CARLINK ECONOMICS:
AN EMPIRICALLY-BASED SCENARIO ANALYSIS

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SUMMARY

Most cars carry one person and are used for less than one hour per day. A more economically rational approach would be to use vehicles more intensively. Carsharing, in which individuals share a fleet of vehicles, is one such strategy. Smart carsharing employs advanced technologies to facilitate tracking, billing, and system management.

CarLink, a smart carsharing system, was deployed in the San Francisco Bay Area for ten months in 1999 to test this concept. This paper describes the CarLink economic data, and through scenario analysis, identifies several market conditions in which carsharing could become more economically viable. Our study found that CarLink could be sustainable when there is strong cooperation with local businesses, higher user fees are generated, and technology and management costs are lowered.

INTRODUCTION

Most trips in U.S. metropolitan regions are driven alone, which is costly to individuals and society and leads to congestion and air pollution. A more efficient, but less convenient, system would allow drivers to share cars. A shared-use system aims to reduce traffic by reducing the number of cars needed by households and encouraging commuters to walk, bike, and use transit, at least for part of their trips. For commuters and employers especially, shared-use vehicles could offer a low-cost, low-hassle alternative to private vehicles. Furthermore, carsharing could help air quality by incorporating low-emission vehicles into shared-use fleets.

Carsharing could reduce government spending on arterial street systems and mass transit by increasing transit ridership through added reverse commuters and midday, evening, and weekend riders. Sharing vehicles could even free up parking space; by serving multiple users each day, vehicles would spend less time parked at transit and employment centers. It could aid employers by attracting and retaining employees (e.g., to the suburbs) and reducing the need for additional corporate vehicles to support travel needs. Moreover, carsharing could reduce the need for additional household vehicles.

Individuals and employers would benefit by gaining the mobility of a car (linked to transit) without individually carrying the full ownership costs; transit operators could benefit by tapping a much larger potential market; and society might benefit by diverting travelers from single-occupancy vehicles to transit for part of their trips.

The CarLink field test combined short-term rental vehicles with communication and reservation technologies to facilitate shared-vehicle access. The ten-month demonstration was implemented and researched by two teams at the Institute of Transportation Studies at UC Davis. Project partners included American Honda Motor Company, the Bay Area Rapid Transit (BART) District, Caltrans, PATH, and Lawrence Livermore National Laboratory (LLNL). INVERS (a Germany-based smart carsharing technology company) and Teletrac provided the advanced carsharing and vehicle tracking technologies.

Using surveys and focus groups, we explored attitudes and CarLink use over time. Although the CarLink participant sample was not statistically significant (i.e., 54 enrolled), valuable lessons may still be drawn from the results. CarLink findings include: operational understanding, participant profiles, behavioral findings, economic viability, and directions for future research (1). This paper builds upon the economic analyses and empirical data collected during CarLink, and through scenario analysis, identifies several market conditions in which carsharing could be more sustainable.

The paper is organized as follows. First, we provide an overview of the CarLink carsharing model and field test. Next, we describe CarLink costs over a three-year time frame. Third, we present three different revenue scenarios, including:

- Scenario One, CarLink initial, based on field test user fees and usage potential;
- Scenario Two, based on a slightly modified CarLink model, which focuses on Homeside Users and Employers as principal revenue sources; and
- Scenario Three, reflecting increased user fees, based on user experience with the adapted CarLink model described in Scenario Two (above) over time.

Finally, we conclude with a summary of several market conditions needed for promoting a more economically viable CarLink enterprise.

CARLINK BACKGROUND

The CarLink program 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 from premium parking spaces at the Dublin-Pleasanton BART station. It incorporated traditional and reverse commute travel patterns and a day-use fleet application, tested at an employment center (i.e., LLNL).

The CarLink model includes three separate user structures: a Homeside User lease, transit links for Workside Commuters, and shared vehicle access at employment sites through Day Use. During the field test, each group paid a distinct fee according to the duration of car use. A brief description of each user group follows.

- ***Homeside Users*** drove a CarLink vehicle between home and the Dublin/Pleasanton BART station daily, keeping the car overnight and through the weekends for personal use. There was a fee of $200 per month for this package.

- ***Workside Commuters*** took BART to the Dublin/Pleasanton station and drove CarLink vehicles to and from work at LLNL. There was a fee of $60/month per car, which was shared with a co-worker by carpooling.

- ***Day Users*** employed CarLink vehicles for business trips or personal errands during the day. The fee was $1.50 per hour and $0.10 per mile for personal trips. Participants did not pay for work trips because LLNL donated the CNG fuel for this program.

All user fees included fuel, insurance, and maintenance costs. Roadside assistance and an emergency taxi service were also provided. Interestingly, neither of these latter options was used during the test. In addition to vehicle support services, CarLink implementation staff supported the program, providing cleaning and occasional refueling services, as well as e-mail and phone contact for addressing user questions or problems.

CARLINK COSTS

For this analysis, costs were separated into fixed, or startup, and monthly operational costs over a three-year period. Startup costs are paid once at the beginning of the program and sometimes renewed yearly (e.g., registration and insurance). Operational costs are those paid monthly. As a research project, field test operations were handled differently than they would be in an economically viable venture. The primary research objective was to investigate participant response rather than to optimize costs and revenues.

Principal CarLink program costs include the vehicle fleet, fuel, insurance, maintenance and administration, and the COCOS and Teletrac technologies. These numbers should only be used as a guide. Other programs will each have a unique combination of vehicles, tracking and billing technologies, and personnel needs.

American Honda provided the vehicle fleet, insurance, maintenance, operational support staff (i.e., fee collection service, refueling, and cleaning), 24-hour roadside assistance, and guaranteed ride service. The BART District provided parking spaces at the Dublin/Pleasanton station, a key manager kiosk with electricity and telephone service, an advertising poster at BART, and advertisements in the *Tri-Valley Times* and the *Diablo Dealer*. LLNL provided CNG for vehicle refueling and CarLink parking signs. Caltrans provided support for the field test manager and the implementation team.

This section presents CarLink costs over a three-year period. This time frame was used because many carsharing organizations replace vehicles in three-year increments (2). Table 1 shows CarLink program costs, with an average monthly cost of between $9,267 and $9,759, depending on vehicle model used. Based upon these projections, revenue generation would need to be between $772 and $813 per car per month to achieve a breakeven point.

Table 1: CarLink Three-Year Cost Projections				
CarLink Costs	**Year One Costs (CNG)**	**Year One Costs (Gas)**	**Average Monthly Costs[1]**	**Average Yearly Costs[1]**
Vehicles and Licensing Fees	$52,800	$40,800	$3,017- $2,317	$36,200 - $27,800
Vehicle Maintenance and Insurance	$15,000	$15,000	$1,250	$15,000
Advertising	$1,000	$1,000	$83	$1,000
Fuel	$4,320	$6,436	$384 – $592	$4,608 - $7,104
Management and Support Staff	$45,000	$45,000	$3,864	$46,368
Cross-Country Emergency Service	$600	$600	$50	$600
Smart Carsharing Technology	$26,764	$26,764	$1,111	$13,332
Total	$145,484	$135,600	$9,759 - $9,267	$117,108 - $111,204

[1]Average monthly and yearly cost totals reflect CNG and gas vehicle cost range when applicable.

<u>Vehicles and Vehicle Licensing Fees</u>: The vehicles used in the field test were 1998 Honda Civics, fueled by natural gas. The majority of costs are due to depreciation. Year Two and Three CNG costs are $35,400 and $20,400. Gas vehicle costs for Years Two and Three are $27,180 and $15,420. The cost difference is due to higher CNG Manufacturer's Suggested Retail Price than that of the gas Civic.

<u>Vehicle Maintenance and Insurance</u>: Costs are $1,250 per month per vehicle each year.

<u>Advertising</u>*:* During the field test $1,000 was spent on advertising; however, press coverage and word-of-mouth were considered more effective. Thus, $1,000 is assigned to this category for the final two calendar years.

<u>Fuel</u>: CNG usage was approximately $360 per month during the field test. Accounting for increased usage, $396 per month is assigned for final two years. Gasoline use is projected at $536 per month in Year One and $590 and $650 per month for final two years.

<u>Support Staff</u>*:* Staffing costs reflect a three percent cost of living increase each year, assuming a Year One level of $3,750 per month.

<u>Roadside Assistance</u>*:* For the 12-vehicle fleet, costs are $600 per year.

<u>Carsharing Smart Technology</u>: The majority of COCOS smart carsharing system costs included hardware, software, and installation (i.e., $16,648). COCOS is assigned $1,000 in Years Two and Three for preventive maintenance and is included under "Yearly Costs." Vehicle tracking hardware

and software costs were invested in Year One (i.e., $4,500) and air-time costs are $468 each month for all three years.

COMMERCIALIZATION SCENARIOS

To explore CarLink economic viability, various market scenarios are considered here to investigate and test commercial sustainability and to gain a better understanding of the various market conditions that could support it. CarLink revenues are based on actual user fees. However, willingness-to-pay was explored after participants used the system.

To gain more insights into system viability, this section presents several scenarios for comparing long-term revenues and costs. “Long term” is defined as three years or greater. This should be a sufficient period for members to make more significant behavioral changes, such as selling a household vehicle. Indeed, if CarLink had become a permanent service, several Homeside Users stated that they would likely sell a personal auto. Likewise, institutions (e.g., large employers, transit agencies, and activity centers) also need time to understand the concept and benefits and adapt to the carsharing service.

This section explores several scenarios where revenues might be increased by adapting the CarLink model. These scenarios assume a fleet of 12 vehicles (as in CarLink) and a fully operational program (i.e., maximum membership levels). Scenario One reflects the CarLink field test model and actual user fees. The modified CarLink program, presented in Scenarios Two and Three, reflects a slightly adapted model in which employers pay a monthly fee to lease vehicles for trip making during the workday and commuting to and from the employment site and transit station. The final scenario introduces higher willingness-to-pay (WTP) user rates, based on experience with the system (e.g., households decide to sell one of their vehicles and can pay a higher user fee to cover CarLink costs). Bernard and Collins (1998) found that program permanence is critical to behavioral adoption and change (3). Thus, CarLink use and WTP might change appreciably over time.

Table 2 below presents projected yearly revenues for three different scenarios. Although revenue estimates are hypothetical, they are based on WTP data from the field test.

Table 2: Yearly CarLink Scenario Revenues

	Homeside Users	Workside Commuter	Day Use	Employer Lease	Yearly Total
Scenario One	$28,800	$7,200	$28,356	--	$64,356
Scenario Two	$36,000	--	--	$50,400	$86,400
Scenario Three	$54,000	--	--	$64,800	$118,800

Scenario One: CarLink (Initial)

Scenario One reflects the actual CarLink rate structure (i.e., $200 per month for Homeside Users, $30 per month for Workside Commuters, and $1.50/hour and $.10/mile for personal Day Use). This scenario assumes full user group membership (i.e., 12 Homeside Users, 20 Workside Commuters, and 30-Day Use trips per day).

This scenario results in $64,356 in yearly revenues, over twice that of the actual CarLink field test. Most of this increase is a result of expanded Day Use participation. The revenue generation rate for Day Use trips in Scenario One is based upon empirical data. The average Day Use trip would have generated $3.75 (i.e., $2.70 based on time and $1.05 based on mileage). Total Day Use revenues are based upon three round trips per vehicle per day (i.e., 30 Day Use trips per workday). This trip rate is applied to 21 workdays per month. Although revenues greatly exceed those of the field test, a permanent enterprise would have less difficulty attracting new members and increasing use.

Scenario Two: CarLink Modified

Scenario Two assumes a revised model with Homeside Users and Employers, who pay a monthly fee to lease vehicles for their employees to commute to and from a transit station and an employment site and for use during the workday. This scenario applies fees for Homeside Users of $250 per month and Employers of $350 per vehicle per month. By increasing revenues, this new model results in an additional $22,044 in annual revenues.

Scenario Three: CarLink "Experience"

Scenario Three reflects Homeside User membership levels and Employer support similar to Scenario Two. However, Homeside User fees are increased to $375 and Employers to $450 per vehicle.

While the Homeside User fee is above most surveyed CarLink users' WTP, it assumes that households would be able to sell a personal vehicle in a permanent CarLink program and would be willing to pay more (4). This scenario increases total revenues by $32,400.

CONCLUSION

This analysis results in average costs of $117,108 per year ($111,204 with conventional fuel Honda Civics) and best-case revenues of $118,800 per year (Scenario Three). One of the main findings of this analysis is that more research is needed to explore a CarLink commercial venture, particularly the adapted CarLink model (i.e., Scenarios Two and Three). Additional revenue sources, such as advertising from corporate sponsors and increased Day Use, should be explored as well as ways to reduce system costs. The best-case scenario (Scenario Three) resulted in a surplus ranging between $1,692 to $7,596 (depending on vehicle used).

Despite shortfalls of the commercial scenarios presented above, there are several benefits of a carsharing program to individuals and society. Although exceedingly difficult to place a dollar amount on societal benefits of reduced congestion and pollution, employers seeking to decrease the number of employees driving to work to comply with clean air regulations or to reduce parking burdens may be willing to partially subsidize carsharing. Furthermore, transit partners benefit from increased ridership and more efficient parking space usage (i.e., a CarLink space could serve three or more transit customers per day).

CarLink researchers will continue to explore several potential cost reductions, such as:

Streamlining technology. The field test enabled researcher to specify the technology requirements needed at a more affordable cost. By streamlining tracking, billing, and reservations, there is a potential to reduce labor and management costs.

Operations personnel. A chief advantage of a smart system is program expansion without the need for increased operational personnel. While the CarLink field test implementation staff was very busy during the field test, much of the time was focused on partnership management and program development. Thus, personnel costs might be substantially reduced in the future, along with smart technologies.

More efficient use of parking spaces. Parking is another instance where potential economies of scale were not realized. Through the use of carpooling, a successful carsharing program would reduce an employer's need for parking (and the value of the CarLink program), while potentially helping to meet air quality control requirements. At a transit station, six, or possibly more, parking spaces could be released as dedicated CarLink spaces and opened to the public. This could help reduce transit and employer parking costs considerably. For the field test, researchers estimated that CarLink could reduce parking demand at the BART station by four spaces or $400 per month (i.e., each space is valued at $100/month) (5).

Increased user fees. The most significant revenue increase would likely result from higher user fees. All CarLink user groups appeared to be willing-to-pay more for the system than they paid to participate in the CarLink field test. Further investigations are needed to estimate market rates accurately (6).

Alternative fuel vehicle incentives. A potential way to reduce CarLink capital costs would be to buy cleaner vehicles and utilize alternative fuel vehicle purchase incentives. Several incentives have been established on federal, state, and regional levels to encourage the purchase of low-emission vehicles. Some are in the form of direct air quality management district incentives; others include federal and state credits and sales tax exemptions (7). By using alternative fuel vehicles, carsharing would contribute further to the social and environmental benefits associated with a shared-use vehicle system.

In the future, different commercial ventures should be examined, such as rental car markets and the business-lease model (i.e., Scenarios Two and Three). Research should also explore non-monetary carsharing benefits, including pollution reduction, congestion relief, and reduced land use impacts. Transportation policy analysis should also investigate tax incentives for carsharing and alternative fuel vehicles, as well as government subsidies. Finally, more willingness-to-pay experiments should be conducted.

The CarLink field test provided a starting point for a full benefit-cost analysis of a commuter-based carsharing model. Many societal benefits and costs were not estimated and economies of scale could not be calculated, as the CarLink program was not large enough to extrapolate. To summarize, further study is needed to better understand the long-term viability and societal benefits of various carsharing models in the U.S., as well as the role of public-private partnerships in fostering such enterprises in the future.

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ACKNOWLEDGEMENTS

The authors would like to acknowledge John Wright and David Dick for their invaluable assistance with CarLink data collection efforts and earlier economic analyses, from which this paper builds. We'd also like to thank the California Department of Transportation, PATH, Honda Motor Company, BART District, LLNL, National Science Foundation, University of California Transportation Center (UCTC), and Dwight David Eisenhower Fellowship Program for their generous contributions to the CarLink program.