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IDEA Innovations Deserving Exploratory Analysis Project

TRANSIT COOPERATIVE RESEARCH PROGRAM

Market Study and Operational Test Results for the Instant Rent-A-Car (IRAC) Station Car Field Tests

CFInternational, Reno, Nevada

Report of Investigation

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Market Study and Operational Test Results for the Instant Rent-A-Car (IRAC) Station Car Field Tests

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INNOVATIONS DESERVING EXPLORATORY ANALYSIS (IDEA) PROGRAMS MANAGED BY THE TRANSPORTATION RESEARCH BOARD (TRB)

This investigation was completed as part of the TRANSIT-IDEA and ITS-IDEA Programs, which are two of the four IDEA programs managed by the Transportation Research Board (TRB) to foster innovations in surface transportation. TRANSIT-IDEA focuses on products and results for transit practice in support of the Transit Cooperative Research Program (TCRP). ITS-IDEA focuses on products and results for the development and deployment of intelligent transportation systems (ITS), in support of the U.S. Department of Transportation's national ITS program plan. NCHRP-IDEA focuses on products and results for highway construction, operation, and maintenance in support of the National Cooperative Highway Research Program (NCHRP). HSR-IDEA focuses on products and results for high speed railroads in support of the Federal Railroad Administration. The four IDEA program areas are integrated to achieve the development and testing of nontraditional and innovative concepts, methods, and technologies, including conversion technologies from the defense, aerospace, computer, and communication sectors that are new to highway, transit, intelligent, and intermodal surface transportation systems.

The publication of this report does not necessarily indicate approval or endorsement of the findings, technical opinions, conclusions, or recommendations, either inferred or specifically expressed therein, by the National Academy of Sciences or the sponsors of the IDEA program from the United States Government or from the American Association of State Highway and Transportation Officials or its member states.

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Market Study and Operational Test Results for the Instant Rent-A-Car (IRAC) Station Car Field Tests

This Transit-IDEA final report provides a summary of IDEA project T-14, "Instant Rent-A-Car Technology Applied to Transit Station Car Practice," conducted by CF International, at Bay Area Rapid Transit (BART) facilities and at the University of Nevada, Reno. Included in this report are (1) a description of the research procedure and results used in this study, and (2) a preliminary market study that explores the commercial potential of this technology.

I. EXECUTIVE SUMMARY

As Americans, we tend to take our transportation abilities for granted, scarcely noticing their nature or overall use. In this document, we will attempt to provide a look at the how and why of such use, in addition to an overview of the implications involved in our society's growing tendency to commute in and out of the ever-expanding metropolitan areas.

The nature of our travel has been dictated in the past few decades by our ability to own and operate private automobiles and is typified by the following quote: "The number of vehicles has risen by 144 percent [between 1969 and 1995], to 176 million. The number of drivers has also risen, but only 72 percent. Drivers used to outnumber cars by 30 percent; now the two are equal."[1]

With the work sites of America extending further and further into suburbia, it has also become increasingly necessary for us to commute longer distances to work, therefore making ownership of a private auto necessary. The auto facilitates this increased travel perfectly: it's convenient, perceived as cost-effective and delivers door-to-door accessibility.

But the associated costs of commuting via a private auto contain many hidden dues, paid by, not only the owner, but society in general. Air and water pollution, oil-dependence, and inefficient land use are just a few of the side-effects of a society involved in a love affair with the advantages of a private auto.

One solution is to change the way in which society views their vehicle use. Another is to encourage mass transportation use through alternative travel choices. This second solution currently has two major prohibiting factors: a parking problem and a walking limitation.

Using the Bay Area Rapid Transit (BART) as a case study, it was established that many commuters would like to ride public transit, but are unable to due to the lack of sufficient parking. An estimated 40,000 parking spaces are provided by BART, yet most are full at approximately 7:00 a.m., which severely limits BART's ability to increase ridership. Also, if the commuter's home or work site is located more than a comfortable walking distance (approximately 1500 feet) from a BART station, it isn't considered convenient to ride mass transit.[2]

To alleviate these limitations, CFI has introduced the Instant Rent-a-Car (IRAC) system. The IRAC system has been envisioned as the "missing link" in intermodal transportation use by providing conveniently reserved/rented compact automobiles at transit stations for the start and completion of transit trips. It is an integration of user interactions and interfaces which allows us to offer a unique commuting option.

This document contains the following components:

- Background into why this project was chosen;
- Description of the operational tests;
- Brief market analysis; and
- The future possibilities of the IRAC system.

The transit industry includes all multiple-occupancy-vehicle passenger services of a local and regional nature provided for general public use. However, for the purposes of this paper, "transit" will refer to heavy or light rail.

Note on ITS and Transit Collaboration

This was a combined IDEA ITS and TRANSIT project. The ITS innovation is the successful integration of technologies (vehicle location, communication, reservation, and cost accounting) to produce an efficient fleet management process so that each vehicle can be used by several different drivers per day. As an innovative TRANSIT Project, the economic and operational feasibility of a IRAC system was tested in association with a functioning mass transit system, BART. The foregoing tables showed the benefits that may be derived from such a transit ancillary system in support of a mass transit enterprise. This "pilot project" research suggests that the following steps would be needed to enter into and maintain a successful IRAC venture:

- The overall plan, as outlined in the Final Report, would consist of 3,000 vehicles occupying 10 different stations and all being serviced by the same transit authority;

- The number of vehicles at any given station would be determined by the characteristics of that station and the user patterns found during the market survey. For example, one station might only need 50 vehicles due to low volume while another might need 400 in order to meet demand. A roster of interested participants would have to be updated on an on-going basis;
- A partnership would be created between CFI, a transit authority and an auto rental agency in order to facilitate the operation, maintenance and use of the IRAC system vehicles;
- CFI would be hired by the transit authority to operate the business, including the market development and any implementation/ integration efforts for multiple uses. CFI would also maintain the system for two years to develop a large and educated target market. This two-year contact could be renewed or an information transfer could take place and a separate entity could be trained to provide the continuation service;
- The auto rental agency would purchase sufficient electronics for the vehicles (tracking and smart card systems) and lease the vehicles to the transit agency as well as operate and maintain the vehicles; and
- The transit authority would contract with CFI, lease the vehicles from the auto rental agency, and provide the land for queue parking and a concession building (for operation of the vehicles).

Implementation of the project would begin with:

- Conducting the initial market survey to determine demand, discover station characteristics and identify user patterns;
- Solidifying the partnership between the three primary entities (CFI, auto rental agency and transit authority); and
- Placing 300 vehicles at one station (preferably a station with a large user base and high volume, continuous traffic flow).

By following this outline, the PI of CF International believes that an IRAC project could be a highly successful enterprise supportive of ITS and TRANSIT innovations.

II. PROJECT PURPOSE AND SCOPE

A. Description

The corporation of CF International (CFI) was formed as a means to address and research growing transportation concerns and to develop possible technological solutions relating to those concerns.

Upon completion of initial studies involving mass transportation use, CFI began development on the Instant Rent-A-Car (IRAC) system, which at that time focused on an integrated electronics package with full communications and vehicle location capabilities. The development was funded by a Phase I grant from the Transportation Research Board (TRB) of the National Academy of Sciences, ITS-IDEA program (Figure 2-1).

The next course of action was determined upon the award of a Phase II grant from the TRB. This grant was awarded to determine operational feasibility, to begin limited scale operational testing and to provide an estimate of the potential market.

Since the original IRAC system was designed to allow instant rental, not advanced reservations (it did not provide the ability to reserve a vehicle at a specified location on a

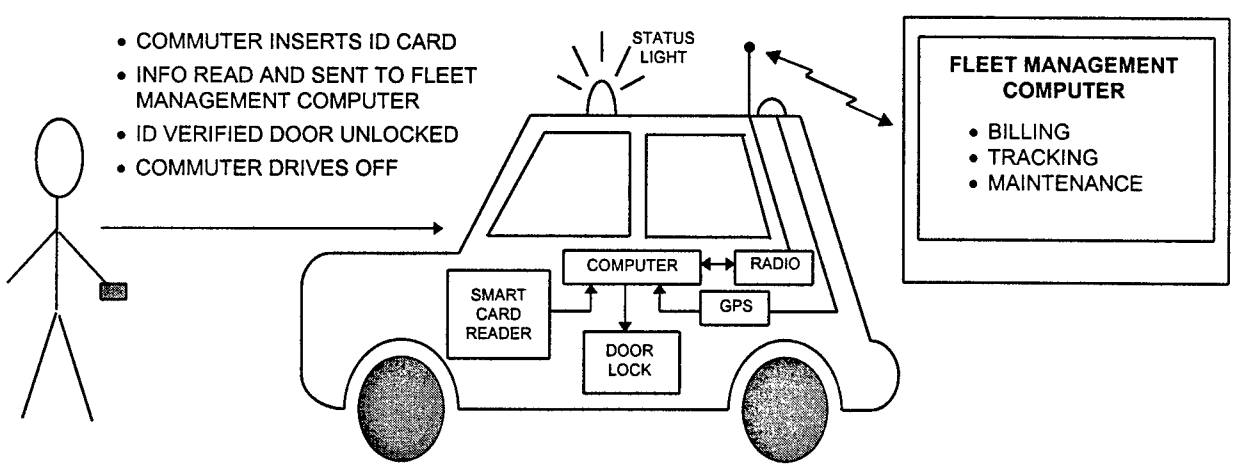


Figure 2-1: IRAC concept.

specific date), the needs of the Phase II operational test were reviewed. A communications/vehicle location provider, Teletrac of Los Angeles, California was contacted and subsequently involved. The Teletrac system was deemed more appropriate and cost-effective for Phase II and so was used in place of the original IRAC electronics package. However, the Teletrac system does not encompass any type of reservations ability, therefore, a web site and 800 number were established to serve as the reservation components.

B. Reasons for Selecting the Product/Service

Urban transportation consumes approximately 50 percent of the $1 trillion of all annual transportation expenditures in the U.S. Achieving a 10 percent increase in the efficiency of such expenditures, i.e., $50 billion annually, appears to be an achievable goal. The hardware and software utilized to achieve such savings represents an annual market of several billions of dollars.

The belief that the emerging market can be successfully pursued is based on several studies. One is a completed study and associated technology demonstration that was sponsored by the Transportation Research Board (TRB) of the National Academy of Sciences via a grant to CF International of Reno, Nevada.[3]

One other study, which points out the importance of transportation in our society and the increasing probability of establishing a profitable business associated with transportation, is a 1996 cooperative survey completed by the Department of Transportation and the Census Bureau. This survey was conducted by making 80,000 random telephone calls to U.S. households nationwide.

The survey found that an average American traveled 3,100 miles in 1995, nearly double the 1,800 miles traveled in 1977. Other information found that:

- Residents of the western United States spend more than 4,500 miles a year in their private auto;
- Nearly five times as many people travel by car as by air; and
- Minority groups have increased their travel since the 1977 survey, but Caucasians travel nearly twice as much as African-Americans and Latinos.

All of the above combined with the changing demographics of American society, point to a vital need for uncongested, efficient travel in both metropolitan and urban areas.

C. Project Objective

The project objective was to increase the use of mass transit by offering a technologically advanced, intermodal alternative to single occupant auto commuting. Transit ridership is currently limited by a walking paradigm. This paradigm states that a person will only walk approximately 1500 feet to either access or egress a transit station. This must be overcome in order to expand transit ridership.

Transit ridership is additionally limited by a parking problem afflicting modern transit systems. If a commuter wishes to ride on a transit system, they must arrive at the station parking lot prior to its being filled for the day—typically at 7:00 a.m. This is a major prohibitive factor.

Both of the strategies below allow IRAC to overcome the walking and parking limitations inherent in the present transit practice. (See Figure 2-2.)

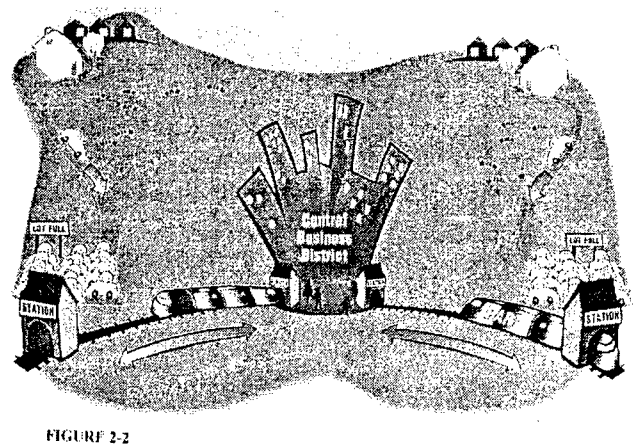


FIGURE 2-2

Figure 2-2: Current transit practice.

1. Strategy I

Consumer access to this intermodal alternative must be *instantaneous* in order that the time required for the rental procedure is consistent with the time spent traveling on mass transit. By the term instantaneous, it is meant that the time required to rent must be relative to the time spent traveling. On a subconscious level, a traveler has a waiting paradigm that she will follow. For instance, if a traveler has spent 3 hours flying from coast to coast, she is willing to spend a relative portion, perhaps 30 minutes, of that flight time waiting to rent a vehicle. Since the average travel time on BART is 22 minutes[4], the commuter would most likely be willing to spend 2 or 3 minutes to access the IRAC. (Figure 2-3. This BART system map shows the possible brevity of travel from one station to the next.) This time would consist of smart card insertion, personal identification number entry and egress from the station.

a. Tactics

Group I - Subscribers

The participants within this group will subscribe to the system on a time-limited basis, for example: monthly, semi-annually, etc. They will subscribe via the IRAC web site, 800 number, or, in the future, a kiosk. Upon approval of credit card and driver's license information, the participants would receive confirmation of acceptance into the program, a personal identification number and access to the reservations system within the web site.

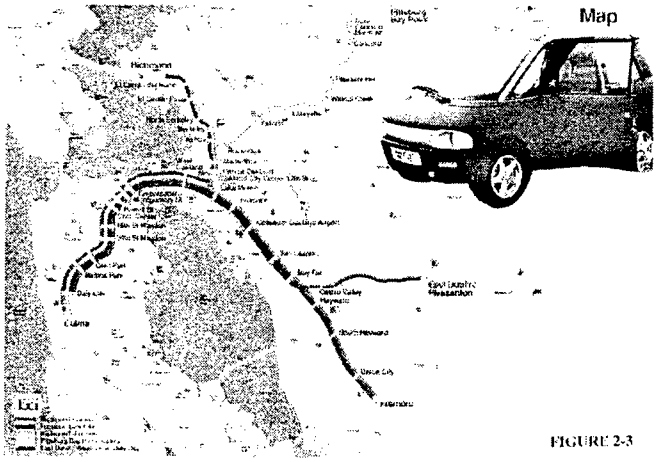


Figure 2-3: Bart system map.

The vehicles will be used to travel from home to the station, the station to work, and possibly be domiciled at the user's home for the weekend.

Group II – Occasional Users

Occasional users are the people who would access vehicles, not at the transit station, but at work sites. The vehicles would be used for local area demands such as errands, lunch, or shopping. In this way the system provides conveniences that traditional carpools eliminate, because the pool car typically is owned and used only by the driver, and is unavailable for use by the other occupants.

b. Modes of Registration, Reservations and Information

Web site

The web site is located at **www.irac-sc.com**. This web site serves as both a database for the system operators and an interactive system of registration for participants. The participant has only to enter the pertinent information one time, unless changes are needed, and from that point forward the web site database will retain the information for future use. This site serves primarily as a reservation system, but also provides the following:

- Information about the IRAC system
- Links to other transportation programs
- Mass transit operating schedule
- User registration, reservations and confirmation
- User feed back to the system operators
- Administrative access to system information

800 number

The telephone option provides information that is available on the web site for those who cannot or will not access the site, including making reservations. It is anticipated that the majority of users who use the 800 number will be elderly or welfare-to-work participants.

Although established, the 800 number was not used for reservation capability during the Phase II operational test.

2. Strategy II

The intermodal alternative must have *multiple users* per day in order that the cost of an individual rental is consistent with current transit costs.

Once again, the commuter has a paradigm regarding associated rental costs. The cost of the IRAC must be consistent with and relative to what the commuter pays in mass transit fees. The average costs of a 22-mile commute is $2.90[5], therefore the commuter would be willing to pay a portion of that to access the work site from a transit station.

The commuter also has to shift their paradigms regarding the true costs of driving alone in a privately owned vehicle. Most commuters feel that they pay a minimal costs to own a car and that incremental costs are about $.10 per mile, when in reality, the true cost of driving is approximately $.70 per mile.[6]

If this paradigm is overcome, through promotion efforts and public relations education, commuters will be aware of the true costs of automobile ownership and will also be more readily willing to accept a multi-use program.

a. Tactics

Although many different scenarios can be envisioned for multiple users (subscribers and occasionals), the most commonly theorized IRAC use will occur in the following manner.

In the morning, commute Subscriber A will drive the IRAC vehicle, domiciled at their residence, to the nearest transit station. They will park the IRAC in the designated queue and board the train. Traveling from the opposite direction, Subscriber B's access will be occurring simultaneously and in the same manner. Each will arrive at their destination transit station and use the other's vehicle to travel to their respective work sites. (See Figure 2-4.)

At the work site, the vehicle will be available for use by both subscribers and occasional users. The evening commute will be a reverse of the morning commute.

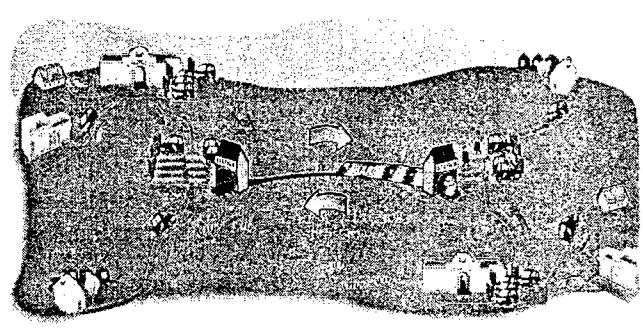


Figure 2-4: IRAC system commutiong pattern.

III. ENVIRONMENTAL ANALYSIS

A. Macro-environment

1. Social

a. Urban Sprawl

Since World War II, our country's idea of how metropolitan areas should be developed focused on low-density housing and suburbanization. This pattern of growth created a better lifestyle for many Americans. It meant that many could become homeowners, children could attend modern schools, and enjoy an uncrowded environment of clean air and green lawns. However, this pattern also brought many negative consequences.

The high costs of maintaining and building highways, sewer systems, and other infrastructure systems needed to support these suburban communities continue to soar. Additionally, we continue to leave underutilized infrastructures behind, because the short-term cost of building in suburbia is low. Low income housing rarely is built in the suburbs. This forces the lower income citizens to reside in the cheapest buildings, which are usually found in the inner city. Often these people have no form of personal transportation, and are therefore isolated from the jobs that are moving to the suburbs. In fact, in the last 40 years, two-thirds of all job creation has taken place in the suburbs. This combination of poverty and isolation creates unemployment and crime.[7]

This pattern of growth in the suburbs, requires extensive automobile driving. This has led to increased congestion on our roads, pollution in our air, and consumption of our oil. Increased driving also means increased fatalities. Each year 40,000 people die from car accidents, and another 5 million are injured, costing our nation's economy over $100 billion.

This trend is requiring that transit authorities provide reverse-commute programs. The traditional role of public transit was to bring workers into the city. However, there is an obvious need to move inner-city employees to their suburban jobs. Currently nationwide, there are 50 reverse commute programs in the works or in operation, however, there is a need to increase the efficiency of these programs. For example, once employees get to the station in the suburb, they may not be able to reach their final destination.[8]

b. Demographic Trends

A number of demographic changes are currently occurring in our nation:

- the number of persons over the age of 65 is growing at a faster rate then the general population;
- the number of women entering the workforce continues to grow; and
- minorities will account for 60 percent of the population growth through the year 2000.[9]

These increases will require that increased attention be paid to the travel preferences and patterns of these groups. Both nontraditional and traditional forms of transportation will need to be increased.

c. Energy Trends

Transportation energy use in the United States continues to increase. In 1995, the energy required to power the U.S. transportation system increased by 1.7 percent. From 1949 until the first oil price shock in 1973, transportation energy use grew at precisely twice that rate. Between 1973 and 1985, transportation energy use grew at only 0.6 percent per year, as supply shocks and higher prices dampened demand and inspired significant improvements in energy efficiency.

For decades, the U.S. transportation system has been overwhelmingly dependent on petroleum. Recent energy and environmental legislation spawned a small but rapidly growing trend of alternative and replacement fuel uses. Despite this, transportation relies on oil for 95 percent of its energy needs. At the same time, petroleum prices remain volatile, as was proven in spring 1996 when U.S. gasoline prices suddenly jumped by 20 cents per gallon, and U.S. oil imports were nearing a record high.

Transportation energy efficiency in the United States was down slightly in 1994, although some modes improved, their gains were offset by an apparent 5 percent increase in the energy required per passenger-mile of highway travel. The highway mode dominates U.S. passenger travel and energy efficiency trends, with 86.7 percent of all passenger-miles. Energy use per highway passenger-mile increased by about 1 percent from 1993 to 1994, as vehicle occupancy rates declined.[10]

d. Environmental Trends

As our air continues to become more polluted, it is apparent that our nation needs to change it's transportation paradigm. Even a small percentage increase in ridership would greatly help the effort to reduce pollution.

A study released by the Natural Resources Defense Council cited that 64,000 premature deaths are associated with particulate pollution alone. Additionally, health authorities estimate that air pollution is responsible for 7 million sick days each year.[11]

America is just beginning to understand the extreme environmental impacts of gasoline-powered cars and trucks. These vehicles are the single largest source of U.S. air pollution and a major contributor to global warming. They emit tons of carbon dioxide, nitrogen oxide, carbon monoxide, reactive hydrocarbon and particulate matter into the air daily. While reactive hydrocarbons and nitrogen

oxides form the smog found in the nation's urban areas, carbon dioxide, the principal greenhouse gas, is emitted at a rate of more than 20 pounds for every gallon of gasoline burned. Despite continuing pollution control gains and efficiency improvements, overall motor vehicle pollutants are projected to increase by almost 40 percent by 2010 due to an increased number of vehicles traveling more vehicle miles.[12]

2. *Technological*

Available and/or emerging technology has two impacts with respect to the IRAC program.
One is related to the increasing electronic content of the automobile and the other is to the fuel efficiency and pollutants associated with evolving automobile power plants.

a. Increasing Electronic Content of the Automobile

The IRAC reservation/dispatch process utilizes an in-vehicle processor, a vehicle location capability, and a radio link to the central reservation/dispatching processor.
In the technology demonstration portion of Phase I, these capabilities were provided by a special purpose unit that employed cellular radio communication, GPS-based vehicle location and a general purpose microprocessor.

In the Phase II operational test, the unit cost of the Phase I special purpose in-vehicle electronics package (approximately $3500 each) caused CFI to review other systems capable of providing the desired capabilities particularly in view of the fact that it was now planned to configure 16 vehicles instead of the 5 originally proposed for Phase II. This review established that numerous vendors provided equipment that were capable of the required capabilities, with little or no modification.

The Teletrac system was selected because it provided vehicle location and radio communication capabilities with a user-friendly data entry and display terminal at an installed purchase price of $900.

Of particular interest in the review was the German Car-Sharing Organization and Communication System (COCOS), which incidentally is compatible with the Dallas Button. (The Dallas Button was used in the Phase I IRAC in-vehicle equipment for vehicle entry and billing purposes.) By the time information on the COCOS became available to CFI, the decision and commitment to Teletrac had been made. Teletrac has proved to be more than sufficient for Phase II.

The question of what in-vehicle electronics equipment is most appropriate for very large scale use or even the limited experiment envisioned for Phase III (200+ vehicles) is significantly influenced by the ever increasing electronic content of newer automobiles. This increasing content can provide many of the required IRAC capabilities.

Specifically, the newer generation of autos contains relatively powerful in-vehicle processors used, for example, to increase fuel efficiency and output diagnostic data for in-shop use. A recent trend, however, is to radio communicate such diagnostic data to a central processor for on-the-move diagnostic and preventative maintenance purposes.

Simultaneously, there is an increasing use of in-vehicle cellular phones for personal communication, 911 calls, etc. In this connection, 911 calls will, in the future, be required (per the recent FCC mandate) to have associated data on the caller's location, thus inferring that a vehicle location capability such as GPS, will become a standard automobile installation.

The net result of the above trends is that the in-vehicle electronics required for IRAC use will increasingly become standard automotive equipment and hence not a significant cost element in IRAC operation.

b. Changes in the Automotive Power Plant

There is a trend toward the use of electrical powered automotive drive trains with the required electric energy being potentially provided by a number of low-pollution sources i.e., fuel cells, constant-speed internal combustion engines and associated generator, improved performance batteries, etc. This trend offers the potential of significantly reducing the injurious pollution associated with current automotive power plants. In contrast, such improved engines, will not significantly reduce the congestion connected with current transportation practice. A major focus of the IRAC program is to reduce such congestion by making mass transit more "user-friendly."

3. *Economic*

According to the 1997 Transportation Statistics Annual Report:
"Transportation is an indispensable component of any economy. It can increase the value of goods by moving them to locations where they are worth more. It allows people to commute to places of employment where their time has higher value. By extending the spatial boundaries of commodity and labor markets, transportation encourages competition and production. Transportation stimulates demand for various goods and services, thereby contributing to the U.S. economic growth."[13]

Personal consumption of transportation in 1991 was demanded at a rate of $436.8 billion per year. That demand increased to a whopping $554.9 billion in 1995--just four years! The consumption of motor vehicles and parts rose from $187.6 to $247.8 in that same period,[14] which leads to the conclusion many transportation experts have drawn: Americans are keeping their vehicles longer and spending more income on upkeep.

The median age of U. S. owned vehicles is almost 8 years, which is the longest ownership timeframe in almost

40 years.[15] In correlation to these figures, commuters typically drive the oldest car in the household for a long-distance commute. The result of these practices is that there are more older cars on the road which means more maintenance, replacement parts and usually more pollution.

The IRAC program will have a significant impact on the economic welfare of its participants and potentially, society. Not only will the commuter be able to travel from home to station and station to work with the same relative ease and convenience of an auto, but IRAC will enable them to eliminate multiple vehicles (typically the second or third car) per household and thus create additional expendable income for the family. Society will benefit because of the ultimate removal of the "clunker" commuter vehicle—also removing the associated pollution and congestion.

Of course, some of the saved automobile costs will be spent on the cost of transit tickets, but these expenses are usually less than the costs of vehicle ownership, maintenance and fueling costs, in addition to the implied societal expenses.

4. Governmental

Current legislative action to improve transportation, both nationally and in urban areas is broken into multiple segments:

- The allocation of funds to build new freeways (currently a difficult sell in urban areas);
- The allocation of funds to increase the "thruput," or number of vehicles that can be accommodated without delays due to increased traffic on the road;
- Congestion Pricing Programs; and
- Intelligent Transportation Systems or ITS.

a. Imposition of Congestion Pricing (CPr) Charges

CPr is the procedure, implemented via legislative action, of charging for highway use during periods of congestion. The CPr charge is maximized during periods of major congestion at rates varying from $0.10 to $0.25/mile, in order to (1) divert trips that can be accomplished at off peak congestion periods, and (2) encourage car pooling in order to share CPr charges.

To date, while CPr practices have been implemented very successfully in Singapore and a few other countries, CPr test programs in the United States on existing highways are almost non-existent despite the availability of almost $150 million in Federal Highway funds for such test efforts. This is because CPr implementation requires legislative action which is difficult to obtain due to the political opposition of users who object to additional charges/taxes. These users feel that they have already paid for the use of highways and are concerned that the charges/taxes imposed will not be used to improve transportation problems.[16]

A significant exception is the use of CPr on a recent privately funded section of freeway (actually a toll road) in the Los Angeles, California area. Of interest in this program is that commuters are willing to pay a fee for its use based on their estimation of the dollar value of time saved via its use.

This ITS corridor along Highway 91, which is privately owned, was previously the median section of the freeway. The section runs from Riverside to Orange County and was implemented to relieve two-hour congestion times in the Santa Ana canyon section where lanes narrow from six to four in each direction. The toll collection procedure is accomplished through an overhead reader. The commuter installs the reader's companion onto the back of the rearview mirror and as they drive under the overhead reader, it electronically removes the appropriate toll from their account.

The success of these types of programs may lead the government to further enable private companies to explore and implement ITS functions on public freeways, highways and congested inter-city travel.

5. Natural

a. Increasing Cost of Energy

The automobile is at the heart of several of the nation's most pressing problems, including escalating energy consumption, import oil dependency, severe economic consequences and increasing environmental impacts. United States transportation is almost exclusively dependent upon petroleum as an energy source, requiring millions of barrels of oil each day. Meanwhile, U.S. domestic crude oil production continues its long-term downward decline. Importing oil from foreign sources has filled the gap between transportation oil demand and U.S. production. This trend in increased demand for imported oil grows worse each year. Transportation demand for imported oil is also affecting the U.S. economy by requiring tens of billions of dollars in annual oil purchases and billions more in securing foreign supplies. Both the oil embargo of 1973-74 and the recent gulf war in Kuwait show how economically tied the nation is to imported oil, and what extremes America will go through to protect it.[17]

b. Increasing Pollution

Increasing air pollution levels in the United States, as a result of automotive travel, has created a renewed interest in environmental issues. New infrastructure such as roads, rail and other transportation- related work are being constructed at an increasing pace to support the metropolitan encroachment of urban areas.

The opportunity to address these environmental concerns is through the use of public transit in place of the automobile.

c. Land Use Impacts

Land used to create parking for vehicles is completely unproductive and usually estimated at having little return on investment. A recent report compiled by Bank of America and a coalition of environmental groups, reveals that California's ongoing trend toward low-density suburban development (suburban sprawl) threatens not only the state's economic well-being and quality of life, but the natural environment as well.

Although parking lots or garages currently consume one-third of the average business park's land use, the economic return to the businesses could be considerably greater if additional, productive revenue sources were placed there instead. Additionally, most of this land is used approximately 50 hours out of a five-day work week. Since elimination of parking can be considered in theory only, a more constructive use of the spaces should be found.

With multiple daily and evening uses, each IRAC can utilize a parking space multiple times, resulting in twice or three times the productive use. Not only would this occur at the transit stations, but would also occur at the work site where cars are driven in and then used as company pool vehicles.[18]

B. Task Environment

One option for addressing the environmental problems is to encourage greater use of public transit. But in recent years, transit use has stabilized or declined in many U.S. cities. In contrast, although motor vehicle travel also has increased in many other industrialized nations, public transit systems in those countries have been able to retain high levels of ridership and public support. In many industrialized nations, public transit is experiencing high levels of ridership and public support, even though motor vehicle travel is also increasing, while in the many U.S. cities, just the opposite is occurring.

CFI's task is to assess the problems faced by potential users of transit, to overcome those obstacles and present public transit in a new, innovative manner so as to capture public interest.

C. Organizational Environment

CFI is a privately-held corporate entity with a focus on improving urban transportation. Funding for CFI's research and development of potential transportation solutions was provided by both private and public sources, including the National Academy of Sciences, Transportation Research Board, the University of Nevada, Reno and the Lemelson Foundation. CF International has been and continues to be the dominant investor in the IRAC system.

IV. MARKET OPPORTUNITY ANALYSIS

A. Market Structure and Market Requirements Analysis

The target markets for the IRAC system are those that wish to ride transit but, because of the walking or parking limitations, cannot. These people can be classified into two groups, primary and secondary, which are described below.

1. Target Market

a. Primary

The primary target market consists of commuters who cannot or do not currently ride transit. The subsets of this primary market are:

- commuters who drive alone, but could ride transit; and
- "welfare-to-work" program participants.

Commuters who currently ride alone account for the largest number of potential users of the IRAC system. These travelers state that the two primary reasons for them *not* using transit are:

- there is no parking when they arrive at the station; and
- they either live or work too far from a station to conveniently walk.

The IRAC system can provide the "missing link," between the station and either work or home, that can enable commuters to conveniently access a transit station. Next are several descriptions of large metropolitan area commuters discovered from the 1993 Bay Area Rapid Transit Commuter Profile.[19]

The average Bay Area commuter spends 26 minutes traveling to work in the morning and 28 minutes traveling home from work in the evening—travel on BART could decrease that time. More than half of the Bay Area commuters (54.2%) live within ten miles of their work sites which means that the IRAC would fill the "short-distance" travel in a sufficient manner to meet the needs of those commuters. Only 7 percent of commuters have commutes longer than 40 miles one-way.

The Profile also shows that significant demographic changes are underway. The percentage of female commuters continued to increase to 55 percent and were 60 percent during peak travel periods. The percentage of adult commuters (45 to 64 years of age) has also shown an increase from 16 percent to 24 percent since the 1987 survey.

The IRAC system will have to be molded to fit into any metropolitan area's specific demographic needs. For instance, in Southern California, the typical commuter can be characterized as:

- middle class with a median household income falling at $24,900;
- household average is 3; and
- probability of auto ownership is relatively high.

The Welfare-to-Work participant is another story entirely. These non-commuters would like to ride transit since they don't customarily own a vehicle, but can't because the work sites to which they would travel are too far from a transit station. The typical welfare recipient is:

- single, female, and aged 31;
- has held a job within 4 months of accepted welfare aid;
- has 2 children; and
- ranks her three top needs as: training, daycare and transportation.

Currently in the Bay Area, welfare agencies spend an estimated $5 billion dollars on welfare provisions. A correlation can be made that if the government invested a similar dollar amount to what an average American spends on transportation (which is 17 percent), an estimated $850 million should be spent on improving/providing transportation for welfare recipients.[20]

A new "dignity card" has just been issued to a select group of welfare recipients. This card operates much the same as a smart card, in that it has assigned to it a PIN number and account information for the user. These cards could be adapted to "fit" the kiosks to be used for the IRAC system. In this manner, the recipients could participate, receive the transportation they so desperately need to go "back to work" and save the U.S. government (hence, the taxpayers) millions of tax dollars each year.

b. Secondary

The secondary target market includes business subscribers and occasional users, such as:

- companies who subscribe to use the IRACs as company car pool vehicles; and
- users that only wish to have access to IRACs for short periods of time.

Company targets would be solicited and signed up for a specific number of IRACs that would be brought to the premises by the subscribers. For instance, if 10 IRAC vehicles arrived at the company premises, the first 5 would be reassigned to the company. This would happen by simply taking 5 of the 10 out of the available pool in the web site database.

Additional occasional users would be those at or around the work site that only needed the IRAC for an hour or so to run errands, go to lunch, or travel to meetings.

2. Market Barriers Overview

The IRAC program, as implemented by CF International, is designed to encourage commuters who have not been using mass transit to replace their private auto with the BART system and a station car at either end of the transit system. Research has shown that people who have a choice tend to use mass transit only if their walking commute at either end is less than a quarter mile. This program is aimed at those commuters whose travel, at one end or the other, is greater than what they would prefer to, or could, walk. The program will allow the commuters an alternative means to use mass transit by providing a mode of transportation at one end of their commute. This program is being run as a pilot.

a. Market Barriers

A market barrier can be defined as "any characteristic of the market that helps to explain the gap between the actual level of investment and that which would appear to be cost beneficial".[21] Within any market system, there are barriers which tend to keep people from adopting technologies or behaviors which would appear to be advantageous. Programs can be designed to intervene at some point within the market and attempt to reduce the market barriers. Market effects are defined as "a change in the structure of a market or the behavior of participants in a market that is reflective of an increase in the adoption of services and is causally related to market interventions".[22] If these market effects last after the intervention is withdrawn, then the market can be said to have been transformed.

The operational test required that the users change their behavior (by changing to mass transit) and use new technology (by driving an IRAC electric vehicle and using a vehicle location device upon entering and departing the vehicle). The test attempted to intervene in a user's behavior by changing the options available, providing financial incentives (at least in the first two phases), and to change their awareness and attitudes towards mass transit. Hypothesized market barriers, which the operational test is targeting, are listed below:

- **Performance Uncertainties** – the difficulty faced by a potential client in determining if the service will perform as needed and expected;
- **Hassle or Transaction Costs** – indirect costs in time, materials, or labor involved in a particular service;
- **Bounded Rationality** – behavior during a decision making process which seems inconsistent with a stated goal. This barrier refers to the way a person processes and acts upon the information they may have; and
- **Product or Service Unavailability** – difficulty obtaining the services desired.

While a person may state that they would like to take mass transit for specific reasons, such as the environmental benefits or decreased hassle of driving, there are individual reasons why they currently are not utilizing transit. The difficulty reaching their work site from the BART station in a timely manner is one possibility and is being directly addressed by the operational test program. While buses often go from BART to within walking distance of many work sites, the time involved within the total commute may have prohibited individuals from using this mode of transportation. A previously unavailable service, the station car, was made available to participants which will allow them to arrive at work quickly and efficiently.

The test vehicle operator, Green Motorworks, provided a paging service in case of emergencies related to the electric vehicle. A back-up service to assure the participants that they will be able to get to and from BART even if the station car has problems or there is a missed connection with other riders. Participants will be able to take a cab and be reimbursed by the test program (Assured Ride Home). This is targeted at reducing any performance uncertainties. Purchasing the BART tickets and providing the station car free of charge during the first phase were both aimed at decreasing the hassle or transaction costs and performance uncertainty to the individual.

It was hypothesized that successful participation in the test would change how the individual makes future decisions, especially when the program moves to phases which require cost-sharing or cost-bearing by the individual. Creating a change in bounded rationality may be the most difficult barrier faced by the test.

A pre- and post-participation survey was drafted which addresses each of these market barriers. Results will be analyzed for any possible market effects caused by the program.

B. Industry Structure and Practices Analysis

1. The Industry

a. Definition of Industry

The transit industry includes all multiple-occupancy-vehicle passenger services of a local and regional nature provided for general public use. These services include:

- public and private bus, rail, and water service;
- vanpools operated by or under contract to a transit agency;
- taxi services under contract to a transit agency; and
- non-profit agency transportation for the aged, disabled, and disadvantaged.[23]

Different types of services are called modes, which are defined as: "A transit system category characterized by specific right-of-way, technological and operational features."[24] There are three primary modes in this industry, road, rail, and water. Road modes include bus, trolley, vanpools, jitney, and demand response, which are: "Passenger cars, vans or buses with fewer than 25 seats operating in response to calls from passengers or their agents, to the transit operator, who then dispatches a vehicle to pick up the passengers and transport them to their destinations."[25] Rail modes includes heavy rail, light rail, commuter rail, cable car, monorail, and aerial tramway. Water modes includes all ferry boats.

Currently, there are close to 6,000 transit agencies operating in the United States. The true number, however, is much greater due to the fact that many agencies have several contractors.[26] Most agencies operate more then one mode of transit.

b. Industry Funding and Expenses

Sources of Funds

Capital Funding

Two types of funds are required in this industry. The first is capital funds, which are used to fund transit infrastructure. To receive federal funding, the amount requested must not exceed 80 percent of the total project costs. Typically, only 47 percent of the overall industry expenses are provided by the federal government with additional and incremental funding provided by state and local governments.

There are distinct differences in the income of the various transit authorities based upon the governing board. Some transit authorities do not take advantage of federal funding at all and are completely funded by their state and local governments. Other agencies only accept a portion of the federal funding maximum and still others collect portions from tolls and added taxes.

Currently, transit agencies collect 27 percent from taxes, tolls, and fees. States contribute 14 percent and local governments contribute 12 percent. In total, $7 billion was provided, as capital funding, to the nation's transit authorities by all available sources. Of this amount:

- 36 percent was for bus-related projects;
- 32 percent for rail modernization;
- 31 percent was for the start of new rail projects; and
- 1 percent was allocated for planning.

Operational Funding

The other type of funding required is the operational funds. Approximately three-quarters of the required amounts come from the area that the agency is serving. Of this amount:

- 39 percent comes from paying passengers;
- 22 percent is provided by the local government; and
- 13 percent is obtained from non-government sources.

State and federal governments provide 22 percent and 4 percent respectively.[27]

Expenses

Capital Expenses

Moneys paid for transit planning, design, land acquisition, and related costs are all capital expenses. In 1995, 36 percent of the $7 billion total capital expenses was spent on heavy rail and 10 percent was spent on light rail. The majority of the money was spent on the maintenance and acquisition of facilities, 22 percent was spent on services and equipment, and 25 percent was spent on vehicles.[28]

Operating Expenses

In 1995, total operating expenses for the industry equaled $18.1 billion. Salaries and wages constituted the majority of the budget, at 47 percent.[29]

c. Transit Ridership Trends

Accurate historical data on transit ridership are hard to find. It was not until 1980, that a standardized method of data collection was established. The industry, however, was criticized as early as 1917, for its lack of data collection and analysis. Ridership trends have been established from analyzing different reports, such as the Electrical Industry Census of 1902, 1907, 1912, and 1917. All other years before 1921 are speculative. Other documents used include Barger's "The Transportation Industries, 1889-1946: A Study of Output, Employment, and Productivity" and various corporate entities from Moody's Transportation Manual.[30]

Despite the problems with the data, five segments have been established for the twentieth century. The data is speculative, but it is helpful in establishing trends. The first trend occurred from 1900 to 1919, and is known as the stage of initial rapid growth. During this period, per capita ridership rose faster than the urban population.[31] The prime reason for this trend is attributed to the introduction of electricity to the horse-drawn railways.

The next trend has been coined the period of fluctuation and lasted from 1920 to 1939. At the end of World War I, ridership continued to increase, but not at the rate it had previously. Due to the high growth rate of the urban population, this period actually incurred a decreasing share of the urban transportation market. The Great Depression of the early 1930's caused a 20% decrease in revenue passengers. In the late 1930's, much of this loss was regained as the country pulled itself out of the economic slump.

The next trend has been termed the period of war induced growth. This segment began in 1939, and was induced by gas rationing, increased production, and a shortage in automobile tires and parts. By 1945, ridership had climbed to almost double its prewar level.

The years 1946 to 1972 marked the period of the lengthy decline. The primary cause of this decline was the dramatic increase in consumer demand for automobiles. With the exception of congested urban areas, transit became the mode for those who had no other choice.

The period of modest growth from 1973 to 1990, was the last segment analyzed. This modest growth can be attributed to the gas shortage in the 1970's and the availability of public funds for transit support. In the late 1980's and early 1990's, ridership continued to slowly increase as the quality of services increased. In addition, consumers have become more conscious of the environmental impacts of single person driving.[32]

C. Key Competitors Analysis

1. Identification of Competitors

The competition consists of all forms of motorized transportation that is capable of conveying commuters from home to the transit station and/or from the transit station to home. The following transportation alternatives have been identified as potential competitors to the IRAC/station car system.

a. Primary Competitors

Primary competition is defined as the various modes of transportation available to consumers that are operated by both the private and public sectors.

Low-Capacity Modes: Paratransit[33]

Private Automobile

The private automobile is by far the staunchest form of competition for the IRAC system. The average commuter drives alone or with family members in their automobile to and from their destination. Driving alone is also the predominate mode of transportation for work travel.[34] While the private automobile provides instant access to transportation for the user, it also allows people to live outside urban areas while retaining access to mainstream activities. Households that contain two or more adults account for seventy-seven percent of those with at least two vehicles.[35]

Taxis

Taxis are automobiles operated by a driver and hired by users for individual trips. The service they offer is tailored entirely to the user's desire. Users may find a taxi at a number of locations in the city. Since most of the cost covers the driver's time, a high price is inherent in this mode which prohibits it from being as cost-effective as a personal automobile.

Dial-a-ride or dial-a-bus

Dial-a-ride service consists of minibuses or vans directed from a central dispatching office. Passengers call the office and give their origin, destination, and desired time of travel. The office plans the bus routings so that as many passengers as possible are served on a single trip.

Dial-a-bus usually operates within geographically delineated low-density areas. It serves trips that have one common end ("one-to-many" or "many-to-one") or both ends dispersed ("many-to-many"). Thus, this mode provides a service between those of taxi and regular bus, but due to time delays, is not as convenient as single occupant auto use.

Jitneys

Jitneys are privately owned large passenger cars or vans (6 to 15 seats) that operate on a fixed route (minor deviations in some cases), without fixed schedules. They pick up and drop off passengers along their route by request at designated stops or, in some cities, practically anywhere, contributing to traffic congestion. Because of their small capacity, jitneys operate in large numbers and offer high-frequency service on major routes; on lightly traveled routes their service is often unreliable. Since each individual jitney stops less frequently than a bus, jitneys' travel speeds are higher than those of buses on the same facilities. They are used extensively in many developing countries with very low labor wages, particularly in cities with inadequate transit services.

Medium-Capacity Modes: Street Transit

Regular Bus

Regular bus service consists of buses operating along fixed routes on fixed schedules. Buses comprise, by far, the most widely used transit mode. With vehicles varying in capacity from minibuses (20 to 35 spaces), to articulated buses (up to 130 spaces), and the ability to operate on nearly all streets, arterials, and freeways, buses provide services covering a wide range of LOS, performance, costs, and impacts.

At the lower end of their application range, regular buses serve low-volume suburban routes, overlapping somewhat with the domain of dial-a-ride applications. In marginal cases it is possible to operate regular buses as dial-a-bus service during hours of low demand. The more the travel demand is concentrated along corridors, the more advantageous the regular bus becomes.

The most typical bus services are street transit routes, which may represent the entire transit network (small and most medium-size cities) or supplementary and feeder services to rail networks. At the upper end of their application range, regular buses overlap with the light rail transit (LRT) domain.

b. Secondary competitors

The secondary competition is defined as all other station car programs currently in operation or currently in the operational testing phase of their program. There are many demonstrations and field tests currently occurring in, New Jersey, Atlanta, Southern Florida, Southern California, and Sacramento and other areas as well.[36]

c. Tertiary competitors

In addition to other ITS programs, any other form of ITS-enabling technology, such as the COCOS[37] system would be considered additional competition to the IRAC program/package.

D. Analysis of Market Potential and Forecasts

Demand cannot be determined until acceptance from the initial introduction of this innovative form of intermodal travel is established. No conclusive secondary data studies have been found that allow formulation of demand for this service. However, based upon the operational tests conducted by CFI, it was determined that a 5 percent demand could be used as a preliminary estimate for this document. The base number of vehicles will also be determined by funding unless a significant increase in demand becomes apparent. For the purpose of cost estimation, the demand was conservatively estimated at 3,000 vehicles.

According to one study of station car fleet operation, conducted by Sandia National Laboratories,[38] the largest market prohibitor and cost contributor is the initial vehicle purchase price. This obstacle can be overcome by involving an auto rental operator who's primary business is purchasing and operating fleets.

V. OPERATIONAL TESTS

A. Introduction

The initial intentions of the tests were to prove concept viability and establish some base of user data and market demand. The hypothesis was that potential users would be intimidated by the introduction of advanced technology (electric vehicle and Teletrac) into their commute and that these elements would need to be overcome in order for adoption to occur and the operational tests to succeed.

The first test, consisting of 2 cars, was completed in April 1997 at the University of Nevada, Reno (UNR). The next two tests were conducted simultaneously at Alameda Hospital (Hospital) and at the Ashby BART Station (Ashby), consisting of 4 cars and 8 cars respectively. Each

test scenario was to be made of different variables so as to find the best scenario (work site) and potential user "mix" for a pilot test.

Since it is additionally hypothesized that with each test the advantages and disadvantages of the IRAC program would continue to be uncovered, an additional test of 8 cars was conducted at the Harbor Bay Business Park. All aspects of learning that occurred in the Ashby and Hospital tests were applied to that effort and more data was collected.

B. Ideal Test

The concept testing of Phase II was to be additionally divided into three sub-phases:

1. Sub-Phase I

Sub-phase I would consist of initial contact and enrollment of an undetermined number of users; training; and establishment of the program. Upon completion, users would be asked to drive the EVs on a regular daily basis. The participation would consist of driving the vehicle from the destination transit station to the work site. Sub-phase I participants would be given prepaid transit tickets and have use of the EVs at no cost.

This sub-phase was simply intended to collect user patterns. A post-participation survey would be given at the end of the eight weeks to collect further data, such as willingness to pay. This data would be used to establish Sub-phase II.

2. Sub-Phase II

During this sub-phase, users would be asked to pay for the transit ticket, but use of the EV would continue at no cost. This was intended to record the number of participants who would continue the program when asked to contribute to the costs. Also, if additional participants were needed (due to Sub-phase I participants' unwillingness to pay), how easily the new users would agree to the program would be recorded. In order to establish willingness to pay, at the completion of Sub-phase II, a post-participation survey would be given to current users. A similar pre-participation survey would be given to potential Sub-Phase II new users, who, upon completion of this phase, would receive a post-participation survey as well.

3. Phase III

In Sub-phase III, the established users would be asked to pay for the transit ticket and contribute some amount to the lease of the vehicle. That amount would have been established during the Sub-phase II post-participation surveys.

Upon completion of the project sub-phases, it was assumed that data would exist to show the following:

- user patterns;
- user's willingness-to-pay; and
- a base for market demand that could be extrapolated into a larger public.

C. University of Nevada, Reno (UNR) Test

An operational test consisting of two leased internal combustion engine (ICE) vehicles was conducted in the spring of 1997 on the UNR campus at the Engineering school. The college campus was selected partially because of the Parking Services desire to promote carpooling and partially because of a reported parking problem.

A survey was conducted, several years prior to this operational test, by CFI staff members. This survey asked many questions regarding carpooling, in particular, why don't you carpool. The predominant reply was that the users felt their travel flexibility would be impacted. In essence, they would be left with no vehicle in which to run errands, go to lunch or, if the need should arise, to leave the work site at a time other than that which had been established with the carpool.

It was concluded at that point that if a "rentable" vehicle was made available, more users would have the flexibility to carpool. The carpoolers would then help relieve the parking problem. The test was conducted to establish some base of user patterns in order to show an increase in carpooling and to see if a manual reservation system was adequate for a relatively small test.

1. Methodology

The original IRAC communications system was installed on these two cars and used for collection of data, although as stated above, the reservations feature was covered by a manual procedure. No transit ridership was involved and carpooling/ use of the IRAC was strongly encouraged.

Two preferred parking spaces were allotted by the Parking Services department and signs were posted stating such, thus allotting an incentive to carpool and use the IRACs for lunch time errands, etc.

An office was set up and staffed with an operator who granted reservations, dispersed keys and maintained the reservations log book.

The experiment was conducted for eight weeks, in which the engineering college staff members were allowed to reserve and use the vehicle at no cost simply by making a reservation. Two engineering staff members were selected to be home-end users. All other users were considered occasional users.

2. Findings

During this operational test, the manual reservations system was discovered to be appropriate and satisfactory. In fact, the data collected helped to determine the reservations design strategy for the web site.

3. Conclusions

No conclusive evidence was found that showed an increase in carpooling. However, the limitations placed on the experiment, such as a limited user base and a limited number of cars to offer potential riders, were shown to be overwhelming. The fact that the manual reservations system was shown to be satisfactory rendered the experiment successful for CFI purposes.

D. Ashby Station (Ashby) Test

The Ashby Station test was conducted primarily to solicit shared vehicle use for existing transit riders and EV renters. This test consisted of 8 vehicles that had been previously used by a sole driver at an access station and, since none of the current drivers had a common destination, car-sharing was not an existing possibility. This test was conducted by Green Motorworks via financial and equipment support from CFI.

The Ashby test requested that these participants begin shared vehicle use. The test would consist of two work-end users (one participant would drive during the day and one at night), or one participant being a home-end and one a work-end user. No alternative would be allowed but to conclude participation altogether. Previous to this request, the participants could use the car not only to travel to the access station, but the vehicle was domiciled at their residence and available for short-trip use. (See Figure 5-1.)

1. Methodology

To solicit participation, flyers were distributed at the Ashby station. Interviews were conducted, but no controls for existing transit ridership were established.

Not only were users paired by Green Motorworks, but existing participants were encouraged to continue participation by looking for car-sharing partners themselves so as to raise the comfort of the car-sharing scenario.

2. Findings

Enough current participants elected to continue with the program to enable new participants to begin without a time impact and the program has had few problems.

3. Conclusions

No conclusions regarding an increase in transit ridership could be made since this test was not controlled for current transit ridership. It can be assumed that at least some of the participants were not current riders. This test is considered successful for CFI purposes since it has shown the work-end/home-end scenario to be not only possible, but viable.

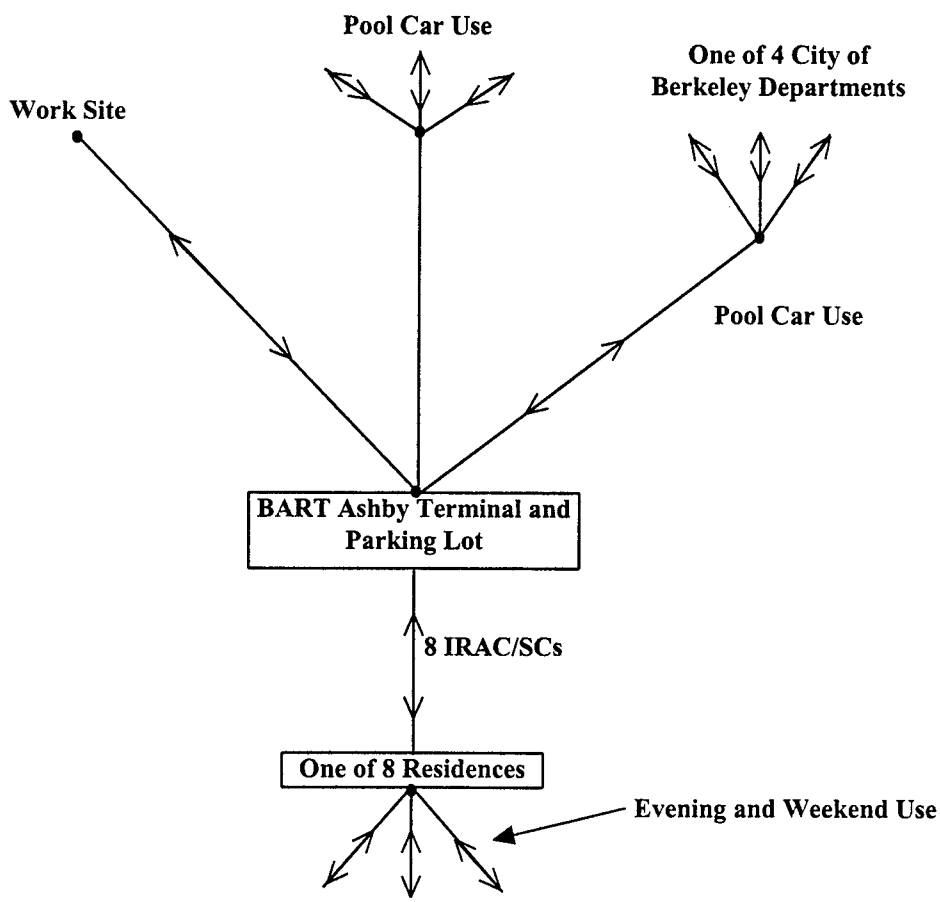


Figure 5-1: Ashby station operational test configuration.

E. Alameda Hospital (Hospital) Test

Alameda Hospital was originally chosen by CFI due to the fact that they offer a 24-hour, 7-day per week, 3-shift work scenario. Within this scenario, CFI could potentially use a small number of vehicles to move multiple employees back and forth between the Lake Merritt BART station and the Hospital. It was envisioned that with this use, not only would transit ridership increase, but would increase at off-peak periods of time when transit is typically under-utilized.

The Hospital also has a parking phenomenon similar to that of UNR. If the employee does not arrive at the Hospital in the early morning, all available parking is used and the employee must park on the street up to four blocks away. Due to the site on which the Hospital is placed, expanding parking is not an option.

The initial contact with Alameda Hospital was through Ginger Bonnar, Human Resources Analyst, who proved to be invaluable in setting up the experiment. Through Ms. Bonnar, CFI was able to contact the Hospital employees with some level of trust and comfort already established.

This "trust and comfort" has not yet been discussed within the context of these phases or sub-phases, but is vital to the success of any marketing effort associated with changing a user's behavior. Once established, trust creates loyalty which can, in turn, create success. But if the trust or comfort within the program is broken, it can lead to failure. It is therefore considered imperative to create and maintain a high level of user confidence.

It was hypothesized that within the IRAC/station car program efforts, the introduction of new technology into a person's daily commute would have the most impact and would lead to either the adoption of the alternative or a decline to participate.

1. Methodology

So that users could make the appropriate reservations via the web site, it was first established that the Hospital had Internet access. Upon affirmation of that fact and that the access was available to all employees (in the Library), it was assumed that all participants would be trained on the web page. The Librarian confirmed that she would leave detailed instructions on how to access the web and the IRAC web site.

After this, an introductory survey was distributed via U.S. Mail to 204 of the 500 Hospital employees. Controls were placed on which employees would receive the cover letter and survey by selecting only those employees who worked full-time and lived outside of the immediate Alameda zip codes.

A cover letter was also sent along with the survey to explain who, what, and why in regards to the IRAC program and the survey was mailed on Wed., November 19, 1997. Although the employees were requested to return the questionnaires within a week, due to the Thanksgiving Day weekend, response time was expected to be much slower.

The first screening question within the survey was "May we call you?" It was felt that if the respondent did not wish to be contacted, they did not want to participate.

Because the entire objective of the IRAC/SC program is to increase transit ridership, the second screening question asked: "Do you currently use public transportation to commute to work?" With this question, CFI would be able to solicit participation only from those employees who did not currently ride any form of public transportation.

The second step was to contact all those employees who indicated CFI could call them, did not then ride transit and worked a "typical" 8- hour shift (7-3, 8-5, 3-11, and 11-7). These users could be described as "ideal" and were desirable due to the "Optimum Schedule" established by CFI. (Figure 5-2). This optimum schedule allowed for maximum use of three cars by 5 full-time users, 3 day-time users and 3 weekend users.

The full-time users would be established as those who worked 8-hour or full-time weekday shifts and currently traveled by auto alone. They would drive the station cars alone, thus creating the convenience and flexibility of their own private auto. The day-time users would be users who could either carpool or walk to work, but were currently driving alone because they were in need of a vehicle at the hospital premises. The weekend users were similar to the full-time users with the exception of working primarily on

Car 1	Driver 1	5:45 am to Hospital
	Driver 2	7:15 am to Lake Merritt
	Driver 3	8:45 am to Hospital
	Driver 1	3:15 pm to Lake Merritt
	(car use is concluded for day)	
Car 2	Driver 4	2:45 pm to Hospital
	Driver 3	6:15 pm to Lake Merritt
	Driver 2	10:45 pm to Hospital
	Driver4	11:15 pm to Lake Merritt
	(car use is concluded for day)	
Car 3	Driver 5	9:45 am to Hospital
	Driver 5	7 pm to Lake Merritt
	Driver 6, 7, and 8	Random Day Use
	(this car is designated to be a random day use vehicle)	
Additionally:		
Car 1	Driver 9	Weekend use
Car 2	Driver 10	Weekend use
Car 3	Driver 11	Weekend use

Figure 5-2: Optimum schedule.

the weekends. If these users also worked during the weekdays, that information was disregarded.

CFI then set up appointments via telephone conversations, met with the individuals and deduced whether the employee was a potential participant. During the interviews, it was discovered, that the idea of participating in an introduction of new technology was exciting, but the idea of riding on BART was not. Employees had established paradigms associated with BART travel and that association was the primary reasoning for not riding transit. Although the walking and parking issues were important, they were not as negative as the associations made with BART itself.

These pre-conceived notions ran from "BART stations are inconveniently located" to "I do not feel safe either riding BART, parking at the station or leaving my car at the station."

Since CFI did not have, nor has, control over the operation of BART, if the idea of participation did not diminish the negative association, that potential participant was eliminated from the pool.

Upon completion of a successful interview, the employee was given the pre-participation survey to complete and a telephone call was placed to Green Motorworks to arrange a convenient training time.

Green Motorworks was sub-contracted by CFI to participate in this program on both a one-time and continual capacity. The one-time efforts were to "commonly key" all of the EVs, and install the Teletrac systems. Although Teletrac installs the systems at no cost, due to the experimental nature of the PIVCO EVs, it was decided to be more time-efficient if completed by Green Motorworks. The continual efforts were to train the potential users on EV and Teletrac use as they were selected. A space was also leased to house the web site and Teletrac computers.

Upon completion of training by Green Motorworks, the potential user was given a PIN to use with the Teletrac system, a set of keys and the user's name was entered into the web site database. At this point, the potential user was considered a participant and encouraged to drive the car as arranged.

At the conclusion of the test, a post-participation survey was given to each participant in order to:

- measure any change in attitudes;
- conclude if a user would be willing to participate in the next sub-phase of the test; and
- to ascertain willingness to pay and what dollar amount.

An exit interview was also conducted both verbally and in written form. The written format was distributed as anonymous (no place for "name" was provided on the form) and participants were told that the data collected from these exit interviews would be reported anonymously, perhaps in a larger database along with the Harbor Bay data. In this manner, CFI could gather some insight into the participant's true feelings toward the project without the participant feeling that they would be singled out and questioned.

2. *Findings*

Of the 204 surveys distributed, 70 surveys (34%) were returned within the requested week timeframe. In addition, an additional 11 surveys were returned within 10 days, bringing the total returned to 81 (40%). There were 19 (23%) of the 81 respondents who declined to be called, eliminating them from the selection pool. Of the 62 respondents remaining:

- 2 were current transit riders; and
- 2 were out on paid sick leave.

At this point, it was also discovered that the controls had not provided for elimination of Oakland, San Leandro, etc. zip codes. The employees that lived within that range consisted of 22 (27%) of the 81 respondents and were eliminated by hand, leaving 36 potential participants for 11 participation slots.

Of these 36 potential participants, the typical respondent could be described as:

- female, between the ages of 41-50;
- non-transit user;
- drives alone from Pleasanton;
- leaves work during the day, usually for lunch; and
- works the 7 – 3:30 pm shift.

As willing participants were identified from this group, they were trained, given a vehicle and instructed to begin the program. It was felt that this would maintain momentum and excitement about participation. What occurred, however, was different than expected.

Four participants were identified almost immediately and four cars were initially put into use because each of these participants worked a day-time shift and rotation was not possible. Although, these four were told to reserve the vehicle via the web site, only one user was consistent, in part because the web use was not enforced. In effect, unless told that they must use the site or be dropped from the program and knowing that they were the only users of the vehicles, the users didn't feel the need to make reservations. However, CFI informed them that restrictions would be enforced upon full enrollment of the schedule (all needed users identified, trained and participating).

Using an introductory type of approach was not as successful as thought. CFI introduced each element separately to give the user time to adapt before introducing the next element. This will not be done in the future. It was discovered that participants were willing to accept the introductions upon entry into the program, but then "rebelled" against any further changes.

The length of time needed to identify potentially "ideal" users (as described above) became a prohibitive factor and therefore, only Sub-phase I could be implemented before the close of the Phase II TRB grant. Part of this inhibiting factor was due to the above discussed negative associations with BART itself. Several (3) potential employees were deemed good candidates, only to call several days later and say "I don't feel safe leaving my car at the Richmond

station." Since there were only 36 potential candidates, and 11 slots were needed, losing 3 had a tremendous impact.

Another issue was one of transfers. One employee began participation, yet quit the next day due to the time involved in transferring at the 12th Street station only to go several blocks to the Lake Merritt station (where the cars were located).

Yet another issue, and one of the most important, was that of trust and confidence in the program. Every participant wanted to know what to do if they arrived at the egress station only to find "that there was no car." They were reassured that the likelihood of that occurrence was rare, yet it did happen very early in the project. Fortunately, the participant involved was resilient and continued with the program, although trust and confidence was lost in the operator.

Ultimately, participants were found for all shifts through the use of various publications. These publications consisted of:

- inclusion of an article in the Hospital newsletter;
- a flyer posted in various break rooms and nursing stations; and
- an announcement mailed to a controlled group (as before, with the exception of Oakland, San Leandro, etc. employees) offering an opportunity to win free airline tickets.

Although all desired participants were found, the schedule differed from the original as follows:

- there would be 7 full-time users, with 4 users sharing the time slots of 3 p.m. to 11:30 p.m., 11:00 p.m. to 7:30 a.m. and weekends; and
- 3 day-time and 1 weekend users remained the same.

Next, an incident occurred which caused a pivotal participant to withdraw from the program. The participant paged for assistance and did not receive it. Therefore, this participant lost trust and confidence in the safety of the vehicles involved with the program and the test itself. This participant withdrew from the program the following day. At that time, CFI concluded that, for the time being, it would bring the Hospital project to a close.

3. Conclusion

After 8 weeks of partial participation, CFI decided to close the Alameda Hospital test. This was ample time to uncover any user issues and valuable data on user adoption, including user patterns, in this scenario. From an economic viewpoint, a majority of the full-time participants would be willing to adopt the IRAC station car system into their commute even though this operational test consisted only of the station-to-work portion and the participant would still have to drive their private vehicle to the access BART station. The willingness to pay portion of the post-participation survey indicated that participants would pay for their BART ticket and pay for use of the IRAC/SC within a range of $50 - $75 per month. It has been previously hypothesized that for economic success, the IRAC system vehicles must replace the second or third household vehicle. This willingness- to-pay shows that the participants would not replace a second vehicle, but would, in an economic sense, add a vehicle to the household.

A local EV operator, Green Motorworks was utilized to both lease and maintain the vehicles. This was somewhat satisfactory for a test situation, but the future operator choices will be restricted to established national fleet organizations because of the high visibility, professionalism and needed reliability for the public's acceptance of the program. Also, it may become necessary to choose a recognizable brand name operator, such as Enterprise or National Rent-A-Car to increase adoption by the consumer.

The perception of the fleet operator's reputation will also enable the IRAC system to benefit from brand association, credibility and trust without the customarily massive advertisement expenditure.

Perceptions of safety surrounding BART use should be addressed by BART if transit ridership among current non-riders is to occur.

F. The Harbor Bay Business Park (Harbor Bay) Test

1. Methodology

The Harbor Bay Test was planned to be conducted beginning on or about April 1 for a period of 8 weeks involving at least 8 electric vehicles and 16 carpooling participants. The actual start dates were April 22 with two vehicles and June 1 with four additional vehicles, for a total of 6 vehicles and 12 participants. To solicit participation, a local consultant was hired who distributed flyers, created by CFI, to several businesses in the park. Approximately 21 responses were received. These respondents were called and interviewed to control for the desired variables:

- Did not previously used transit;
- Worked full-time; and
- Were willing to participate.

A presentation was set up to introduce them to the IRAC system concept and to answer any questions. At the presentation, they were asked to complete the same pre-participation survey that was distributed at Alameda Hospital. In this manner, it is assessed that the responses could be combined into a larger database and thus a greater chance of valid conclusions would exist.

Although several members of the RIDES car-sharing organization were contacted, all declined to participate.

Next, the property manager was contacted for permission to install three donated electricity pedestals with the capacity to charge 6 EVs. One pedestal is being permanently donated to the site by the Bureau of Electricity, Alameda (Bureau). Alameda is committed to becoming an electric vehicle-friendly city and has whole-heartedly

supported these efforts. Two other pedestals are being installed on loan from BART.

It was discovered in the Hospital test that charging at the transit station was not as desirable as charging at a work site, therefore, CFI determined that, if possible, charging capability would be provided at the Harbor Bay work site. A common area was located, the Bureau dispatched an electrician, and a construction plan was developed. All of this was required by the property manager prior to giving permission to begin construction.

The Bureau financed 75 percent of the labor to install the BART pedestals as well as the donated pedestal. CFI financed the remaining 25 percent. The property manager did not contribute any cost, as the electric cost was eligible for an "Electric User Rebate" from the Bureau. Therefore, costs incurred for electric use were reimbursed through the rebate.

Initially there was a work-end scenario consisting of carpoolers in and out of the Lake Merritt BART station. Participants agreed to carpool, log in for the Teletrac system and to make reservations on the web. Only one of the two users was asked to make reservations on the web site because the reservation schedule could not accept two users for the same vehicle. That capability can be incorporated.

Since the Lake Merritt Station is not the most convenient access to Harbor Bay, a map showing the easiest route was distributed to all participants. An overview map of the Alameda area operational test locations was also provided.

This operational test was run in a very efficient, business-like manner with much less of the personal interaction that existed in the Alameda Hospital test. Correspondence was accomplished primarily via e-mail, information and training was presented in a seminar atmosphere (instead of individually) and, since the chargers were established on the same premises as the work site, there were no reported problems with re-charging.

2. Findings

The pre- and post-participation surveys were constructed exactly alike for Alameda Hospital as for Harbor Bay, therefore the information collected will be presented here as one collective group. It is important to note here that of the 23 pre-participation surveys given, there were only 18 corresponding post-participation surveys and 17 exit interviews, since 2 users dropped out and didn't return the post-participation or exit surveys and the other 3 were day-time users only. Rather than disregard the extra information, the data will be presented here as 100 percent of the participation population at the time of collection.

Pre-participation

Although the attitudes varied widely between the hospital and Harbor Bay populations, the typical participant had the following characteristics and pre-participation attitude toward the project:

- Drove alone for 46 - 60 minutes to commute to work;
- Had not used BART on a regular basis to commute to work in the past two years;
- Strongly agreed that "there is no easy way to get from the station to work;"
- Somewhat agreed with the following reasons for not riding BART:
  - It takes too long;
  - It costs too much; and
  - They wanted a car at work.
- Were neutral about the following:
  - I feel BART is unreliable; and
  - I can't find a parking space at the station.
- Strongly disagreed that "it's not safe for either myself or my car;"
- Felt that participation would work with their schedule;
- Had not driven an electric car on a regular basis; and
- Was neutral on their comfort level with an electric car.

The population at the Hospital was more apprehensive about the electric car (safety and reliability) and more concerned about safety at the BART station than the Harbor Bay population. It was assumed that attitude was because the Hospital users would be driving the car very early in the morning and very late at night.

Post-Participation

The post-participation survey and exit interview were given to the Hospital users on an individual basis. At Harbor Bay, the users were given the post-participation survey to complete on their own prior to a focus group/exit interview session. The following are the typical characteristics and attitudes post-program (18 responses):

- The commute was lengthened to 76 – 90 minutes;
- Either strongly or somewhat agreed that the commute was too long;
- Somewhat agreed that the BART station was safe;
- Strongly or somewhat agreed that it was now easy to get from the station to work;
- Were neutral about BART's reliability;
- Strongly disagreed that "I couldn't find a parking spot at the BART station;"
- Strongly agreed that the station car was reliable;
- Was somewhat satisfied with how participation worked with their schedule; and
- Were very comfortable with the electric car.

Once again, it's important to note here that Lake Merritt Station is not the most convenient to Harbor Bay, hence part of the reason for the longer commute time.

The participants were also asked if the current program was continued, would they participate. "Yes" was the response for 71 percent of the users and 82 percent of those stated that they would even pay for the BART ticket. 54.5 percent of those users said that they would pay for BART

and the station car with an average willingness-to-pay of $50 - $75.

Exit Interviews

During the focus group session (and after the post-participation surveys were completed), a hypothetical question was posed to the group. They were asked: "If the program offered you a car at both ends for a reasonable cost, would you participate and for economical reasons, be willing to give up one of your cars?" The poster of the theoretical IRAC commute scenario was prominently displayed and the proposed system was explained. Three of the users said "yes" immediately and three answered "no." Then the concept was discussed further with some economic comparisons made between private auto use and IRAC use. Two of the three "no" respondents converted to a "yes," with the one participant stating "No, I love my car!" The following are the main ideas that were arrived at from the focus session. These were also described as caveats for future participation:

- A multi-type fleet of vehicles was desired;
- Vehicles were needed at multiple stations;
- Insurance issues are important and need further discussion;
- The environmental aspect of the EV is very important;
- Cost per mile is perceived as a barrier to riding BART;

With education about what it really costs to drive a private auto, perceptions could be readily changed. On the written exit interviews, 78 percent of the respondents agreed with the statement: " In my opinion, purchasing BART tickets would cost me more than driving my own car." This percentage also corresponds with the attitude prior to education within the focus group.

The single best aspect of the program was listed as the ability to use electric cars, with the second best listed as not having to use their own cars to commute. The single worst aspect was the lengthened commute time and second worst was that the system was not as convenient as having their own car, partially due to scheduling conflicts with a carpool partner.

3. Conclusion

It has been concluded, from all of the above data, that:

- a demand of 5 percent of the population could be estimated;
- convenience and commute time were issues;
- having more cars at various stations or a station closer to Harbor Bay would be considered a solution to both the convenience and commute time issues; and
- perceived cost paradigms could be dispelled with education.

One very important factor to focus on was that one of the primary reasons for participants not using BART was due to the fact that there was no way to get from the station to work. On the written exit interview, participants stated that it was now "easy to get from the station to work," and were willing to pay for the BART ticket because of that change. Also, the scenario of varied-type vehicles at 10 stations with costs between $50 and $75 for subscriber use, described in this document, fits the needs and wants of the test group very well.

The Harbor Bay data, combined with the Alameda Hospital information was proved to be valuable and the test successful. Several of the participants wrote in on the exit interview that they would like to participate in future projects and so CFI will focus on an avenue to take advantage of that opportunity.

VI. TECHNOLOGY TESTS

In addition to the limited scale operational tests, the technological portion (web site and Teletrac) of the system was tested as well. A smart card system was designed and demonstrated as well.

A. Introduction

The Phase II reservation/rental procedure operation is outlined in Figure 6-1. The left portion is associated with the reservation process, the right with vehicle location and communication and the center portion depicts the IRAC vehicle and an IRAC dispatching center.

The dispatching center includes a personal computer with web site access, a Teletrac terminal, and a toll-free telephone circuit. A customer with a computer and web site access can make a reservation directly. If such access is not available, the customer can request reservations via the 1-800 toll-free number.

B. Web site

The IRAC web site was designed to be informative to casual browsers and to allow reservations of the IRAC system vehicles. All of the participants in the Harbor Bay project were told to make a reservation for use of the car, both on a subscription and occasional use basis. Participants were asked to access the web site and send e-mail if there were any problems. The operator received only one telephone call saying that access was difficult (apparently due to server problems). The problem was addressed and resolved. Many comments were made on the attractiveness and usability of the site. A limitation of the site was its inability to accommodate carpool partners.

It was initially thought that the web site and the Teletrac system would work in tandem to enable a more accurate collection of user data regarding Harbor Bay use. In some instances that did occur, but since the web site reservation

system was used on a consistent basis by only one user, and Teletrac information was inconsistent as well, no comparisons could be determined. It became apparent upon collection of the database information that future use of the web site would have to be monitored for compliance. Also the site would have to be upgraded for future use. Additional funding has been set aside in the CFI Pro Forma (Figure 8-5) for the web site upgrade.

C. Teletrac System

The most important aspect of the Teletrac system in terms of obtaining usage data during the Phase II test was its versatile two-way messaging capability, and in particular the in-vehicle Message Display Terminal (MDT). The messages can be either canned messages (CM) or user formatted messages (FM).

Upon vehicle entry, the user first sends a formatted message containing a PIN, which was displayed (and stored) on the Teletrac dispatch terminal. Since electric vehicles (EVs) were being used, a CM was also sent to indicate the battery charge remaining.

The second formatted message is also included upon vehicle entry and exit. This message provides odometer reading for collecting usage pattern data as well as for billing purposes. While trip mileage can be generated by Teletrac location updates, such updates normally are made only every 15 minutes is not adequate to provide the mileage resolution required by IRAC use. Infrequent Teletrac location data, combined with entry and exit odometer readings is adequate for establishing some user patterns.

It is realized that erroneous odometer readings may be entered, or not entered at all. An en-route message can then be sent from the dispatcher promoting such data entry. An additional canned message is also transmitted, upon vehicle entry which indicates the purpose of the trip. CM #11, could correspond to a BART access trip, CM #12, recreation, etc., as for example, when the vehicle is used by a home-end user on a weekend.

The dispatcher can establish via a PIN message that a work-end user has entered the vehicle at the Lake Merritt BART terminal for work site access and that the vehicle has adequate charge for that trip. At the completion of the trip, prior to exit, the user will again enter the battery charge data, etc.

As insurance that proper data is entered, the dispatcher is alerted when the vehicle transitions a "Zone of Compliance" that is established at the operation start-up. The dispatcher can then establish whether proper data has been entered. If the data is not satisfactory, the dispatcher can send a message to the vehicle, which could state: "Please enter the following information..." Current vehicle location is, of course, displayed to the dispatcher in conjunction with a message relayed periodically. Figure 6-2 outlines a possible message sequence.

The system was operated by Green Motorworks for the initial operational test phase and was then operated by Equipoise Consulting for the second test phase.

a. Participant Response to the Teletrac System

Participants were asked to enter one piece of information per message (in the above manner) so that the data would be more easily extractable at the operational tests conclusions. While this system seemed user-friendly, many participants complained about having to send more than one message and ultimately, did not send the required information in a consistent manner.

This inconsistency was discovered when the final data was assembled and categorized by PIN. Of the 20 users at Alameda Hospital and Harbor Bay, only 13 users recorded using the Teletrac more than 4 times, although *all* participants used the vehicles for at least 10 trips. In the Ashby tests, 13 of the 35 users recorded using the Teletrac more than 4 times.

Data pertaining to mileage was inconclusive primarily due to the same inconsistencies in data entry by the participants. Typically, beginning mileage was recorded, but not ending mileage. Some trips were then taken with no beginning or ending mileage recorded.

This information regarding participant data entry, or lack thereof, has pointed to the need for an all-inclusive entry system, such as the smart card or the relatively new "lifestyle" card[39]. These card system methods would give all the necessary information to the operator with one swipe of the participant's personal card, including time of rental, PIN and charging of the appropriate fee.

D. Smart Card Introduction

Smart cards carry 8-bit microprocessors and many tens of thousands of bytes of data storage – roughly equivalent to the desktop computers of the early 1980's. These resources are ample to provide secure storage and retrieval of information sufficient to ensure that the holder of the card is in fact an authorized user of an IRAC vehicle.

In the Phase I IRAC program a "Dallas Button" was used to simulate a credit card / smart card for enabling vehicle ignition and billing purposes although this feature was not included in the transition to the vehicle location and communication system at the initiation of Phase II. However, significant customer/user interest has been expressed in integrating this capability into CFI's IRAC system. In response to this interest, CFI contracted with Beyond, LLC, a Virginia-based smart card specialist, to prepare a demonstration of the application of smart cards to the IRAC system. The following goals were established.

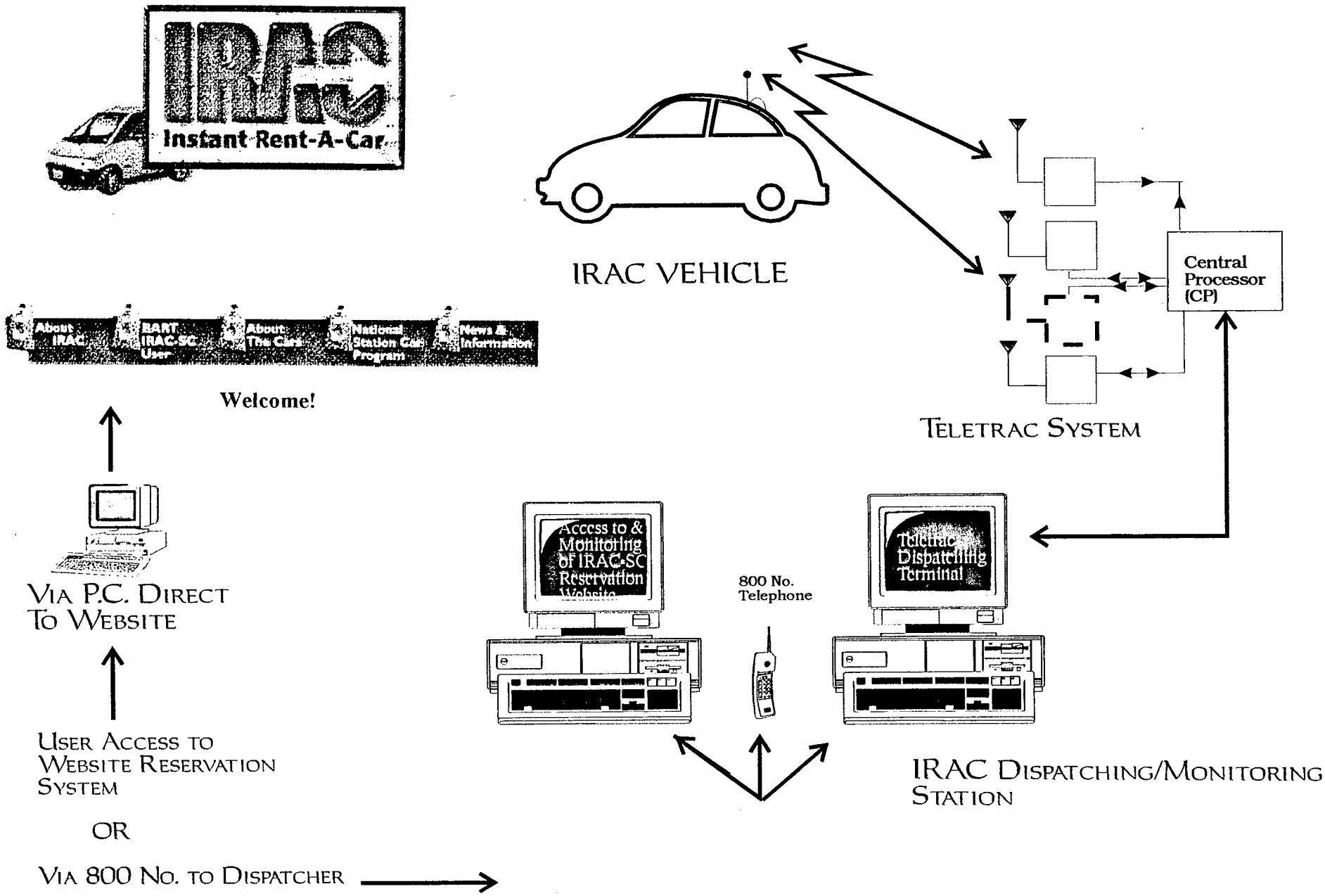


FIGURE 6-1: IRAC Operational System

USER MESSAGES (IN-BOUND)	DISPATCHER MESSAGES (OUT-BOUND)
UPON ENTRY **Canned Messages (CM) - (40 available)** Battery Charge, CMI ⧖ CM 10 Purpose of Trip, CM11⧖ CM17 **Formatted Messages (FM-5 available)** User ID. FM-1 Odometer Reading FM-2 **UPON EXIT** Battery Charge, CM 1 ⧖ 10 Odometer, FM ⧖ 2 **EN ROUTE** CM and FM messages as needed	**PRIOR TO ENTRY** Canned Messages (40 available) Please enter the following data ___ ____ ____ CM-1 **EN ROUTE/ZONE OF COMPLIANCE** Canned, formatted (5 available) or Free Text (unlimited) messages sent At dispatchers discretion, depending on in-bound messages received, vehicle location, etc.

Figure 6-2: Possible message traffic between vehicle and dispatcher.

1. Purpose

To provide a feasibility demonstration of a smart card system for:
Enabling ignition of a rental vehicle; and
Performing a series of simulated payment transactions using a smart card for the car rental charges.

2. General Requirements

A smart card is inserted into a reader on an office PC/laptop (not located near the car), wherein the computer provides a display of information about the dollar amount currently available on the card and the ability to add additional "cash."

The smart card is inserted into a reader mounted in the vehicle for purposes of enabling vehicle starting system and effecting rental payment. If authentication takes place and funds are available, the car's starter is enabled. The card remains in the interior reader throughout the journey. Money is periodically deducted from the balance on the card while the smart card is in the reader and the car ignition is enabled.

After removal from the reader on the car, the in-car controller disables the starting system of the car and awaits the next insertion of a smart card.

3. Specific Demonstration Requirements

After insertion of a smart card into vehicle reader, the user enters a PIN. The controller responds to a correct PIN by changing the state of a high-current relay normally interrupting the function of the car's starting system to "on". This relay remains "on" for as long as the smart card remains in the reader.

Display functionality will include: a prompt for insertion of a smart card into the interior reader, a prompt to retry after incorrect PIN entry, and a status message stating that the ignition has been enabled (after correct PIN has been input).

Mock-up of electronic purse function as follows:

- After ignition is enabled, the user is presented with a display of the amount of money remaining in the smart card.
- While the ignition is enabled, the balance of the electronic purse decrements at a rate of $0.xx per minute.
- After card is removed, the controller reverts to the prompting state.

LLC completed this system in time for a successful demonstration in the first week of March 1998, which took place at the offices of Keith Gates, ITS-IDEA program manager and Selwyn Berg, Transit-IDEA program manager. This demonstration proved the feasibility of using smart cards to instantaneously grant physical access to IRAC vehicles; and to substantiate with a high degree of confidence (whether via the familiar PIN or other advanced means) the identity of the user already granted access to the vehicle. It also showed that the IRAC system need not approve each use from a centrally-maintained database with its attendant communication delays, capacity issues (e.g., rush hour or mass transportation unit's arrival at an mass transportation), safety issues, and communications reliability / availability issues. In addition, this demonstration proved that a smart-card access and payment system is small and inexpensive enough to be incorporated in intermodal transportation systems such as the IRAC vehicles.

VII. MARKETING STRATEGY DESIGN

A. Selection of Target Markets

CFI has chosen to focus all of its efforts on a concentrated marketing design. Within this design, CFI will serve the two target segments previously outlined: commuters who currently drive alone, but who *could* ride transit; and welfare-to-work program participants who qualify to ride transit.

This focus will enable CFI to best utilize its currently limited resources. Although the customers will be purchasing the service through the transit authority, CFI chooses to concentrate on satisfying the needs and wants of these customers before pursuing other markets. As additional funding becomes available, optional markets will be further investigated.

B. Marketing Objectives

To introduce a new method of technologically-supported transportation in adjunct to mass transit (heavy rail, light rail, ferries) which enables mass transit to be used more effectively.

C. Design of a Marketing Program Strategy

1. Product/Service

CFI will provide an intermodal alternative to single occupant auto use in order to increase mass transit ridership. In order to accomplish rapid integration, CFI is creating a public-private partnership which will result in the IRAC system. The partnership is described below. Within this framework, each partner will have a specific role, although each may also have individual company goals. The following scenario is envisioned.

CFI will contact a metropolitan transit authority, such as the Bay Area Rapid Transit (BART) or Washington METRO and establish the transit authorities' desire to participate in the program. It is necessary to stay within a metropolitan area because these areas provide the demographic and sociographic needs for the success of system. Also, if a radio frequency tracking system would be used, it is usually limited to metropolitan areas.

CFI would make presentations and provide educational material to the transit authority and the general public being served. Through surveys, interviews (both with the public and with corporations), focus groups and sampling, CFI would determine the potential demand for that area and at which stations demand would be highest.

After the initial demand is estimated, CFI would enter into a 1-year contract to complete the integration and coordinate the facilities and partnerships. Within this year, they would also complete the initial phase of the educational task of informing the public, industry and transit authority and setting up the initial user base.

Thereafter, CFI would be retained by the authority on a yearly basis to maintain the user base, maintain use of the web site and to provide labor for the on-going education/promotional efforts.

CFI will form an exclusive partnership with an automobile fleet operator, in anticipation of future contracts, outside of the initial contract with the transit authority. This fleet operator could be one of several entities including either an independent or national auto rental agency.

The fleet operator will be the provider for most of the capital costs of startup, although none of these costs are outside of their usual line of business. These capital costs consist of automobiles, the purchase of the tracking system (described next) and the provision of a small (100 sq. ft.) operator building on the transit authority premises (land provided by the transit authority).

The operator will operate and maintain the vehicles within their normal line of business. A wide array of vehicles will be provided, such as: electric vehicles, light trucks, sedans, compacts and luxury classifications.[40] It is important that various types of vehicles are available to satisfy the possible needs or wants of the commuter.

CFI will also form an exclusive partnership with a vehicle tracking provider in anticipation of additional contracts. This could be a radio frequency tracking provider that has integrated communications equipment in their location devices. These devices are installed into the vehicles and consist of a user interface touchpad and screen.

For example purposes, we will discuss the Teletrac system. Their system works similarly to GPS, except that it is inverse: the radio devise installed within the car sends signals *out* to the radio towers allowing location instead of a satellite sending a signal *in* to an AVL device. Teletrac will sell, install and, for a monthly fee of $40 per vehicle, maintain and operate this equipment for the fleet operator. Teletrac's retail price for the system and installation is $900, although it is possible, through negotiation, that the price could be reduced for volume.

When all of the partnerships are in place—the transit authority, the vehicle tracker and the fleet operator—CFI will begin making contact with the users. Various forms of media will be used to ensure that people with various learning styles can be reached and the market penetrated and transformed. This multi-modal information transfer will consist of educational endeavors in the form of:

- web site database enrollment which will match users with similar commute patterns for potential carpooling;
- an educational CD-ROM; and
- a brochure, distributed at public relations demonstrations and tradeshows.

As with any product that is difficult to explain or needs a "hands-on" approach to inform the public, CFI will provide "sampling" of the vehicle at the demonstrations. Sampling

will also be made at various high potential user bases, such as corporations or business parks.

In this context, sampling means to' allow industry or individuals to test drive the vehicle. This allows the potential user to ask questions about particular features and would give them a feeling of potential ownership.

After the informational promotions, the persuasive promotions will begin. Billboard advertisement and direct mailings are just two of the possible avenues.

Next will come the selection process. Users with similar patterns will be matched, and schedules will be made to arrive at the highest number of users per car, per day. It is estimated that at a corporation with three shifts, subscribers could complete 6 trips per day and occasional users could complete 3. This allows for 9 uses per day, effectively eliminating 3 full-time vehicles.

2. *Channels of Distribution*

Rapid changes in all marketplaces have made distribution issues particularly important. With the introduction of the internet, more knowledgeable and sophisticated consumers, and rapidly changing technology, distribution can be made through many non-traditional channels. The methods of distribution will be vital for the success of the IRAC product.

Initially, the IRAC system will be distributed to consumers through selected metropolitan transit authorities. The means for selection will be on the following basis:

- authorities that have the ability to assign available funding, which is necessary to explore technological advances aimed at improving ridership;
- authorities that can change parking practices (from traditional to queues) and assign space for the operational facilities (which will be minimal, approximately 100 sq. ft.); and
- authorities that exist in metropolitan areas.

Transit authorities will be responsible for the following elements of the IRAC system:

- provide area for parking queue;
- provide any infrastructure required for electric vehicles; (Note: Unless the transit authority desires to have EVs as part of the fleet, low-emission vehicles or LEVs will be used as the primary operational vehicle.)
- install and maintain the smart card kiosks which will be the ultimate source of their revenue; and
- provide land for an operational facility.

CFI, as part of the initial startup, will be responsible for the following:

- market study
- education, information and persuasive tasks;
- pair users for commutes (home-end, work-end, carpools);
- maintain the web site and the 800 number; and
- gather user data.

Because the public may not be aware of the various options and applications available, or of the differences between technologies, but are highly sensitive to prices, CFI will provide the educational promotion tools to attract IRAC users. In this highly technological environment, it is important for the distribution channel to keep close contact with and provide continual education to the customer.

At the same time, CFI will educate their distributors (the transit authorities) who will, in turn, additionally inform the public. Since the IRAC system is relatively new and initially difficult to understand, it is important for CFI to step up their efforts to educate the distribution channels, not only on the usage of their own equipment and applications, but on how these applications can work with the software and equipment available within the system.

3. *Pricing*

Unlike a typical consumer product, the IRAC system pricing consists of several components. These components are:

- the price that the fleet operator pays for the in-vehicle communications/location system, installation and fee;
- the price that the transit authority pays to the fleet operator for the lease, maintenance and operation of the vehicles;
- the price that the transit authority pays to CFI for the market analysis, business plan, systems integration, and consulting; and
- the price that the consumer pays to the transit authority for the ability to travel intermodally without a personal auto.

4. *Promotion*

a. *Educational Tasks*

As mentioned in the channels of distribution explanation, there will be promotional activity designed for private industry (companies who would participate by encouraging their employees to use the station cars) and one for the public (to make them aware of the service—where it is and how it works).

Our objective is to provide educational information to the public so that they can make intelligent choices regarding transportation decisions. Development and the design of this educational campaign will be critical to the success of this venture. In order to influence behavior toward a more efficient, economic and environmentally sound transportation alternative, the public must be made aware that they are a critical part of the solution to our growing transportation problem.

Our educational efforts would be targeted to attract the attention of local media, policy makers, local businesses, and the selected target market which consists of welfare-to-work participants and single occupant auto drivers. Information to be supplied to the news media would include

the air quality and energy independence benefits of the program. The news media will be reached via news events and public relations news releases. Policy makers will be informed of the development of a new domestic job market and industry base, by way of forums, briefings, and written material. Local businesses would be informed of possible tax credits and an increased public image by using and supporting the program.

Specifically, CFI will send an informative, direct mail CD-ROM to corporations with a large employee population base that falls into our target market. In addition, CFI will be conducting continuous on-site demonstrations, not only for interested companies, but also for the general public. These demonstrations will be staged, public relations events that can serve as devices to keep the IRAC system in the eyes of the community.

Many promotions will be done in order to reach the target markets, as well as the general population. Participation in community activities such as Earth Day celebrations and auto shows will be helpful in increasing both awareness and knowledge of the program. In addition, CFI will be conducting demonstrations at these auto shows, where consumers will be able to touch the electric vehicles and gain a better understanding of the benefits of the system.

VIII. PRELIMINARY DEMAND, COST AND REVENUE ANALYSIS

A. Demand Forecast

In the exploratory research conducted by CFI, it was discovered that out of approximately 160 people approached to participate, 20 became actual participants. Of those, 8 participants (5%) were willing to pay for rental of the IRAC vehicle. We have taken this conservative approach and estimated a 5 percent demand within the target population which results in a provision of 3,000 vehicles for the pilot project.

In order to more accurately describe potential demand, the consumer "buy-in" is shown below. This buy-in comparison is designed to show the potential participant what they currently spend on auto ownership versus what they would spend on commuting and occasional use with the IRAC system.

B. Cost Comparison Between the Private Auto and the IRAC System

In making this comparison it is necessary to specify: an average commute via auto and/or the IRAC system; Other uses of the private auto used in the commute and/or the rental auto when not used in the commute; and the type of vehicle used, its retention cycle and miles driven per year.

The first assumption is that one IRAC at a suburban station will attract two additional customers (one home-end and one work-end) to BART. The first customer is a suburbanite employed in the city whose work site is within walking distance of a BART station. The second customer is a city resident living within walking distance of BART who is employed in the suburbs. The population density of San Francisco is such that approximately 6,000 residents are within convenient walking distance (1500') of each BART terminal. Therefore, an assumption is made that at least some portion of these residents would be members of the target market, either a commuter who doesn't use BART, but could, or a Welfare-to-Work participant.

The average BART commute trip is about 13-miles with a 4-mile average auto access, and walking egress. Therefore, these numbers are used in the IRAC system commute, and for the corresponding yearly auto commute as follows: the all-auto travel consists of 8,000 commute miles and 2,000 residential/ occasional miles for a total of 10,000 annual miles; and The IRAC vehicle system consists of 2,000 access miles, 2,000 egress miles, 3,000 residential/occasional miles and 3,000 work site rentals (corporations and employees) for a similar 10,000 annual miles.

The residential area rental could be used by the home-end user or shared between that user and others for weekend or evening use. For comparison purposes, the costs and savings associated with IRAC use are shown on Figure 8-1 and are summarized as follows (using $120 for the IRAC vehicle and $75 for BART):

IRAC system :	$2,340 yearly
Private Auto:	$3,430 yearly
Savings:	$1,100 yearly

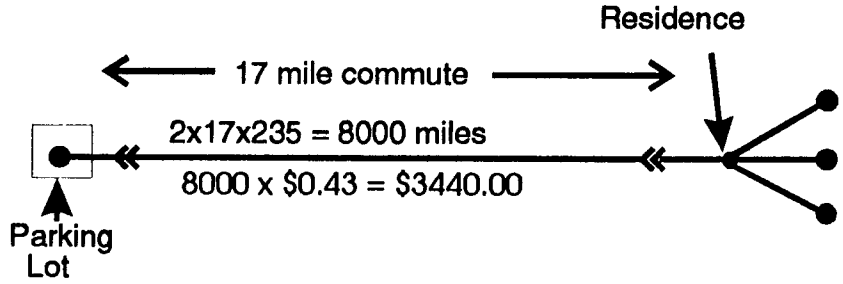
In addition the user can elect a car pooling arrangement which, based on the Harbor Bay test, can be readily arranged. This usage would have a monthly cost of $60.00 per user with a yearly savings of $1,840.00.

Also, if the work site rentals are split between employees and employers (one rental each per day) at $4.50 for each rental the total revenue is $180 per month. It can be noted in this connection that the CarSharing Organization of Portland, Oregon[41] has an average rental of three hours and 18 miles. Their current charges of $1.50/hour and $0.30/mile also result in an average rental charge of $4.50, plus $5.40 or $9.90.

Another scenario can be created regarding the secondary target market. An assumption is made that a significant number of inner city residents can walk to a BART station for transport to the suburbs. At the suburban station, these customers can car pool to a common work site in order to decrease commute costs.

Assuming three participants per IRAC, the individual cost per day for the commute would be the cost of the four mile work site access via an IRAC. The $120/month IRAC

Owned Auto

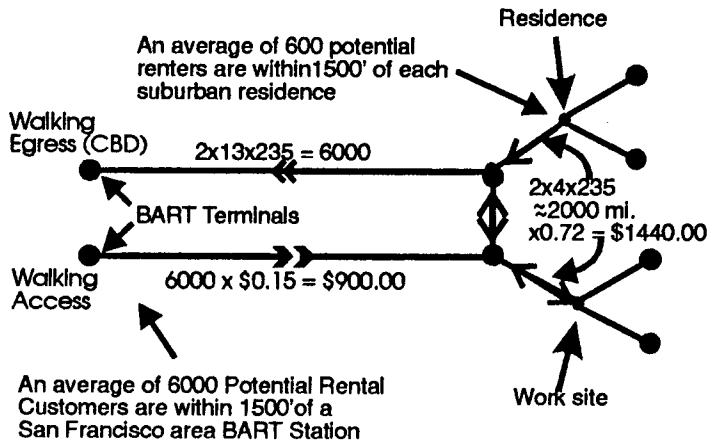


2000 miles
Residential Travel

$0.43 x 2000 = $860.00

TOTAL $4300.00

BART IRAC



Home End User - $90.00/month
Residential Area Use - $180.00/month
Additional Local Area Users - $90.00/month

Employee Use - $90.00/mo.
Work Site Area Use - $180.00/mo.
Company Use $90.00/mo.

IRAC Income

Commute 2 x 1440 =	$2880.00
Residential	2160.00
Work Site	2160.00
	$7200.00

3000 miles/yr of both Residential and Work Site Rentals - $0.72 x 6000 = $4320.00

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cost divided between three carpoolers is $40.00/month each. This is $2.00/day in contrast to owned auto commuting cost of $14.64/day. Since this scenario involves "selling" previously unused capacity under a Welfare-to-Work program, an assumption was made that the BART portion was free or very low cost.

These are just a few of the possible IRAC uses which provide a great deal of flexibility in terms of stated customer preferences These uses also provide a monetary savings incentive for commuters to participate in the IRAC system.

C. Analysis of Key Costs

1. Introduction

The costs of the IRAC systems to the various entities involved are based on the following price components: the price that the fleet operator pays for the in-vehicle communications/location system, installation and fee; the price that the transit authority pays to the fleet operator for the lease, maintenance and operation of the vehicles; the price that the transit authority pays to CFI for the market analysis, business plan, systems integration, and consulting; and the price that the consumer pays to the transit authority for the ability to travel intermodally without a personal auto.

The following provides an analysis of some of the key costs/key revenues, but not all of the details which allow for an accurate prediction of profitability for any of the partners except CFI. An assumption is made regarding the partners that since this systems integration project is simply an extension of their existing business, adequate profits would be made.

2. Assumptions for Key Costs and Revenues

Data on the "average" commute car, the average yearly mileage, and the division between commute use and other uses are not readily available, at least not to IRAC personnel, therefore assumptions have been made regarding that use and associated costs and revenues.

3. Methodology of Establishing Costs and Revenues for Auto Rental

In order to obtain an estimate of IRAC versus private auto use in the commute it was necessary to generate data on the cost elements for both individual auto ownerships and for conventional rental car operation. This methodology is further described in Appendix A.

Two sources of actual cost data were used along with the average percentage data on the individual cost elements of national auto rental organizations to establish the typical overhead rate of auto rental companies. The dollar value of AAA cost elements tend to agree with the corresponding dollar values of cost elements in the quotation provided by a national rental car organization. In addition, these two sources of dollar cost values tend to agree in percentage terms with the national percentages.

From this similarity in data, a number of assumptions were made as follows:

- that the cost of ownership was the same for private or fleet use and was about 50 percent of the total rental costs (overhead) and profit charged by national rental car companies;
- that the estimate of conventional rental overhead costs (including profit) was 100 percent of the cost of ownership;
- that an IRAC system would have less than a 100 percent overhead rate due to high automation (smart cards) and lower labor needs; and
- that BART would be getting significant additional income without a corresponding amount of expense due to increasing their low average load factor of 30.

Under these assumptions (a Ford Escort, 6 year retention cycle and 10,000 miles/year use), an arbitrary 60 percent overhead was used. Since, there is significant user savings to the IRAC system subscriber as well as significant additional income to BART, this cost analysis is quite favorable. When the analysis is combined with participant willingness-to-pay data, it is also very encouraging to the success of an IRAC system.

D. Vehicle Location/Communication Provider

The hardware/software utilized in a convenient auto rental system should provide: controlled access via use of a smart card or lifestyle card; a reservation system; and a vehicle location system as well as two-way communication between the vehicle and a central processor. The communication link should have some form of an in-vehicle messaging/display terminal and user interface.

The actual hardware/software envisioned at the IRAC inception (1970s) has changed greatly due to the dynamics of today's available electronics. Many different types of in-vehicle locating, tracking and communications equipment are readily available and very affordable.

Of specific current interest is the selection of the equipment that would be utilized to provide the requirements for the pilot test vehicle fleet and what equipment configuration might evolve for national implementation.

With respect to the Phase II vehicle fleet, it appears that the Teletrac system provided adequate capability in terms of the primary objective—to track the vehicles and discover user patterns.

In connection with the cost/profitability of operating a much larger national IRAC fleet, it was initially believed that a significant cost element would be the cost of amortizing and maintaining the in-vehicle electronics required for IRAC operation, i.e., the in-vehicle processor with display, location capability, radio access to a central processor, etc.

For example, while the installed cost of Teletrac equipment is less than $1,000 which, when amortized over a 5-year period is significant, is probably acceptable in terms of comparable vehicle costs. In contrast, the cost of $500 per year, per vehicle for Teletrac communication and location services is significant and less acceptable.

It is believed, however, that by the time enough data has been accumulated via a pilot test vehicle program, there will have been enough changes regarding in-vehicle electronics which would be installed for other purposes that the pro rata share of the cost of such electronics for IRAC purposes will not be a significant factor in overall fleet rental costs.

Specifically there are three large, separate, but related markets that are attracting private capital for the development of the hardware and software required to create/capture such in-vehicle electronics markets. Two of these markets are directly related to the in-vehicle electronics required for IRAC system use. The significance of this third market is that the cost and size of basic IRAC electronics is rapidly decreasing and the general availability of such capabilities are increasing.

This situation is outlined in Figure 8-2. Figure 8-2 (a) is a block diagram used in early IRAC reports to indicate common markets for IRAC in-vehicle-type electronics that are currently being pursued. Hewlett Packard, for example, is actively pursuing the on-the-move vehicle diagnostic market. Figure 8-2 (b) indicates that various large organizations, i.e., IBM, Intel, Microsoft, envision that the upcoming generation of automobiles can be viewed as a "personal computer on wheels," connected to the Internet, with vehicle location built-in as a standard feature.

Figure 8-2 (c) indicates that the dominant suppliers of cellular radios envision that future versions of such units will be a hand held computer with a display, (and probably GPS), in two-way radio communication to, among other terminals, the Internet.

In essence, the cost and size of mobile processing, display, communication and location equipment is decreasing at an increasing rate and its use expanding. It can be noted however, that the auto manufacturers do not necessarily agree with the IBM, version of a "PC on Wheels."

There are several implications to the IRAC program resulting from this trend. One is that the pilot test IRAC program should focus on user acceptance and fleet operating costs (other than the cost of the in-vehicle electronics) on the assumption that the IRAC pro rata share of such in-vehicle electronic costs are likely to decrease very significantly over the next decade.

E. Fleet Operator Key Costs and Revenues

Figure 8-3 provides an estimate of the costs and revenue for the fleet operator. It is assumed that the fleet operator would operate, maintain and fuel the vehicles involved. The vehicle revenue would be collected via the use of smart cards issued by BART at kiosks installed at BART stations. These preliminary figures show a potential profit of $814,800 for each of the first three years. This total does not take into consideration any other new or increased costs or additional revenue.

F. Transit Authority Key Costs and Revenues

The transit authority will benefit from the IRAC system based on the sales of unused capacity in the reverse commutes (city to suburb in the morning and suburb to city in the evening) that serve the target audience. Since the average load factor is a low 30 percent, BART will increase revenues without significant cost increases. (See Figure 8-4.)

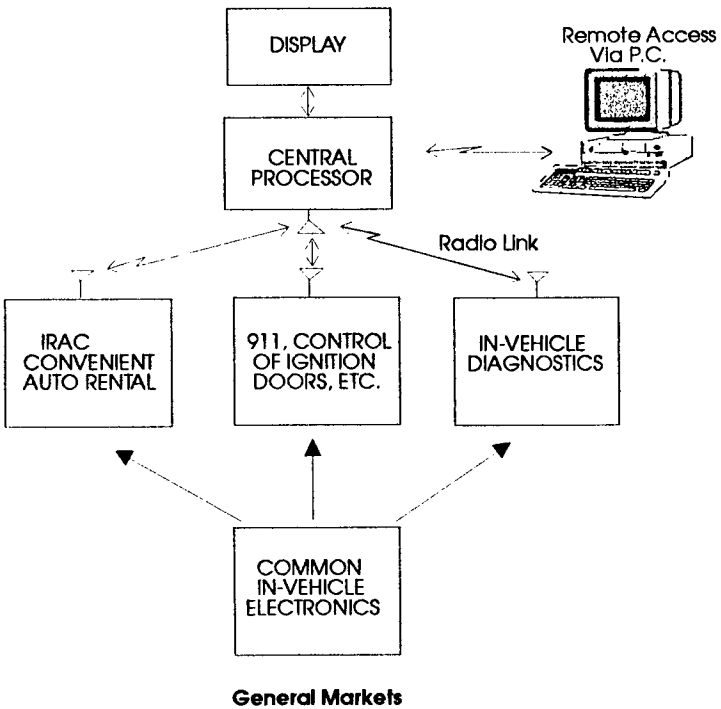
The potential profit from these preliminary figures is $4,543,341 for each of the first three years. This does not take into consideration new or increased costs or increased revenue over that period of time.

G. CFI Pro Forma

CFI will benefit from the sale of the marketing/business plan and implementation. The successful creation of the partnership will also establish CFI in the role of transit systems integration.

The potential profit from these preliminary figures would be $106,623 for the first year, $70,149 for the second year and $68,970 for the third year. (See Figures 8-5a, b, c.) Significant assumptions are listed in Figure 8-6.

During year one, CFI would actively seek the next location for an IRAC system. Upon completion of the tasks at the initial location, CFI would start on the next integration effort. For purposes of simplicity, the preliminary pro forma figures do not reflect any additional revenues or costs from the second, third or consecutive integration efforts.



(a) Common Markets for IRAC Type In-vehicle Electronics

The personal computer is making its move into the auto industry, and the result is a new definition of the automobile.

"We're incredibly busy around here," says Barbara Churchill at IBM, project manager for the Network Vehicle. "This is a worldwide effort," explains Mike Iannitti, market development engineer for the Connected Car PC at Intel. Kate Monberg, engineer at Visteon Electronic Systems, declares, "It is absolutely crazy here." And Perry Lee, product manager for the Auto PC at Microsoft, says, "People are excited. The buzz is growing louder."

The race has commenced for affordable ways to more fully engage our senses while we drive or ride in a car. By 2010 if not before, an integrated, mobile multimedia system, operated by powerful microprocessors integrating security, safety, entertainment, communications, and information, will be standard equipment in most vehicles. Pioneering efforts to bring the electronic environment of the home and office to the vehicle are being advanced by different consortia, each led by one of the Big Three — Microsoft, IBM, and Intel.

(b) Extract From Recent Article about the PC on Wheels

A Mobile-Phone Software Venture

LONDON, June 24 (Bloomberg News) — **Psion** P.L.C., a British palmtop computer company, is joining with **Nokia** of Finland, **Ericsson** of Sweden and **Motorola** — which together make 70 percent of the world's mobile phones — to develop software for mobile phones that behave more like computers.

The venture, called Symbian, is intended to surpass Microsoft Inc.'s Windows CE, now used in many palmtop computers, to become the standard operating software for mobile communication devices. Psion estimates the market could be worth $900 million by 2002.

The mobile-phone makers hope that Psion's Epoc software, which uses less power and memory than Windows CE, will give them an advantage in getting consumers to buy smart mobile phones rather than bulkier palmtop computers. The support of the three big mobile phone makers means that Epoc becomes the market leader in smartphone software.

David Potter, Psion's chairman and chief executive, said the company expected that within a few years, people would use smart phones and other mobile communicators to retrieve information.

(b) Recent Article about the Palmtop Radio/PC

FIGURE 8-2, a, b, c: Changing Electronic Content of the Auto and Expanding Market for Radios and PCs

IX. FUTURE VENTURE PERFORMANCE CONTROLS

A. Operational Performance Objectives

1. Multiple Use

The multiple user base will consist of the subscribers and occasional users of the system. Theoretically, the multiple use will occur in the following manner.

In the morning commute Subscriber A will drive the IRAC-SC vehicle, domiciled at their residence, to the nearest transit station. They will park the IRAC in the designated queue and board the light-rail train which will transport them to the station closes to their work site. Traveling from the opposite direction, Subscriber B's access will be occurring simultaneously and in the same manner. Each will arrive at their destination transit station and use the other's vehicle to travel to their respective work sites.

At the work site, the vehicle will be available for use by both company subscribers and occasional users (for another variation of multiple use, see Figure 8-1.) Thus the system operates in a multiple-use auto rental process.

2. Instant vehicle reservations

All users will have a personal identification number which will allow them to access the web site. New users will access the home page and then be required to fill out information on the "user information" page.

3. Smart Card System

The smart card system will provide the following controls:

- prohibitive entry. This feature would allow some measure of security not only for anti-theft, but so that only members of the system would be allowed access into the vehicle;
- PIN tracking, so that user data could be continuously collected; and
- payment method, so that when a current smart card and PIN are used, the payment for use is immediately subtracted from the card.

4. Tracking System

Teletrac's history, as an integral part of the PacTel network, established them as the best possible choice to provide communications equipment for the IRAC system. This electronics system, which is installed in each vehicle, employs a vehicle tracking device which will keep track of the location of each vehicle in the fleet. The control of the fleet's location is enabled through this radio communication system. Teletrac will allow the vehicles to be tracked and located in case of emergency, need of road-side assistance, and in the case of auto theft.

However, as in-vehicle electronics become a standard feature for new cars, the need for a separate tracking/communications equipment will be lessened, if not eliminated. CFI will continue to keep abreast of the in-vehicle electronic field and make the necessary changes for future systems integration packages.

5. Fleet Operator

For the Phase II operational test, a local EV operator was utilized to both lease and maintain the vehicles. This was satisfactory for a test situation, but the future operator choices will be restricted to established national fleet organizations because of the high visibility, professionalism and needed reliability for the public's acceptance of the program. Also, it may become necessary to choose a recognizable brand name operator, such as Enterprise or National Rent-A-Car to increase adoption by the consumer. The perception of the fleet operator's reputation will enable the IRAC system to benefit from brand association and credibility without the customarily massive advertisement expenditure.

B. Information Control and Feedback Plan

CFI will implement several different control procedures to insure that current objectives are being met. These will include, but are not limited to the following:

1. In-vehicle survey forms

Short surveys will be located in the vehicles for users to fill out. Through these surveys we will maintain contact with the users and ensure that our program adequately fits their needs.

2. Web site surveys

A user survey will be integrated into the web site. The survey will allow CFI to gain information on potential and current users and their respective beliefs about the system. In addition, a comments page is available on the web site.

3. Random surveys

Random surveys will be distributed to households and businesses in the Bay area on a continual basis. The objectives of these surveys are to find out how aware the general public is of the program and attitudes and opinions about the program. In addition, these surveys would allow CFI the ability to create a database of interested potential users. Direct mailers could be sent to these consumers via the local utility bill mailings.

	Cost per Unit	Revenue per Unit	Number of Units	Cost per Month	Revenue per Month	Cost per Year	Revenue per Year
Vehicle Cost of Ownership	$283		3000	$849,000		$10,188,000	
In-Vehicle Electronics*	$900		3000	$45,000		$540,000	
Communications	$42		3000	$126,000		$1,512,000	
Fuel - Maintenance	$66		3000	$198,000		$2,376,000	
Buildings**	$20,000		10	$4,100		$49,200	
Overhead	$170		3000	$510,000		$6,120,000	
Lease of Vehicles to Transit Authority		$600	3000		$1,800,000		$21,600,000
TOTAL				$1,732,100	$1,800,000	$20,785,200	$21,600,000

* Depreciated over 5 years.

** Depreciated over 5 years including finance charges.

FIGURE 8-3 Fleet Operator Key Costs and Revenues

	Cost per Unit	Revenue per Unit	Number of Units	Cost per Month	Revenue per Month	Cost per Year	Revenue per Year
Vehicle Lease	$600		3,000	$1,800,000		$21,600,000	
Purchase of Smart Card Kiosks	$20,000		10	$3,333		$40,000	
Kiosk Maintenance Personnel (per hour)	$25		167	$4,166		$49,992	
Marketing Plan**				$13,889		$166,667	
Promotion/Education**				$41,667		$500,000	
Retainer**				$8,333		$100,000	
Subscribers (3000 x 2 users)		$120	6,000		$720,000		$8,640,000
Occasional - Additional Rentals		$180	6,000		$1,080,000		$12,960,000
Additional BART Income		$75	6,000		$450,000		$5,400,000
TOTAL				$1,871,388	$2,250,000	$22,456,659	$27,000,000

* Five-year depreciation including cost of financing.

** Averaged over 3 years - see CFI Pro Forma.

CFInternational

Income Statement For Years Ending Dec. 31, 1999 Through Dec. 31, 2001

	1999	2000	2001
INCOME			
Marketing/Implementation Plan	$500,000	$0	$0
Retainer	$0	$150,000	$150,000
Promotion/Education Implementation	$750,000	$500,000	$250,000
Capital Investment	$60,000	$60,000	$60,000
TOTAL INCOME	$1,310,000	$710,000	$460,000
EXPENSES			
Accounting	$1,000	$1,050	$1,103
Air Fare	$15,000	$3,938	$4,134
Auto Mileage	$3,100	$814	$854
Auto Rental	$15,000	$3,938	$4,134
Business Tax	$180	$180	$180
Corporate Fees	$85	$85	$85
Equipment	$3,000	$3,000	$3,000
General Reserve	$20,000	$20,000	$20,000
Internet	$900	$945	$992
Lodging	$51,000	$13,388	$14,057
Mail Expense	$1,200	$1,260	$1,323
Meals & Entertainment	$24,000	$6,300	$6,615
Office Expense	$1,000	$1,050	$1,103
Parking Fees	$500	$131	$138
Payroll Taxes	$55,000	$17,500	$17,500
Promotion & Education Campaign	$700,000	$450,000	$200,000
Telephone	$10,000	$3,500	$3,675
Wages	$220,000	$70,000	$70,000
Web site & upgrades	$25,000	$5,000	$5,000
TOTAL EXPENSES	$1,145,965	$602,079	$353,893
NET INCOME BEFORE TAX	$164,035	$107,921	$106,107
Income Tax	$57,412	$37,772	$37,137
NET INCOME	$106,623	$70,149	$68,970

FIGURE 8-5a CFI Pro Forma – Income Statement

CFInternational
Balance Sheet
For Years Ending Dec. 31, 1999 Through Dec. 31, 2001

	As of 12/31/99	As of 12/31/2000	As of 12/31/2001
ASSETS			
Cash	$166,623	$130,149	$128,970
Equipment	$0	$0	$0
TOTAL ASSETS	$166,623	$130,149	$128,970
LIABILITIES	$0	$0	$0
TOTAL LIABILITIES	$0	$0	$0
EQUITY			
Paid in capital	$60,000	$60,000	$60,000
Retained earnings	$106,623	$70,149	$68,970
TOTAL EQUITY	$166,623	$130,149	$128,970
TOTAL LIABILITIES AND EQUITY	$166,623	$130,149	$128,970

CFInternational
Statement of Cash Flows
For the Years Ended Dec. 31, 1999 Through 2001

	Year 1	Year 2	Year 3
OPERATING ACTIVITIES			
Net Income (Loss)	$106,623	$70,149	$68,970
Depreciation	$0	$0	$0
Cash flow from operations	$106,623	$70,149	$68,970
FINANCING ACTIVITIES			
Proceeds from Investors	$60,000	$60,000	$60,000
Cash provided by financing	$60,000	$60,000	$60,000
NET CASH FLOW	$166,623	$130,149	$128,970
Beginning cash balance	$0	$0	$0
Ending cash balance	$166,623	$130,149	$128,970

FIGURE 8-5c CFI Pro Forma – Cash Flow

The following is a list of assumptions that are made regarding this document and the CFInternational Pro Forma Statement.

1. Purchase, by a transit authority, of the Market Study/Business Implementation Plan for $500,000. This cost is based on the fact that this first sale would be a beta trial and will set the benchmark for future sales of the program.

2. Consulting contract, for year two and year three, with the transit authority for one employee. This maintenance contract would be for $150,000 per year.

3. Expenses for CFI will increase by 5% per year.

4. The transit authority would have sufficient monies to allow an intense advertising/educational effort (print, billboard, corporate seminars, etc) at the cost of $750,000 for the first year, $500,000 the second year, and $250,000 the third year. Future educational needs would be determined at that time.

5. CFI's plan is based on a partnership between an auto rental agency and a transit authority, with consulting assistance from CFI.

6. The auto rental agency would be willing to put 3,000 vehicles into this operation, build a concession building at each of 10 stations.

7. The transit authority would authorize use of land and permission to build a concession building or trailer and allow for the vehicle parking queue to the auto rental agency.

8. Subscription use of the IRAC system would be accepted and paid for by home-end, work-end, and corporate users.

9. Occasional use would be accepted at the cost of $5 per hour by a sufficient number of users.

10. A fuel source for the vehicles would be readily available or attainable.

FIGURE 8-6: Summary of Significant Assumptions

4. Number of hits from informational IRAC web site.

This tool would allow us to track the number of consumers who access our site. CFI would analyze these numbers in order to find trends of consumer interest and awareness.

5. Feedback from paid operators of the system

Teletrac, combined with the smart card information, will provide extensive information on the travel patterns of the various users. With this information, CFI will be able to better estimate the time of travel for each user's trip and better control any overlap of use, resulting in control of user dissatisfaction.

C. Promotion

1. Educational Tasks

There will be push-pull promotional activity designed for private industry (companies who would participate by encouraging their employees to use the station cars), and one for the public (to create awareness of the service—where it is and how it works).

Our objective is to provide educational information to the public so that they can make intelligent decisions regarding transportation choices, which will in turn, create awareness of the IRAC partnership. Development and the design of this educational campaign will be critical to the success of this venture. In order to influence behavior and transform the market toward a more efficient, economic and environmentally sound transportation alternative, the public must be made aware that they are a critical part of the solution to the growing transportation problem.

CFI's educational efforts would be targeted to attract the attention of local media, policy makers, local businesses, and the selected target market, which consists of welfare-to-work participants and single occupant auto drivers. Information supplied to the news media would include the many benefits of air quality and energy independence. The news media will be reached via news events and public relations news releases. Policy makers will be informed of the development of a potential new domestic job market and industry base, by way of forums, briefings, and written material. Local businesses would be informed of the possible tax credits and increased public image which would occur as a result of utilizing and supporting the program.

Specifically, CFI will send an informative, direct mail CD-ROM to corporations with a large employee population base that falls within our target market. In addition, CFI will be conducting continuous on-site demonstrations, not only for interested companies, but also for the general public. These demonstrations will be staged, public relations events that can serve as devices to keep the IRAC system in the eyes of the community.

Many other promotions will be done in order to reach the target markets, as well as the general population. Participation in community activities such as Earth Day celebrations and auto shows/trade shows will be helpful in increasing both awareness and knowledge of the program. In addition, CFI will be conducting demonstrations at these auto shows, where consumers will be able to come in direct contact with the equipped vehicles and gain a better understanding of the benefits of the system.

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APPENDIX A

Establishing Costs and Revenues for Auto Rental

Driving Costs

Details of Car Costs 1996 Ford Escort LX/4-cycle (1.9 liter)/4-door Hatchback	
Operating Costs	**Cost Per Mile**
Gasoline and oil	4.5 cents
Maintenance	2.6 cents
Tires	0.9 cents
TOTAL	**8.0 cents**
Ownership Costs	**Costs Per Year**
Comprehensive insurance ($250 deductible)	$161
Collision insurance ($500 deductible)	$309
Bodily injury and property damage ($100,000, $300,000, $50,000)	$426
License, registration, taxes	$180
Depreciation	$2,710
Finance charge (20% down; loan @ 9%/4 yrs.)	$579
TOTAL (or $11.96 Per Day)	$4,365
Depreciation for excess mileage per 1,000 miles over 15,000 miles annually	$141
Cost per Mile	
Based on the above figures, the motorist driving 15,000 miles a year would pay:	
15,000 miles @ 8.0 cents	$1,200
*365 days @ $11.96	$4,365
TOTAL	$5,565
Cost per Mile	**37.1 cents**
The same person driving 20,000 miles a year would pay:	
20,000 miles @8.0 cents	$1,600
365 days* @$11.96	$4,365
Added depreciation per 1,000 miles over 15,000 miles @$141	$705
TOTAL	$6,670
Costs per Mile	**33.4 cents**
The same person driving 10,000 miles a year would pay:	
10,000 miles @8.0 cents	$800
365 days** @$9.81	$3,580
TOTAL	$4,380
Cost per Mile	**43.8 cents**

* Ownership costs based on a 4-year/60,000-mile retention cycle.
** Ownership costs based on a 6-year/60,000-mile retention cycle.

AAA Data

National Averages Shown as Percentages
1996 Minimum Objectives

Expense Description	Percent of Revenue
Vehicle Tags	0.4
Vehicle Interest	9.9
Vehicle Depreciation	33.1
Vehicle Sales Gain	-1.0
Total Unit Expense	42.4
Gas, Oil Wash (Net)	-0.2
Maintenance, Tires	1.3
Damage (Net)	0.4
Miscellaneous Operating	0.6
Vehicle Insurance	7.0
Telephone	0.7
Office Supplies	0.6
Credit Card Commission	2.2
System Fees a)	4.0
Total Direct & Variable	16.6
National Advertising	2.7
Local Advertising, Sales, Reservations, Commissions	5.2
Total Sales	7.9
Salaries & Wages b)	14.5
Payroll Tax, Benefits, Uniforms	2.2
Total Personnel	16.7
Rent c)	4.0
Other Occupancy/Utilities	1.5
Total Occupancy	5.5
Non-Vehicle Interest and Insurance, Bank Charges, T&E, Professional Fees, Misc. General & Administration	2.1
Total Expenses	91.2
Net Profit Before Tax	8.8

(a) Will vary depending upon.
(b) Per car fixed costs such as off-airport rent and permanent staff payroll will vary depending on size of operation.
(c) Varies based on airport or off-airport operation.

Informal Quotation from a National Rental Car Organization for a 100 Car Fleet at a BART Terminal.

"Enclosed are the cost estimates that I feel would be more accurate for this type of a program based on 100 Geo Metros that would be used for the station car program."

MONTHLY EXPLANATIONS

A) **MONTHLY DEPRECIATION:** The monthly depreciation of $217 is based on a depreciation factor of 2% of the actual cost of the vehicle. When calculating the cost of a 1996 4-cylinder Geo Metro LSI 4-door, which would include air conditioning, automatic transmission, California Emissions and AM/FM radio, the cost totaled $10,857.

B) **INTEREST EXPENSE**: I have expensed interest on the outstanding balance at 8.5%, which is 1% over the prime interest rate.

C) **LICENSE COSTS:** The anticipated annual cost of licensing fees would be $230 per year.

D) **INSURANCE RESERVE:** This would include the reserve for collision/comprehensive and liability costs involved in this type of a program. The cost analysis of $80 per unit is on the very, very low side, and I took into account the fact that many of these drivers will be going short distances and do work in the vicinity of the station car base office.

E) **PERSONNEL EXPENSE:** In order to run an efficient, service-oriented type station car program, it would require approximately 25 cars per employee, and we would look to staff this type of an operation with a minimum of four employees. I have included a cost based on a monthly salary of $2100 to $2200 per month, and an allocation of $300 per month for employee benefits.

(F) **FUEL AND MAINTENANCE:** I have used your number that was given.

G) **RENTAL FORMS, FURNITURE DEPRECIATION, TELEPHONE, MISCELLANEOUS EXPENSE:** I have included a cost of $100 per month for basic depreciation of office furniture, rental forms, telephone usage, and other miscellaneous items that are normally found in any office setting.

a)	monthly depreciation 2%	=	$ 217.00
b)	interest @ 8.5%		59.00
c)	license ($230/year)		20.00
d)	insurance reserve (coll & comp)		80.00
e)	personnel expense (4 emps @ $2500/mo)		100.00
of)	fuel/maintenance		75.00
g)	rental forms/furniture/telephone		100.00
			$651.00/month
	profit		(?)
	lease of space		(?)

Comparison of Cost Data Used to Establish
Overhead Rate of Rental Car Organizations

Cost of Ownership	AAA	National Auto Rental Company Quote	National Average	
			Dollars	Percent
Depreciation	$2,700	$2,604	$2,652	33
Cost of Money	$579	$708	$644	10
Sub Total	$3,279	$3,312	$3,296	43
Comprehensive Insurance	$161			
Collision Insurance	$309			7
Bodily Injury Insurance	$426			
License, registration, taxes	$180	$1,200		0.4
TOTAL	$4,355	$4,512	$4,434	50
Rental Operation Overhead				
Personnel		$1,200		16.7
Office Supplies				0.6
Credit Card Commission				2.2
System Fee				4.0
Utilities				1.5
Telephone		$1,200		0.7
TOTAL		$2,400		
Rent				4.0
Misc. Expenses				4.0
NET PROFIT (Pre Tax)				8.8
TOTAL				100%