home
☐ Personal Related ☐ Medical/Dental ☐ Transit Station
☐ Passenger Drop-off/Pick-up ☐ Refueling ☐ Social/Entertainment/Recreational

Did you pay anything for this trip, such as parking, transit fare, tolls (but not gas)? How much?

Day/Date	Start Time	Start Odometer	Trip Mode: ☐ Vehicle ☐ Bicycle ☐ Public Transportation ☐ Walk ☐ Carpool/Vanpool ☐ Other
How many passengers?	End Time	End Odometer	

Trip Purpose:
☐ Work/School ☐ Business Related ☐ Shopping ☐ Home
☐ Personal Related ☐ Medical/Dental ☐ Transit Station
☐ Passenger Drop-off/Pick-up ☐ Refueling ☐ Social/Entertainment/Recreational

Did you pay anything for this trip, such as parking, transit fare, tolls (but not gas)? How much?

Day/Date	Start Time	Start Odometer	Trip Mode: ☐ Vehicle ☐ Bicycle ☐ Public Transportation ☐ Walk ☐ Carpool/Vanpool ☐ Other
How many passengers?	End Time	End Odometer	

Trip Purpose:
☐ Work/School ☐ Business Related ☐ Shopping ☐ Home
☐ Personal Related ☐ Medical/Dental ☐ Transit Station
☐ Passenger Drop-off/Pick-up ☐ Refueling ☐ Social/Entertainment/Recreational

Did you pay anything for this trip, such as parking, transit fare, tolls (but not gas)? How much?

Day/Date	Start Time	Start Odometer	Trip Mode: ☐ Vehicle ☐ Bicycle ☐ Public Transportation ☐ Walk ☐ Carpool/Vanpool ☐ Other
How many passengers?	End Time	End Odometer	

Trip Purpose:
☐ Work/School ☐ Business Related ☐ Shopping ☐ Home
☐ Personal Related ☐ Medical/Dental ☐ Transit Station
☐ Passenger Drop-off/Pick-up ☐ Refueling ☐ Social/Entertainment/Recreational

Did you pay anything for this trip, such as parking, transit fare, tolls (but not gas)? How much?

Day/Date	Start Time	Start Odometer	Trip Mode: ☐ Vehicle ☐ Bicycle ☐ Public Transportation ☐ Walk ☐ Carpool/Vanpool ☐ Other
How many passengers?	End Time	End Odometer	

Trip Purpose:
☐ Work/School ☐ Business Related ☐ Shopping ☐ Home
☐ Personal Related ☐ Medical/Dental ☐ Transit Station
☐ Passenger Drop-off/Pick-up ☐ Refueling ☐ Social/Entertainment/Recreational

Did you pay anything for this trip, such as parking, transit fare, tolls (but not gas)? How much?

Day/Date	Start Time	Start Odometer	Trip Mode: ☐ Vehicle ☐ Bicycle ☐ Public Transportation ☐ Walk ☐ Carpool/Vanpool ☐ Other
How many passengers?	End Time	End Odometer	

Trip Purpose:
☐ Work/School ☐ Business Related ☐ Shopping ☐ Home
☐ Personal Related ☐ Medical/Dental ☐ Transit Station
☐ Passenger Drop-off/Pick-up ☐ Refueling ☐ Social/Entertainment/Recreational

Did you pay anything for this trip, such as parking, transit fare, tolls (but not gas)? How much?

Day/Date	Start Time	Start Odometer	Trip Mode: ☐ Vehicle ☐ Bicycle ☐ Public Transportation ☐ Walk ☐ Carpool/Vanpool ☐ Other
How many passengers?	End Time	End Odometer	

Trip Purpose:
☐ Work/School ☐ Business Related ☐ Shopping ☐ Home
☐ Personal Related ☐ Medical/Dental ☐ Transit Station
☐ Passenger Drop-off/Pick-up ☐ Refueling ☐ Social/Entertainment/Recreational

Did you pay anything for this trip, such as parking, transit fare, tolls (but not gas)? How much?

APPENDIX III

CARLINK II INTERIM INTERVIEWS

CARLINK II INTERIM INTERVIEWS

INTRODUCTION

CarLink II is a commuter-based carsharing pilot project administered by the Institute of Transportation Studies at the University of California, Davis (ITS-Davis) in conjunction with the California Department of Transportation (Caltrans), American Honda Motor Company, and Caltrain. Partners for Advanced Transit and Highways (PATH) researchers are conducting the evaluation of the year-long pilot phase. CarLink II was launched in Summer 2001, and is designed to continue the investigation of commuter-based carsharing that was originally explored in the 1998 CarLink Longitudinal Survey (Shaheen, 1999) and the 1999 CarLink I Field Test (Shaheen *et al*., 2000).

During the first three months of 2002, researchers at PATH conducted 25 personal interviews with participants of the CarLink II pilot program. Interviewees included Homebased and Workbased Commuters, and Workbased Day Users from four participating employers. The topics discussed included changes in travel patterns, satisfaction with different program components, willingness to dispose of personal vehicles, the perceived economic benefits of the program to users and a variety of other subjects that are discussed in more detail below.

These interviews are part of the overall CarLink II evaluation being conducted by a research team under the direction of Dr. Susan A. Shaheen at PATH. The evaluation consists of a variety of different research instruments that are designed to solicit input from the program users to better understand the intricacies of the CarLink II program. The evaluation instruments are:

- On-Line Questionnaires: Completed before participants join the program and at the end of the research period or when they exit the program;
- Focus Groups: Executed during program design to explore expectations, cost issues, and program details and at the close of the research period;
- Interviews: Conducted at the midpoint of the CarLink II pilot project to gather information about user attitudes and to provide feedback to the operations staff, and;
- Automatic Vehicle Data Collection: Accumulated for every trip taken in a CarLink vehicle to monitor usage.

Each instrument provides a unique vantage point for analyzing transit-based, commuter carsharing and, taken together, paint a comprehensive picture of the program from the user perspective, as well as social and environmental impacts.

At this midpoint stage of the pilot project, the initial questionnaires and focus groups and the interim interviews have been completed. The results of the interim interviews are reported here. These interim interviews are designed to capture opinions and perceptions of the users and do not reflect impartial vehicle data or the before and after impacts that will be available after the final questionnaires and focus groups are completed. These data will be evaluated and presented in the final report.

INTERVIEW DESIGN

The design of the interview protocol was overseen by John Wright, with assistance from MollyAnne Meyn, Rachel Finson, Susan Shaheen, and CarLink II Operations Manager Linda Novick. The interview script (Appendix A) presented a series of fixed-response, and open-ended, questions. Because this was the first official feedback from CarLink II users, the research team recognized that there might be issues that participants wanted to address that the research team was not fully cognizant of. The open-ended interview style was chosen to allow for more comprehensive feedback from the participants. The interviewers were instructed to follow up on any interesting answers, departing from the script as necessary. In this manner, new issues could be discovered and explored, which will aid in the design of the final questionnaire, as well as improving our understanding of the project.

For the interim interviews, a sample from four of the participating employers, as well as from Homebased Users who had been members for at least three months, was targeted. Participants from four employers were chosen to capture the impacts of different corporate cultures, geographical locations and expectations about CarLink II (e.g., different levels of interest in promoting carpooling or Day Use by non-commuters). For each employer, a date was chosen and CarLink II members were asked to sign up for available time slots. John Wright, MollyAnne Meyn, and Rachel Finson conducted the interviews in January, February, and March, 2002. Each interview took 10 to 30 minutes, with the majority being 15 to 20 minutes long. The two Homebased interviews were conducted over the telephone, due to scheduling difficulties. The interviewer took notes, occasionally assisted by an additional evaluation team member.

After introductions, each interview began with a discussion of the user's commute, with and without CarLink II. This included connecting modes to Caltrain, other commute modes, carpooling frequency, perceived costs, commute stress, etc. Other topics included: Day Use; changes in vehicle ownership (past or intended); CarLink II vehicle refueling; the CarLink II reservation system, and; willingness-to-pay for CarLink II membership.

Participants were asked to name and describe what they considered to be the three greatest strengths of CarLink II, as well as its three greatest weaknesses. Using a Likert scale of Very Satisfied, Satisfied, Neutral, Dissatisfied, and Very Dissatisfied, interviewees were asked to rate their satisfaction with a variety of CarLink II components. They also stated how much they perceived their travel to change for various modes, from Greatly Increased to Greatly Decreased. The interviews ended with the members giving any final comments, suggestions, and questions.

INTERVIEW RESULTS

These results are based entirely upon the answers of the interview participants, recording their perceptions of what they believed their travel to be. These responses have not been verified by other data sources, such as the vehicles' automatically collected data. A comprehensive evaluation will be presented in the final report after all data collection is completed.

The interim interviews were voluntary and could have been subject to a self-selection bias. Possible biases could be that some users are too busy to be interviewed (and may have different

travel patterns) or they feel that they use CarLink II too infrequently (causing an under-sampling of less frequent users). However, neither of these biases was evident.

Participant Profile

Twenty-five CarLink II members participated in the interviews. Of these, 14 were primarily Workbased Commuters, seven were primarily Day Users, two were Homebased Users, and two were switching to Homebased from Workbased and Day Use.

Eight of the twenty-five interviewees were male, as compared to the 48.1% who were in the program.

Employer Profile

Each of the participating companies has unique characteristics that make the carsharing experience different for their individual employees. The different corporate cultures, distances to Caltrain, proximity of retail areas, on-campus services, parking availability, and other issues gave the research team an opportunity to learn in a variety of settings. Briefly, the four companies can be described as follows:

- **Company A**: This company is located the furthest (approximately 5.25 miles) from California Avenue Caltrain station. This company has three offices; two are located approximately three blocks from one another and the third is about a mile away. There are vehicles parked at each of these locations during work hours. There is a commercial district within easy walking distance, where the employees have access to restaurants and stores. Company A uses four CarLink vehicles and encourages carpooling, so that more employees can take Caltrain. There is no efficient bus or shuttle available. Most of the fourteen members are Workbased Commuters at least one day a week, with only one member using CarLink only for Day Use. Eight of the fourteen users were interviewed.
- **Company B**: The second company is located approximately three miles from the Caltrain station. As the interviews took place, the company was in the process of moving its employees from a few central buildings to locations that are spread out across a wider area. This had a significant impact on the carsharing program, as they went from having all five cars in one parking lot to scattering the vehicles into different parking lots. During this period, all members continued to carpool and worked together to accommodate the new locations. The company provides a cafeteria for its users. There are no retail or commercial activities within walking distance of the job site and few employees regularly leave the campus for personal errands. Company B encourages carpooling in order to reduce parking demand. Of the 26 members, only three are classified as Day Users. The remaining 23 participants are Workbased Commuters, which includes Day Use privileges. Three commuters were interviewed by the research team.
- **Company C**: At program inception, company C was located over a mile from the California Ave. Caltrain station. During the CarLink program, but after the interviews, the company moved out of the CarLink vicinity, with two employees becoming Homebased Users. Employees left the original worksite more often than Company B, although there was no commercial area easily accessible on foot. They used two cars for

four members, although one of the vehicles was primarily used by the worker overseeing the move, and another member had just recently joined prior to becoming a Homebased User. Three employees were interviewed.

- **Company D**: The final company is located 0.8 miles from the California Avenue Caltrain station. They have 33 members, of which ten are classified as Workbased Commuters. Only four of these are consistent commuters, with others either walking or carpooling occasionally. The close proximity to the station allowed members to commute with Caltrain prior to CarLink and many continue to alternate walking and using CarLink for the station to work portion of their commute. The cars at this location are used primarily for day use by the Workbased commuters as well as those who walk, bike, carpool, or take the bus to work. There is some commercial development within walking distance, although it is far enough to discourage casual trips. This company had the most participants, with twelve individuals being interviewed.

Homebased Users

One of the Homebased Users lives one mile from the Caltrain station and one lives 3.5 miles away. They both drive their CarLink II vehicles to the station each morning and use the vehicles during evenings and weekends. Only three Homebased members had been in the program over three months at the time of the interviews and the evaluation team felt that more recent additions would not have had sufficient experience to interview yet.

CarLink II Commutes

The Workbased and Homebased Users commuted with CarLink II an average of 3.7 days each week. Thirteen of the 20 applicable commuters used CarLink II to get to work four or five days a week. The primary reasons for not commuting with CarLink II were unexpected changes in employees' work schedules and late starts in the morning. While many users had intended to commute with CarLink II more often, others intentionally planned to only use CarLink II one or two days each week; because of regular schedule variations or they felt that the CarLink II time commitment was too much to do every day. Furthermore, one of the employers is located only 0.8 miles from the California Avenue Caltrain station and these members often preferred to walk—only taking rides if someone else was already taking a car, or if the weather was poor.

The commuters that were interviewed lived an average of 2.7 miles from their nearest Caltrain station and it takes them eleven and a half minutes to get there. Eight people drove to the station, six walked or biked, four took a bus or shuttle, and two carpooled (one with a non-interviewed spouse member).

Although many participants had previously commuted with Caltrain, overall, the CarLink II project has shifted additional people to transit for the commute. In addition, some participants that had previously used Caltrain for their commute were doing so more often under the CarLink II program. This was especially true for companies which have poor connectivity to Caltrain. In this circumstance, CarLink II made Caltrain a realistic choice for the first time for these employees. The CarLink II final report will present detailed analyses of the changes in VMT and mode choice, using the more complete dataset.

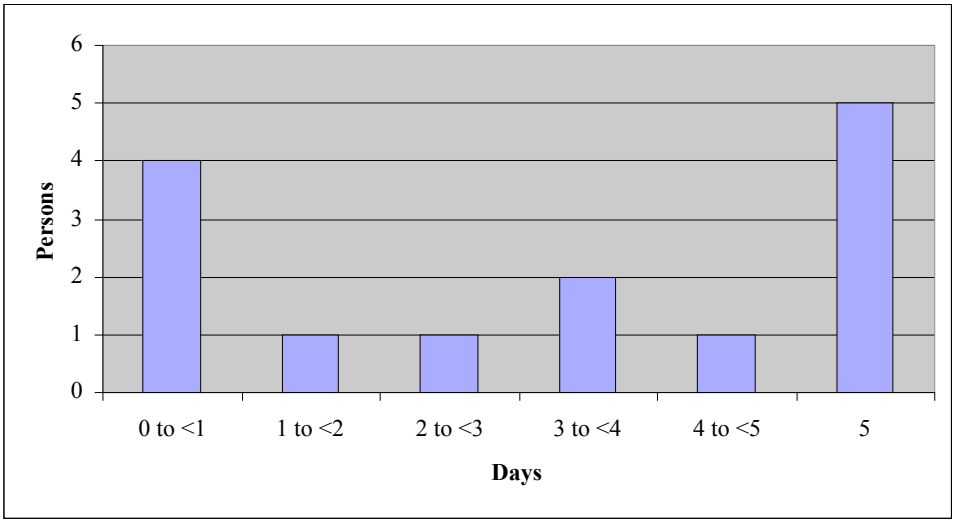
One CarLink II client had subscribed to a shuttle that ferried employees to and from the San Antonio Caltrain station. However, the limited shuttle schedule, and the lack of midday mobility meant that CarLink II offered a better solution. These employees commute more often with the Caltrain/CarLink II combination than they had with the Caltrain/shuttle combination. The chief reasons they cited were that the shuttle was not as dependable, CarLink II is more adaptable as their schedule changes, and CarLink II allows them to complete more errands, either during their commute (e.g., working out at the gym) or during the day (e.g., lunch and meetings).

One of the participating companies (Company D) is located less than a mile away from the California Avenue Caltrain station. The employees from this company that are participating in CarLink II often commuted with Caltrain prior to CarLink II, walking between the station and their worksite. Many of the Day Users from this company still choose this mode and even Company D "Commuters" would sometimes walk the short distance if the weather was nice or if they were unsure whether a car was available (i.e., they did not know if their fellow workmates had already taken their firm's quota of vehicles). CarLink II participants from this company indicated during the interviews that they commuted with Caltrain more frequently since CarLink II began, since they are less likely to drive in when it is raining or when they have errands to do. Because of the close proximity to the Caltrain station, many of these employees did not need a car for the commute to work, but the Day Use component of CarLink II was appealing and 77% of the members were Day Users.

CarLink Carpools

In order to foster as many commute mode switches to transit as possible, while maximizing VMT reductions and to maximize the number of participants per vehicle, the CarLink II program encourages members to carpool. However, since the Workbased clients are the employers, the degree of carpooling depends on each company's internal policy regarding carpooling. For some of the companies, carpooling is not a primary concern, although none discouraged it. Others, especially if they have parking shortages, are attracted to the benefits of carpooling and want their employees to fill the cars as much as possible. Company D, with the most users, saw relatively little carpooling since members would often find it easier to walk the 0.8 miles, rather than waiting for a carpool. On average, the CarLink II commuters interviewed indicated that they carpooled 2.9 days out of every five workdays (Figure 1). The average number of passengers on days with carpools was 1.7, in addition to the driver.

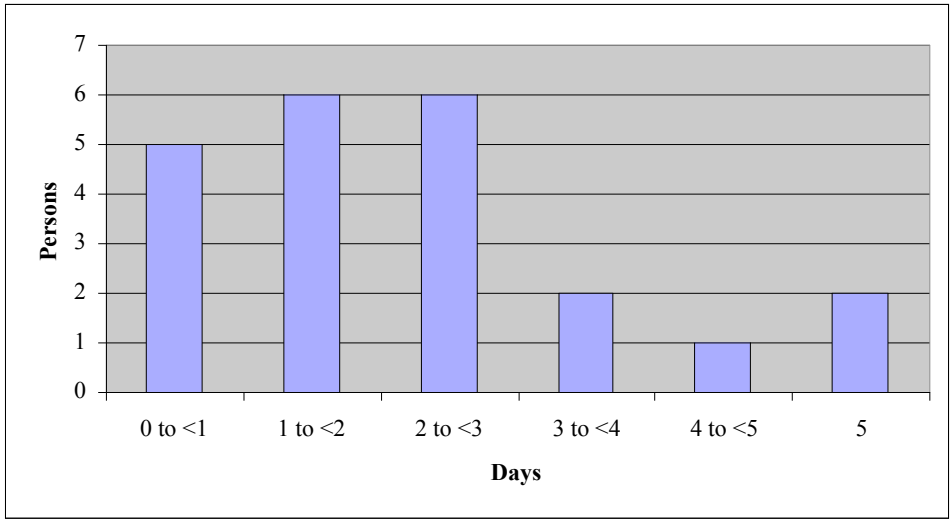
FIGURE 1: Number of Days Carpooling per Work Week



Day Use

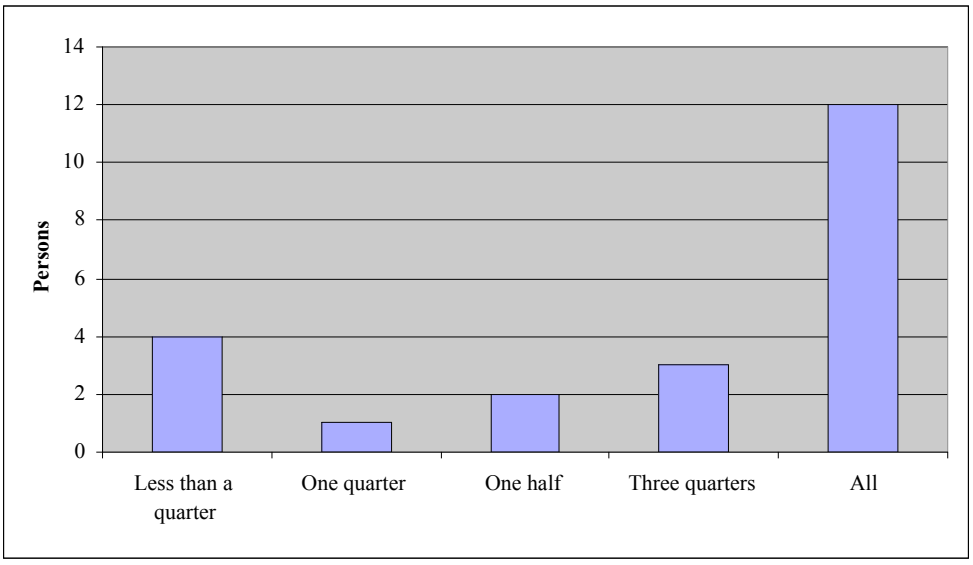
All interviewed Workbased members (Commuters and Day Users) made a Day Use trip at least once a month, with an overall average of two trips per week (Figure 2). In this instance, Day Use trips are defined as any trip away from a member's work location that requires a car. Therefore, walking 20 meters offsite to a store would not count, but driving across a large campus (but still in the same worksite) would count. Employees from the company with multiple job sites (a campus atmosphere), indicated the highest number of Day Use trips, due to intra-campus CarLink II travel. This indicates a possible high value niche for companies participating in CarLink style programs.

FIGURE 2: Number of Days Performing Day Use Trips (with or without CarLink)



The majority (55%) of interviewees indicated that they now use CarLink II for all their Day use trips (Figure 3). For those participants that did not use CarLink II for all Day Use trips, the reasons varied Two of the worksites are located near commercial areas and members preferred to walk, rather than check-out a CarLink II vehicle. If the CarLink II member drove their personal vehicle to work they would generally use it for Day Use trips. Although some members indicated that they would still use the CarLink II cars for Day Use trips even if their personal car was on site. Finally, there were situations when no CarLink II vehicle was available. When this happened, most users indicated that they were generally able to change their schedule to accommodate existing reservations.

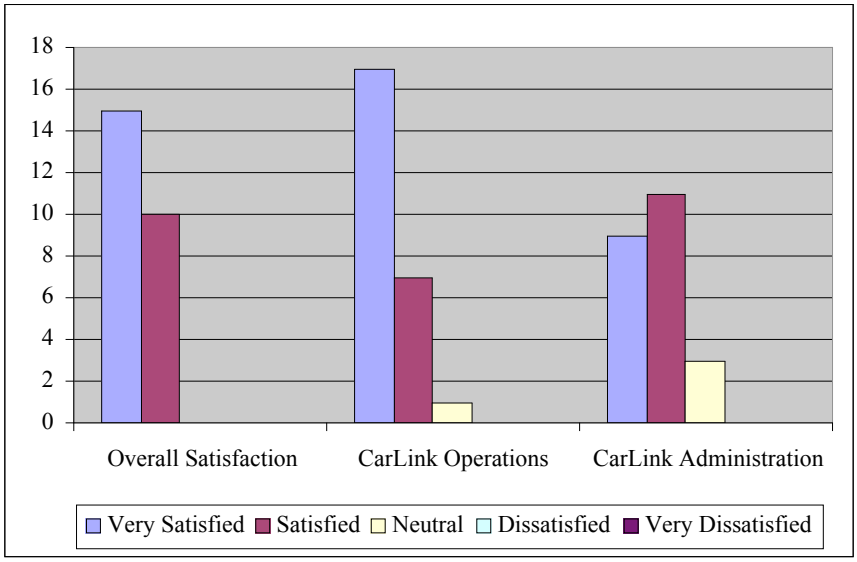
FIGURE 3: Fraction of Day Use Trips Completed in CarLink Vehicle



Overall User Satisfaction with CarLink II

During the interviews, the CarLink II participants were asked about their satisfaction with the program and with individual components of it. In addition to open-ended questions, the interviewers asked each member to rate their satisfaction on a five-point scale ("Very Satisfied," "Satisfied," "Neutral," "Dissatisfied," and "Very Dissatisfied") on various components. The results of these questions are presented in Figures 4 and 5.

FIGURE 4: Satisfaction with CarLink II Program Components



Overall, the members are highly satisfied with the CarLink II program. Sixty percent declared themselves "Very Satisfied," with the remainder being "Satisfied." The majority of the participants that indicated "Satisfied" (80%) came from a single company. At this company the interviewees indicated that there had been some difficulties with the Day Use reservation system. In addition, this company is located close to a Caltrain station and the addition of CarLink II did not necessarily offer the participants as much change in their travel patterns as it did the other companies. In general, many people were enthusiastic in their praise for the program and almost all hoped they would be able to continue in it.

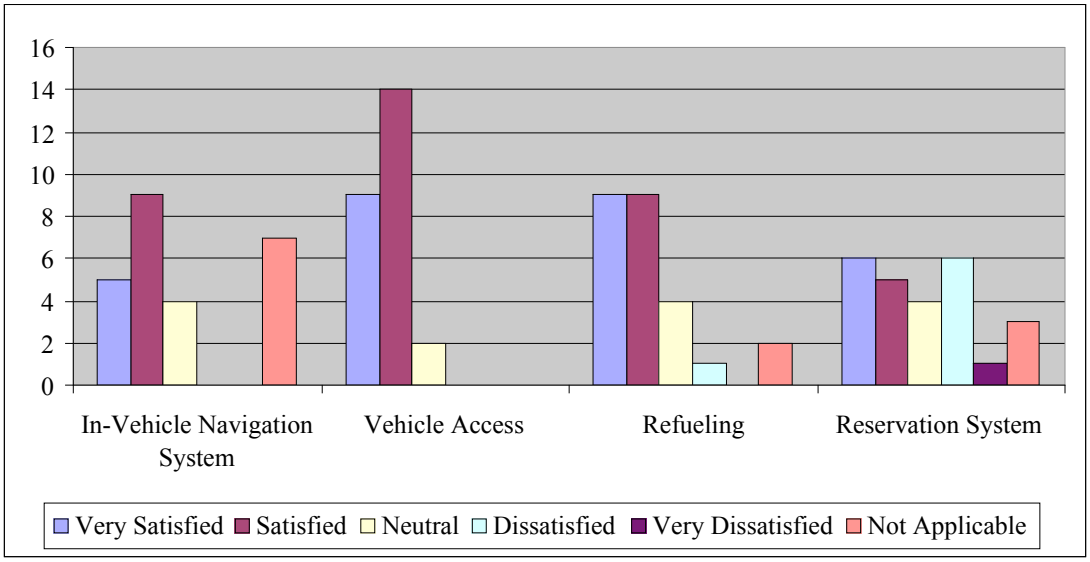
User Satisfaction with CarLink II Operations and Administration

After being asked to rate their overall satisfaction, the participants were then asked for their opinions of how the CarLink II staff handled operations and administration. Operations was defined as involving the care and well-being of the vehicles, training, and resolving issues on scheduling, technology, and other problems, while administration was defined as involving the paperwork and non-urgent communications.

Sixty-eight percent of those responding were "Very Satisfied" with operations; the members said that when problems arose, the CarLink II staff responded to them very quickly and usually kept them well informed of relevant issues. The only complaints were worries that the staff might not be reachable if schedules changed or emergencies came up; a couple of people mentioned that without a mobile phone they could not easily contact CarLink II staff while on the road.

The interviewees were also satisfied with the CarLink II administration, although many people said they had little contact with administration, with which they happy.

FIGURE 5: Satisfaction with CarLink II Features



User Satisfaction with CarLink II Components

The CarLink II components that were addressed during the interviews included the in-vehicle navigation system, vehicle access, refueling, and the reservation system.

In Vehicle Navigation

The interviewees found the in-vehicle navigation system satisfying, although many members had never used it. Of those that had, only two use it regularly (one Workbased and one Homebased commuter), while the rest mostly just "tried it out." Since most trips would have been on known routes, the limited use of the in-vehicle navigation system could be expected.

Vehicle Access

Vehicle access was defined as unlocking the car with the fob and logging into the computerized system. Fifty-six percent of the respondents were satisfied and 36% were very satisfied with the vehicle access. Two people said that the fobs were occasionally difficult to use and one found the keypad difficult. A few interviewees indicated that they had difficulties with the screen at first, but they felt that these problems had been mostly taken care of by the time of the interviews.

Refueling

The participants were pleased with the refueling process, with 36% stating they were very satisfied and another 36% saying they were satisfied. Only seven of the 23 respondents claimed to refuel a vehicle more than once a month, as seen in Table 1. Most of the respondents found that the vehicles were generally sufficiently fueled when they took possession of the cars. The Workbased Commuters told us that it is generally much easier to refuel during Day Use trips,

since in the morning they do not want to be late for work and in the evenings they generally schedule themselves to arrive just in time for the train, leaving them no time to stop at a gas station

TABLE 1: Refueling Frequency	
Never	8
Less than Once a Month	7
Once a Month	1
Two to three times a month	4
Once a Week or more	3

Reservation System

The reservation system was developed by the project partners and allowed Workbased Users to reserve vehicles in advance for Day Use trips. Generally, one of a company's vehicles was unable to be reserved in advance, in order to provide a buffer to the system. The reservation system has no lockout component, so the members were on an "honor system" to not take a vehicle that had been reserved by another user.
As seen in Figure 5, the reaction to the CarLink II reservation system was mixed, with 28% of the respondents claiming to be dissatisfied or very dissatisfied, while 44% said they were satisfied or very satisfied. Table 2 shows the frequency that the interviewees reserved the vehicle. Dissatisfied members had started using the reservation system less often, but most believed that the problems were being solved and would start using it again. The primary reason for dissatisfaction was the lack of a lockout system, guaranteeing that a reserved vehicle would be waiting for the person who reserved it. Table 5 shows how often this problem occurred with those interviewed, since they joined the program.

TABLE 2: Reservation Frequency	
Never	1
Once a Month	5
Two to Three Times a Month	9
Once a Week	5
Never	1

TABLE 3: Number of Times Reserved Vehicle Not Waiting	
Never	9
Once	4
Twice	4
Three to Five	1
More than Five	2

However, even while missing vehicles was a frequent complaint from employees at one company, most interviewees felt that the brunt of the blame belonged to fellow users (rather than CarLink II operations). It was felt that some members were abusing the program by ignoring the

reservation system. At the time of the interviews, most participants felt that discussions with the CarLink II staff were bringing about changes that would effectively solve this problem (i.e., mostly by requiring Workbased Commuters as well as Day Users to "sign-out" vehicles at the front desk). The other complaints about the reservation system were specific to its operations: the scrolling on the web page was difficult; there were too many steps; all cars should be reservable in advance; the system's clock was not always accurate, and; there was no good way to inform the reservation system directly when a Day Use trip was going overtime.

An important fact, not reflected in Table 3, is that many of the participants who were vocal about difficulties with the reservation system seldom if ever actually experienced a problem. However, the perception that a reserved vehicle might not be waiting became so dominant that many users saw this as the biggest problem with CarLink II (although not necessarily a large problem by itself). This is an indication that just a few people who have experienced a problem can convince their entire group that they all have a problem. This lesson should reinforce the importance of responding quickly and thoroughly to future problems.

Although all Workbased Users (Commuters and Day Users) were using the same reservation system in theoretically the same way, the reaction to it varied greatly between the different employer participants.

At company A, which had few Day Users, the carpoolers generally acted as if they had ownership over their car that day. By communicating with each other they would effectively double-check the reservation system. None of the five interviewees had found that a reserved car was not waiting for them (and only once had to use a car of a different carpool).

At company C, one of the two vehicles was generally used by one person who was often away from the office during the day and considered off limits by the rest. One interviewee had only used a vehicle once and another said that the car was used so infrequently there was no need to reserve it. This contradicted the final participant who did reserve the vehicle frequently and often found it missing.

Company D has a mixture of both Day Users and Workbased Commuters and nine of the twelve interviewees had not found their reserved car at least once. Most of the participants felt that if everyone were required to sign out the car at the front desk (i.e., Workbased Users as well as Day Users), then it would be easier to keep track of the vehicles. Furthermore, users sometimes reserved the vehicle for extra time (up to the entire day) in order insure that they had a vehicle available when they needed . This particular company was also the most vocal in their annoyance with the reservation page screen, number of steps, and the fact that you cannot reserve all the vehicles in advance.

Company B members also found the reservation system less useful because of the lack of a lockout feature, leading to less use of the system (if not the cars). The problems were compounded recently at company B because of the reorganization of the campus. Many CarLink II members are now located at new buildings and the cars are not where they once were. Members are now more likely to reposition the cars by driving them between buildings for meetings. This means that the CarLink II cars might be "on-site" but not easy to find by the

person who made the reservation. Since the interviews, the CarLink II staff have implemented new CarLink II parking lots to facilitate the users.

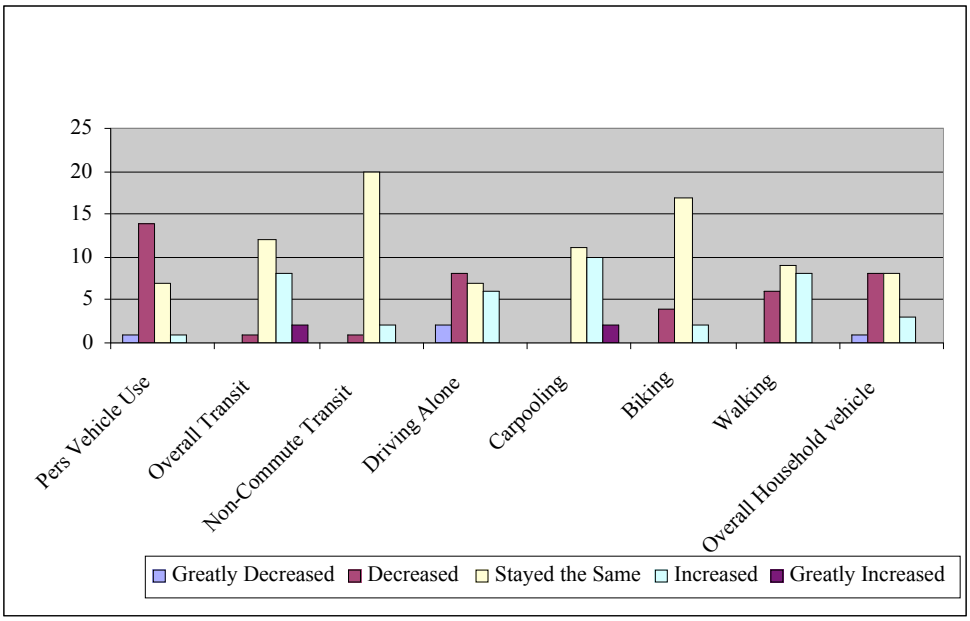
Commute Stress

Interviewees were asked to rate how their stress during their commutes had changed since joining the CarLink II program. Ten of the respondents (45.5%) said their stress had decreased, five (22.7%) said their stress had greatly decreased, and seven (31.8%) said there was no change. Many people found the train very relaxing and enjoyed it more than sitting in traffic. Some people found connecting with CarLink II rather than a shuttle reduced their stress substantially. Some of the participants declared that racing to catch the train added to their stress, sometimes canceling out the gains of a relaxing rail journey.

Overall Changes in Travel Behavior

During each of the interviews, the participants were asked to rate how they perceived their travel to have changed for various modes since they joined CarLink II. They were asked to rate eight different modes on a five-point scale from "Greatly Decreased," "Decreased," "Stayed the Same," "Increased," to "Greatly Increased." The results of this questioning are presented in Figure 6.

FIGURE 6: Travel Changes by Mode



As expected, personal vehicle use went down, with 65.2% saying their individual travel in their personal vehicles had decreased or greatly decreased. This was one of the expected benefits of CarLink II, as many members shifted to transit for their commutes. The approximately 30% that exhibited no change were mainly members who were already commuting on Caltrain before

joining CarLink II. However, even some of the veteran Caltrain users did decrease their personal vehicle travel, since they no longer had to bring their own vehicle for the occasional workday errand.

Overall transit use went up for 43.5% of all the interviewees. Over 50% of the respondents claimed no change in their overall transit usage. This was due to the fact that many of the participants had previously commuted with Caltrain and therefore had less change in their behavior. Non-commute transit showed the least change of any of the modes, with 87.0% choosing "Stayed the Same." One of the hypothesis' of CarLink II was that greater familiarity with transit for commuting might translate into more transit trips for non-commute purposes. This shift in behavior has yet to be demonstrated.

The number of drive-alone trips and carpooling trips went in opposite directions. 34.8% said their driving alone decreased and 8.7% said it greatly decreased. However, 26.1% did show an increase in driving alone; these were generally zero car households, and CarLink II vehicles presented a new opportunity to drive alone. The 30.4% who showed no change were mostly veteran Caltrain users who would only have used their vehicles on the home end of their commutes anyway. For carpooling, 43.5% said it increased and 8.7% said it greatly increased. The 47.8% who saw no change were from employers who did not overtly encourage carpooling and one Homebased Commuter. However, the fact that there were no decreases in carpooling meant that CarLink II did not transfer commuters from carpools to transit.
The mode shifts for biking and walking had small and self-negating changes. 17.4% of the respondents said their biking had decreased, 8.7% had increased, while the rest saw no change. Walking showed more substantial changes, with 26.1% decreasing, 34.8% increasing, and the rest staying the same. These decreases were due to the fact that some people walked to and from the Caltrain station less and, to a lesser extent, used the CarLink II vehicle for the types of trips they had walked to before (but possibly to different specific destinations). The increases were due to members relying less on cars for mobility than they had previously, as well as sometimes having to walk across campus for a CarLink II vehicle.

When asked about changes in travel behavior for the entire household, there was a definite decline in personal vehicle use. Five percent of the interviewees indicated that overall household vehicle use had greatly decreased, 40.0% said it decreased, 40.0% chose "Stayed the Same," and the remaining 15.0% saw an increase. Most of the changes were due to the actual member's travel behavior and were mostly due to his or her commute. The few increases in personal vehicle use were the result of a household vehicle being more available to other members, who used it more frequently.

CarLink II's Greatest Strengths

During each of the interviews, participants were asked to indicate what they considered to be the three greatest strengths of CarLink II. The majority of interviewed participants had very positive things to say about the program. Although this question was open ended, CarLink II researchers coded the answers and Table 4 tabulates the responses. Some participants came up with one or two strengths (often because they said the same strength in two different ways), while others offered more than three.

TABLE 4: CarLink II's Greatest Strengths	
Strength	**Percent Choosing**
Availability/Flexibility	76.0% (19)
CarLink Allows Daytime Usage	44.0% (11)
The Car Itself is Good	32.0% (8)
CarLink Helps the Environment	24.0% (6)
CarLink Reduces Use of Personal Vehicle	24.0% (6)
CarLink Reduces Stress by Transferring Commuters from Traffic to Train	20.0% (5)
CarLink Takes Care of Everything in One Package	16.0% (4)
The Navigation System	12.0% (3)
CarLink Shows Off Company Well	8.0% (2)
CarLink Saves Money	8.0% (2)
CarLink is Good in Bad Weather Instead of Walking	8.0% (2)
The CarLink Staff is Good	8.0% (2)
CarLink Speeds Up Commute	4.0% (1)
Sharing is Good	4.0% (1)
Guaranteed Rides	4.0% (1)

The number one greatest strength of CarLink II, chosen by over three quarters of the respondents, was "Availability/Flexibility." Users liked the fact that they were not highly restricted as to when they could access the vehicles. Specifically, they enjoyed having flexibility in their commute times (especially compared to shuttles) and in when they could make Day Use trips. The second most popular choice was being able to make Day Use trips.

These two features are specific to the CarLink II program and are likely to be newly enjoyed by all the users. However, some features might be less novel to the many interview respondents who already commuted with Caltrain, and so fewer people listed them as strengths. Veteran Caltrain users would not be expected to as readily identify as a strength such features as getting out of traffic, and perhaps even the environmental benefits (i.e., they may identify Caltrain as the environmental benefactor). Furthermore, only 8.0% mentioned that CarLink II saves money (a number lower than hypothesized). In this case, members who previously commuted with Caltrain and have transferred from walking or shuttling to CarLink II will not have recognized much monetary benefit.

CarLink II's Greatest Weaknesses

The PATH evaluation team also asked the participants what they thought the greatest weaknesses of CarLink II were, or what their chief concerns were. The responses are listed in Table 5. Many respondents had difficulty with coming up with unique weaknesses, resulting in approximately two coded weaknesses per interview.

TABLE 5: CarLink II's Greatest Weaknesses	
Weakness	**Percent Choosing**
Reservation System-General/Cars Not There	52.0% (13)
Reservation System-Technical Problems	32.0% (8)
Coordinating with Fellow Users	32.0% (8)
Problems with Vehicle/Vehicle Access	20.0% (5)
Cannot Work Late	12.0% (3)
Vehicles with Low Fuel at Start of Program	12.0% (3)
Would Like More Vehicles	8.0% (2)
Commute Takes Longer	8.0% (2)
Not Personal Vehicle-Cannot Leave Items, Odor	8.0% (2)
Waiting for Train	4.0% (1)
Feel Stranded Relying on Public Transportation	4.0% (1)

The most often-cited weakness was the reservation system. As discussed above, the primary problem was the lack of a lockout system, guaranteeing that a reserved vehicle would be waiting for the person who reserved it. The second class of complaints about the reservation system referred to specific details, such as the web page scrolling, number of steps, and other issues discussed above. The only other major complaint involved the difficulties in coordinating with other users. When participants had to work late or something came up suddenly, they were often required to communicate their needs to their carpool or to the whole group. While this was simple at some sites, it led to problems for many people. Included in this concern, was the problem that assigned drivers felt a responsibility to wait and take passengers, even when they were not sure if they were coming. A related concern was that Workbased Commuters sometimes felt they could not work late, because they were part of a carpool leaving at a certain time.

Ownership of Personal Vehicles

The first six months of the CarLink II program saw only a few changes in the personal vehicle ownership of its members. This is not surprising, since six months (and less for many users) is a very short time to make such sizeable decisions and the participants did not know if CarLink II was a long term option or a temporary research program. Keeping this in mind, the fact that four of the 25 interviewees changed the number of vehicles in their household should be seen as very significant. Two households sold a vehicle (one unrelated to CarLink II membership and one for which CarLink II may have been a factor), two are postponing the purchase of a vehicle, and one bought a car (also unrelated to their membership in CarLink II). In addition, three people said they would possibly sell a vehicle in the future if they could also join as Homebased Users.

CarLink II Cost Issues

During the interviews, respondents were asked various questions about the costs of the program. These interviews were not intended to provide the evaluation team with definitive willingness-to-

pay (WTP), but rather to help set a context for analyzing CarLink II economic results and to assist in developing future research instruments.

Each of the CarLink II members was asked what they perceived the cost of their round trip commute to be each day they used CarLink II, as shown in Table 6. The variation between users was mostly due to variations between employer policy. At the two companies that paid the full cost of CarLink II for employees and also provided Caltrain passes employees all stated that their cost was less than $4.00 per round trip. These two companies account for the entire 47.1% of respondents in the less than $4.00 category. Another company's participants all chose $4.00 to $5.99 and the employees of the fourth company all chose $4.00 or more. The employees of this final company pay for a certain amount of the program through taxes and the two who chose $10 or more bus to their home-end station, raising their overall cost.

TABLE 6: Perceived Cost of Round Trip Commute with CarLink	
$0.00-$1.99	41.2% (7)
$2.00-$3.99	5.9% (1)
$4.00-$5.99	35.3% (6)
$6.00-$7.99	0%
$8.00-$9.99	5.9% (1)
$10.00 or more	11.8% (2)

Most respondents indicated that they were willing to pay some amount of the costs of CarLink II themselves to be in the program. Two people said they would not be interested at all and a couple more said that they would only use it occasionally. The Homebased Users all gave a WTP of $300 or $350 per month. For Workbased Commute use, the most typical range was $30 to $50 per month, although one commuter said under $100 and another under $300; generally, the users want Day Use included as well. Two users who only commute a couple of days a week wanted to pay on a per day basis and thought that $3.75 to $5.00 would be fair.

All the Day Users and some Workbased Commuters wanted to pay on a per trip basis. Per mile was the most popular, while some wanted per hour and some a combination. The typical range was $.31 to $.365 per mile, with one personal going up to $1.00 per mile. The fees per hour varied much more with respondents stating $1.00, $2.00, $2.50.. $5.00, $7.50, and "under $10.00."

Most of the users had very little experience in paying for carsharing and in translating general transportation costs into a per trip basis, and were very unsure of their answers. Generally, they thought about what the standard reimbursement rate is per mile and chose that. A few people did realize time and mileage would both be important components but were not sure of the best way to divide the fees. In later instruments the CarLink II research team will attempt to standardize these cost questions to more fully investigate WTP issues.

CONCLUSION

The 25 CarLink II members that were interviewed at the mid-point of the program, presented a very positive overall view of the program. Most participants felt that having access to CarLink II vehicles allowed them to use transit more frequently, while keeping their mobility high. Participants were pleased with nearly all the different components of CarLink II. The reservation system was the one component to garner significant negative feedback. While employees at all the different businesses were happy with how CarLink II was operating, it is interesting to note that each of the companies had different experiences with the program due to their corporate culture, proximity to commercial areas, distances to the Caltrain station, and other factors.

The interviewees overwhelmingly thought the program should continue, especially as part of a company's benefit program. The interview results reveal noticeable environmental and societal benefits of CarLink II, although a full analysis cannot be completed until the conclusion of the research/pilot project when all sources of information can be factored into a comprehensive evaluation. Carpooling and transit numbers are up, while personal vehicle use is down. Additionally, the CarLink II program is allowing some users to postpone the purchase of a new vehicle and facilitating the sale of personal vehicles. These interim interviews show from the user standpoint at least, the program was strong and healthy at its midpoint and that most of the problems have been or are currently being, fixed by the operations staff.

APPENDIX IV

CARLINK II FOCUS GROUP SUMMARIES

CARLINK II FOCUS GROUP SUMMARY
May 2002

Executive Summary

Introduction

This summary describes the highlights of the two focus groups and one interview session that the University of California's Partners for Advanced Transit and Highways (UC PATH) CarLink II evaluation team conducted in May 2002. Following this overall summary are separate accounts and protocols of each individual session.

Dr. Susan Shaheen facilitated each of the focus groups, with UC PATH researchers assisting and taking notes. A total of 22 individuals participated in the focus groups (n=18) and interviews (n=4), including 12 women and 10 men. The sessions generally began with a discussion of participant's transportation methods prior to and during CarLink II enrollment, including likes and dislikes of these modes. The discussion then moved on to CarLink II experiences and perceived strengths and weaknesses of the program. All groups provided suggestions on how to improve the recruitment process among other recommendations. Overall, the focus group participants had a very positive reaction to their CarLink II program experiences.

Travel Behavior: Prior To and During CarLink II

Participants, who previously used transit, stated that they had less stress when using public transportation as compared to driving in traffic in their personal vehicle. Those who used public transit in conjunction with walking or biking enjoyed the healthy lifestyle and environmental aspects of these combined transportation modes. They also expressed concerns about safety (e.g., pedestrian injuries) and time (e.g., added time to walk to lunch). Many participants received a free Eco Pass and/or Commuter Checks through their employers and stated that this was a significant factor in motivating them to use transit. Caltrain was perceived to have improved in recent years, and participants stated that the trains were generally reliable and safe.

Participants who previously drove stated that they enjoyed the flexibility and time saving of automobiles. They felt that cars were helpful for transporting goods and storing essential items. However, many felt that commute traffic was stressful and gas prices and vehicle "wear-and-tear" made driving costly.

Participants who previously used transit stated that they took the train more frequently after joining CarLink II. Participants that used transit for the first time, as a result of CarLink II, also reported consistent use once they changed modes. They appreciated the free time on the train to work or relax, and most reported saving money. Two people said that CarLink II enabled their household to sell a personal vehicle, while four other members postponed a vehicle purchase.

CarLink II *Likes*

Participants were very satisfied with the CarLink II program. Some mentioned cost savings and reduced hassle. Others liked the flexibility that the program offered for running errands during the day and responding to emergencies. Many members felt that their commute stress was reduced. This was especially true for former solo drivers, who were glad to be out of traffic, and former shuttle users who felt their schedules were much less restricted with CarLink II. Participants stated that the program was run well and, staff responded quickly to their needs and questions.

CarLink II *Dislikes*

Many users, primarily at Genencor, had difficulties with the on-line reservation system. In at least one case, this led to a member dropping out of the program. Some problems were relatively minor, such as difficulty scrolling through the web page. Others were more significant, such as inaccurate scheduling clocks. A more serious problem occurred when members reserved vehicles and found them taken by another user or when individuals reserved a vehicle but did not use it. In the latter case, members were unable to use the vehicle even though the car was still in the lot. Another problem arose when a vehicle was reserved but not returned to the Workbased parking lot on time. Possible solutions offered by the group included: 1) a lockout system for at least the first ten minutes of a timed-reservation and 2) user fines for individuals who take a vehicle, which has been reserved by someone else.

Focus group participants also noted other problems with CarLink II. While some liked (at least at first) the attention the vehicles brought, the CarLink II logo decals were thought to attract unwanted curiosity from other citizens. Nearly everyone reported that the smart key entry fobs should unlock the vehicles faster, and many noted occasional problems logging in (or entering their PIN) on the message display terminal keypad. Some said that they would like to access vehicles at different worksites and transit stations. Several felt they refueled the vehicles more than other members and that small incentives should be implemented (e.g., a free soda or coffee) to reward refueling. To summarize, the most serious complaints came from individuals who had been stranded, either because a vehicle was unavailable or the technology refused access (i.e., malfunctioning). The majority of the complaints focused on convenience and ease of use.

Recruitment Strategies

Participants offered several suggestions for improving recruitment strategies. They recommended advertisements in the automobile sections of newspapers, supermarket boards, Internet advertisements, radio spots, and TV ads. Many thought that recruitment should be focused at transit stations, with large banners, flyers, and brochures, explaining the program and comparing costs among different modal choices. Personal contact was considered very helpful during the recruitment process.

Willingness to Pay

Many participants stated that they would be willing to pay for the CarLink II service in the future. Workbased members said that they would be interested in a modified Homebased program that included a variety of car types to choose from, and others wanted to pay by the hour instead of a monthly fee. Some Workbased members also stated that if their employer no longer paid for their Workbased Use, they would be willing to pay for this service.

CarLink II Focus Group One Summary
Workbased Users: Genencor
May 23, 2002
Genencor, Palo Alto

Overview
Genencor is a biotechnology company located in the Stanford Research Park, approximately 0.8 miles from the California Avenue Caltrain station. During the CarLink II pilot phase, up to 25 Genencor workers used two CarLink II vehicles for their morning and evening commutes and during the workday for personal and business trips. The focus group participants included six women and two men, who all received an Eco Pass from their employer to ride public transit for free.

Modes of Transportation Prior to CarLink II
- Train 4
- Train and Bus 2
- Bus Only 1
- Most Always Car 1
- Sometimes Bike/Walk 3

Transport Modes Prior to CarLink II: *Likes*
Participants reported:

- Less stress with public transport.
- Liked the freedom of a car, especially the time-savings.
- Biking provides exercise and is good for the environment.
- All received a free Eco Pass and Commuter Checks for transit use. Participants noted that their motivation for transit use was largely due to the "free" Eco Pass.

Transport Mode Prior to CarLink II *Dislikes*
Participants stated:

- Concerns about biking safety.
- Disliked limited times offered by bus/train schedules.
- Motivations to start commuting via transit due to rising gas prices.
- Dissatisfaction with the wear and tear on personal autos resulting from daily commute.
- Disliked time needed to walk from office for errands/lunch.
- The price of a transit commute from San Jose to Palo Alto is too high (without Eco Pass).

CarLink II *Likes*
- People liked the freedom and time-savings of the shared-use vehicles to run errands during day.
- Having a car available in the event of an emergency.
- Comfort and size of the cars (four doors).
- Provides an additional option to get to work from train station if weather is bad or they do not want to walk.

- Maintenance and insurance covered by program.

CarLink II *Dislikes & Recommendations*

User Reservation System

- There was difficulty with webpage scrolling, and the scheduling clock was often off by 15 minutes.
- A primary problem occurred when some members took vehicles without making a reservation, often leaving the person with a reservation without a car. Many solutions were discussed including:
    - Providing system lock out of all members except "reserved" user for first 10 minutes of an appointed time. If a vehicle is not used within 10 minutes, the reservation would be released.
    - Imposing fines on users who take a car without a reservation.
- Another problem was reported when members reserved a car, but did not use the vehicle. This prevented others from taking the vehicle, as it is officially reserved. One proposed solution was to provide an e-mail reminder to the member on the morning or day before their reservation.
- A related problem occurred when a car was reserved at the employment site, but it was unavailable for use because it never left the Caltrain Station. Proposed solutions included providing a back-up car at the office or assigning Workbased Commuters the responsibility of finding someone else to drive the car to work from Caltrain, if they are unable to bring it themselves.
- One member stopped using the program after he twice found a vehicle unavailable after he had reserved it.
- Several participants said that they felt nervous that a reserved car would not be waiting for them when they had an important meeting.

Technical Problems

- The automatic car door was slow to unlock (i.e., it took several seconds to unlock) with the smart key fob.
- Members sometimes had difficulty entering their PIN on the message display keypad and expressed frustration that their PIN had to be entered multiple times.
- The navigation system was not used very frequently, partly because members did not know how to use it and were not given instructions/training prior to joining the program.

Miscellaneous Problems/Suggestions

- One participant wanted to know why Genencor users could not take more cars (than those rented by the company) from the Caltrain station, if others were available.
- One participant suggested that the 4 PM car return deadline should be more flexible.
- Another participant wanted different types and car colors, such as a convertible sports car.

CarLink II *Impacts*

- One participant was pleased to have access to CarLink II vehicles for emergencies during the day.
- One participant stopped driving her personal vehicle two to three days to work per week for lunch and errands because she could now use a CarLink II car.
- One individual did not buy a second household vehicle due to the CarLink II Day Use program.

Homebased Use Interest

- One participant stated that their household could become a one-car family, if they had access to Homebased Use.
- Participants thought that 1,000 miles/month for $300 was a reasonable price for Homebased Use, including insurance, maintenance, and fuel, although they would not be ready to join without more in-depth consideration.
- One participant was interested in paying by the mile to join the service vs. a monthly fee.
- All felt comfortable with a $500 refundable deposit.

Advertising/Recruitment Suggestions

Participants suggested the following:

- Providing cost comparisons on posters/flyers (e.g., leasing/buying vs. carsharing).
- Advertising and distributing brochures at Caltrain and BART stations and on trains.
- Allowing individuals to try it for a one-month trial period.
- Genencor has Friday gatherings that are sponsored by workers and often have themes. Such work events were suggested as a good place to talk about CarLink II and recruit new members.

Willingness to Pay & Final Thoughts

- Most were willing to pay individually for use of this service (i.e., Workbased Commuter and Day Use), if employer no longer covered the costs.
- Participants liked the idea of packages: $5/hour up to 20 miles and $.42/mile after that.
- Fifteen dollars per hour with unlimited mileage was considered too expensive.
- The group would like more cars for Genencor, as the CarLink II vehicles were often in use during the day.

CarLink II Focus Group Two Summary
Homebased Users
May 30, 2002
Cubberley Community Center, Palo Alto

Overview

Ten Homebased CarLink II users participated in this focus group, six men and four women, including one secondary driver (i.e., a spouse/partner of a primary member). This focus group included a majority of the Homebased User population (i.e., the pilot program had a peak total of 13 Homebased members in March 2002).

Modes of Transportation Prior to CarLink II

- Transit (Train, Bus, and Shuttle) 5
- Single Occupancy Vehicle (SOV) 3
- Bike 4
- Carpool 2
- Telecommute 3

Transit Issues

- Muni was considered unpredictable. Caltrain is now on time and has a better schedule.
- Caltrain does not always have sufficient space for bikes on board.
- Transit often takes planning.
- There is a final train of the day that must be taken or an alternative travel means found.
- Transit generally feels safe, but is not perfect.
- A few participants used an Eco Pass, which was provided through their employer.

Personal Vehicle Issues

- Private vehicles were thought to be very spontaneous and flexible.
- They are good for transporting and storing items.
- Many in the group did not like the stress of car commuting and preferred the convenience of intermodal connectivity. One reported that commuting via transit took longer than driving, but they could relax or work on the train or both.

CarLink II *Likes*

Participants stated the CarLink II was:

- Useful to run errands such as shopping or picking up kids from daycare.
- Good to have in case of an emergency.
- Cheaper than buying another car.
- Cars are new and clean.
- Maintenance and insurance are covered.

CarLink II *Dislikes & Recommendations*

- Four individuals reported disliking the CarLink II decal stickers because they attracted unwanted curiosity from other drivers in traffic and at parking lots. However, one participant said that he liked the logos because it made the car easy to find.
- Some participants were frustrated that they were unable to store essentials in the cars.
- Participants desired more flexibility in taking car trips over several weekdays in a row.
- Several said that they would like to have access to different types of cars, such as SUVs.
- Two stated that they would appreciate a larger network of car locations, such as more than one transit station.
- Some users would like to be rewarded for refueling, such as a free cup of coffee or soda from the gas station.
- One participant said that she would like her friends to be able to drive the car when they go out together.
- The smart key fob took too long to unlock the door.
- The message display keypad did not always work.
- The message display units asked different questions and in a different orders, depending on the car.

CarLink II *Impacts*

- One person sold their car due to CarLink II.
- Another planned to buy a used car but did not because of CarLink II.
- Another would have bought a used car or leased a new one but did not because of CarLink II.

Advertising/Recruitment Suggestions

Participants suggested the following:

3) Flyers at bus stops and depots,
- Advertisements in auto sections,
- Supermarket boards, and
- Contacting businesses close to other transit stations.

Users in this group discovered CarLink II from many sources, such as: a flyer at Caltrain stations, an Internet search, and a meeting with the CarLink Operations Manager at a public event.

Willingness to Pay

- Participants expressed willingness to pay for a neighborhood carsharing program but did not want to be financially committed on a monthly basis in such a model (i.e., versus monthly leasing as in CarLink II).
- While they agreed that a $300 monthly fee was not too high for CarLink II, they expressed interest in a pay-per use or pay-per mile pricing structure.

- A couple of members noted that neighborhood carsharing would not work in their neighborhood because there was not a transit station nearby.

Final Thoughts

- There was great customer service in the CarLink II program; management was very responsive to their needs.
- The GPS system was fun to use.
- Participants enjoyed the program, especially the overall convenience of intermodal transport for long commutes, less traffic stress, and fewer parking problems.

CarLink II Interview Summary
SAP Interview Notes
May 30, 2002
SAP, Palo Alto

Overview

SAP is located in the Stanford Research Park. Twenty-six SAP workers from three buildings used up to five CarLink II cars to commute via Caltrain and during the day for errands. Due to scheduling conflicts, instead of moderating a focus group, the UC PATH evaluation team conducted four, 20-minute interviews. Thus, the discussions were markedly different than the two focus groups. Two men and two women participated in the interviews. All participants received a Commuter Check incentive of up to $100/month for transit use from their employer in addition to CarLink II privileges.

Prior Transportation Modes & Interviewee Perceptions

- Two interviewees drove their cars. One occasionally carpooled with a spouse.
- One used public transit 60 percent of the time, including bus, train, and the Deer Creek Shuttle and drove a car the remaining 40 percent of the time.
- One participant used to walk to a Caltrain station and then train, bus, and walk to work.
- Users liked how private cars were more spacious and flexible.
- The aspects they *disliked* about private vehicles were:
    - Maintaining vehicles,
    - Paying for insurance,
    - Parking difficulties,
    - Driving itself, and
    - Commuting in a car can be stressful.

Overall Impact of CarLink II on Interviewee Behavior

- One participant reported that CarLink II saved his household from purchasing another new car.
- One participant, who previously commuted with Caltrain three days a week, found it more convenient to travel to and from the Caltrain station to work with a CarLink II car.
- Another participant sold one of five total personal vehicles due to CarLink II program, but might stop taking the train, if SAP no longer subscribed to CarLink II.
- One participant said that if she had access to CarLink II on the Homebased User side she would not have bought her Toyota.
- All participants used CarLink II for commuting three to four times per week and one to six times per month for Day Use.

Factors Influencing CarLink II Use

- Cost savings over owning and maintaining a car.
- Good for long commutes.

- SAP established carpooling groups, which made it easy to carpool.
- Less stressful than driving.
- Great customer service and no hassle with maintenance, insurance, etc.
- Convenient intermodal connectivity.
- CarLink II is good for the environment.

CarLink II *Likes*

- Cost
- Technology was effective.
- Reservation system worked fine.
- Especially good for long commutes.
- The train was relaxing.
- Can work with CarLink II later hours than with the shuttle.
- CarLink is faster than a shuttle.
- Good for running errands.
- Works well with carpooling.
- Less stressful than driving solo.
- Customer service was very professional.
- Convenient.

CarLink II *Dislikes*

- One participant had to take a bus once because no cars were available, and he worried about taking the last available car from the Caltrain station. There are few taxis in the area for emergency backup.
- One participant was confused about which CarLink II cars belonged at the station and which could be taken by SAP employees (vs. employees of other companies).
- One participant wanted to reserve a vehicle, but could not do so as it was already reserved. This individual was quite frustrated because this same car was not used (a less frequent occurrence at SAP than at Genencor).
- Sometimes cars were not refueled.
- One participant complained that it was confusing which cars could be used at various SAP CarLink II lot locations.
- One participant was twice stranded for technological reasons: The message display screen would not come on, and he was unable to contact CarLink II staff for help. This participant suggested a 1-800 number. (Note: A 1-800 number was already provided as part of the CarLink II pilot program.)
- One participant did not like refueling the cars and felt he did this more than others. He also would have liked a gasoline-electric hybrid vehicle in the fleet.
- One participant would like a weekend-use option once her husband comes to live with her in the Bay Area.
- Many were asked to enter their PIN code twice by the in-vehicle system, but overall they reported that the technology in the CarLink II fleet generally performed well.

Advertising/Recruitment Suggestions

Participants suggested the following:

- Marketing to individuals who are always in traffic, for instance, through billboards.
- Making user fees tax deductible.
- Using the Internet and radio advertisements instead of the newspaper.
- TV advertisements.
- Large banners at train stations advertising a free trial.

Willingness to Pay

- One participant would be willing to pay for Homebased Use at a rate of $200/month for 500 miles.
- Another respondent stated that Homebased Use was not an option since they already owned a personal car.

1) One participant responded that they would rather not pay for Homebased Use and preferred to have costs covered by the Commuter Check and employer-sponsored CarLink II program.
2) Another participant stated that they would be more interested in Homebased Use if the fleet consisted of more attractive types of cars, e.g., convertibles and sports cars.

Workbased User Focus Group Protocol
May 23 2002

Part I: Introduction (10 minutes)
- Moderator introduction and focus group purpose
- Agenda overview
- Participant introductions
- Permission to take photos

Part II: Commuter/Day Use Trips (Prior to CarLink) (20 minutes)
- How did you commute prior to CarLink
- How did you get around during the day prior to CarLink
- What do you like about these modes?
- What don't you like about these modes?

Part III: How do you use CarLink to commute/get around? (30 minutes)
- Commuting
- Day Use
- Carpooling
- What do you like/dislike including reservations?
- Do you use transit more now than before?

10 Minute Break

Part IV: Suggestions for improving CarLink (25 minutes)
- Likes/Dislikes
- How to resolve?
- What would it take to get a neighbor/friend to use CarLink?

Part V: Vehicle Ownership (10 minutes)
- Homebased
- Commute
- Day Use
- If price rises would you still use? How high?

Part VI: CarLink Costs (15 minutes)
- Homebased
- Commute
- Day Use

Adjourn and Dispense Incentives

Homebased User Focus Group Protocol
May 30, 2002

Part I: Introduction (10 minutes)
- Moderator introduction and focus group purpose
- Agenda overview
- Participant introductions
- Permission to take photos

Part II: Commuter/Day Use Trips (Prior to CarLink) (20 minutes)
- How did you commute prior to CarLink?
- How did you get around during the day prior to CarLink?
- How did you get around during the evenings and weekends prior to CarLink?
- What do you like about these modes?
- What don't you like about these modes?

Part III: How do you use CarLink to commute/get around? (30 minutes)
- Commuting
- Day Use (i.e., without CarLink)
- Evening and weekend use
- What do you like/dislike?
- Do you use transit more now than before?

10 Minute Break

Part IV: Suggestions for improving CarLink (25 minutes)
- Likes/Dislikes
- How to resolve?
- What would it take to get a neighbor/friend to use CarLink?

Part V: Vehicle Ownership (10 minutes)
- Homebased
- Commute
- Day Use
- If price rises would you still use? How high?

Part VI: CarLink Costs (15 minutes)
- Homebased
- Commute
- Day Use

Adjourn and Dispense Incentives