U.S Department
of Transportation

Research and
Special Programs
Administration

Case Studies of Market Research for Three Transportation Communication Products

March 1994

Prepared by:

Thomas R. Parish

Arthur D. Little, Inc.
Cambridge, Massachusetts

Prepared for:

Economic Analysis Division
John A. Volpe National Transportation Systems Center
Cambridge, Massachusetts

and

Office of Policy Development
Federal Highways Administration
Washington, D.C.

FOREWORD

The following is one of a series of papers developed or produced by the Economic Analysis Division of the John A. Volpe National Transportation Systems Center as part of its research project looking into issues surrounding user response and market development for selected Intelligent Vehicle-Highway Systems (IVHS) products or services. The project, sponsored by the Federal Highway Administration's Office of Policy Development, was one part of FHWA's 1992 Institutional Issues Program entitled – "Public Acceptance and Markets for Various Consumer IVHS Services". John O'Donnell of the Volpe Center and James March of FHWA served as Project Managers for their organizations.

The objective of the Volpe Center project was to better understand factors affecting the development and deployment of selected advanced traveler information products and services (ATIS). The Center addressed the objective by examining the development of markets for selected ATIS-related products and services and reviewing factors affecting the public acceptance and user response to existing traffic information services.

Deployment of many of the newly emerging and projected M-IS products and services will depend upon consumers purchasing and otherwise choosing to make use of advanced traffic and travel information products and services. Through four different projects, each with a distinctive approach to understanding consumer response and market demand, the Volpe Center explored the question: Given the opportunity to buy a product or subscribe to a service that promises to deliver traveler information, will the consumer perceive that there is sufficient benefit to be gained to justify the investment?

The Volpe Center and FHWA jointly conducted a workshop in the Fall of 1992 to discuss issues involved with assessing the market for IVHS products and services. The objectives of the workshop were to help define a research program which would address measuring user acceptance and response to ATIS products and services and the role market research plays in understanding emerging markets for new or unknown products and services.

The results of the workshop are reflected in the four research tasks initiated as part of this program and the seven papers which comprise it. The four task areas are summarized below. Copies of the papers will be provided upon request to the Volpe Center.

TASK 1. Industry Methods for Assessing Consumer Response to New Products/Services

The first project was designed to answer the question of how consumer response and market demand are measured in the commercial sector, where these market demand questions are fundamental to the survival and success of the business. This project has two parts. The first is a primer on how consumer marketing research is done in the commercial sector. The second presents three case studies that examine how three current high-technology communications and travel products applied marketing research in preparation for market release.

Report 1A. *A Primer on Consumer Marketing Research: Procedures, Methods, and Tools*

The Volpe Center developed a marketing research primer which provides a guide to the approach, procedures, and research tools used by private industry in predicting consumer response. The final two chapters of the primer focus on the challenges of doing marketing research on "revolutionary" products, or those products which the consumer has had no direct experience with, as is the case with most IVHS products and services. This primer was designed to provide the non-marketing researcher with a good understanding of how this particular type of human behavior research is pursued.

Report 1B. *Case Studies of Market Research for Three Transportation Communications Products: Electronic Toll Collection, Advanced Vehicle Information and Location, and Cellular Telephones*

Three case studies were undertaken to demonstrate the application of marketing research to products which are analogous to ATIS products and services, to learn from the market experience of these three ATIS-analogous products any lessons which might be applicable to future ATIS research, and also to demonstrate the uncertainty - despite good research design and assumptions - of marketing research predictions. The case studies were written by Thomas Farish of Arthur D. Little, Inc.

TASK 2. ATIS Market Research: A Survey of Operational Tests and University Research

The challenge of marketing research is much more difficult where the consumer has not had direct personal experience using the proposed product in daily life. The operational tests provide an excellent opportunity for gathering consumer response and market demand information from "experienced" consumers. The Volpe Center team surveyed the operational tests that were extant or complete (as of 8/93) to learn whether any consumer response/market demand information had been collected and

analyzed. The survey was extended to include government-sponsored university research projects so as to provide a more complete overview of the current national research program in relation to this question.

TASK 3. *A Market Analysis of the Commercial Traffic Information Business*

What kind of traffic information is available to consumers right now? How do consumers respond to current offerings? What are the market/economic fundamentals that underlie this market?

The traffic information services business is well-established and a study of its market fundamentals yields insight into consumer response to ATIS as well as providing useful information to policy makers who are considering the future role of government in this arena. This report describes how traffic information is gathered, processed, packaged, wholesaled, and retailed on the variety of platforms which are available on the market today.

TASK 4. Laboratory Simulation of ATIS for Testing Drivers' Response

This project was formulated to explore the feasibility of enhancing existing laboratory or PC-based driver decision simulators which have the ability to gather revealed preference data and test drivers' decisions in the presence of traffic information. Such simulators, it was hypothesized, could supplement operational tests as a source of consumer response and market demand data. The work was performed at MIT under the leadership of Professor Moshe Ben-Akiva.

Report 4A. *State of the Art of ATIS Driver Simulators*

The project was divided into three parts. The first, covered in this report, reviewed all existing driver simulators to learn whether any were sufficiently sophisticated to be used, as is, to reliably test drivers' response to traffic information.

Report 4B. *A Review of ATIS Operational Tests*

The design of any laboratory-based simulator is based upon a model of how individuals respond to stimulus, in this case ATIS products. To construct a model, one must first study the natural behavior of live subjects in an actual ATIS driving situation. Report 4B looks to the existing and completed ATIS operational tests to learn whether data has been produced that is suitable for the purposes of developing or improving ATIS models.

Report 4C. *A Modeling Framework for User Response to ATIS*

This report focuses on the information required to support the development of a modeling framework for driver response to ATIS. In it, the author identifies the stages of user response to ATIS, outlines the key factors associated with each decision, and discusses the data which would be required to complete the model, and thus construct a reliable, durable driver simulator.

Table of Contents

List of Figures

Introduction

Background

This report completes a two-part project in support of the Volpe Center program, "Public Acceptance and Markets for Various IVHS Services." The first report, "A Primer on Marketing Research," provides an overview of the research approaches and methods used by the private sector to assess potential market response to new and innovative products. This second report builds on the first by presenting case studies which describe the actual approach and methods used to assess the market for three innovative transportation communications products. In combination, these two reports illustrate some of the market related complexities which confront new "high tech" products of unproven consumer utility.

Market research is a central tool in the development of both new and existing markets. At its core, the objective of market research is to better understand the potential customers for a given product in order to guide product development and reduce the financial and technical risk of entering that market.

Using the appropriate type, timing and amount of market research is critical for two primary reasons:

- First, if used correctly, market research's primary objective is to reduce the risk of entering a new market. Conversely, incorrectly used market research can in fact increase the market risks.

- Second, market research itself represents a significant investment (See Figure 1). If used correctly, this investment can pay back several times in reduced product development expense and in improved market acceptance.

Objective

The objective of this study is to assist the FHWA to better understand how market research is used in the private sector to predict consumer and market response to new and innovative products. This objective will be met by providing illustrations and examples of market development and market research used by existing products/services that are analogous to ATIS. The lessons learned from the case studies will allow FHWA to gain the most value from market research undertaken in support of ATIS.

The types of issues addressed in the case studies include:

- What methods were employed to identify and assess market demand for new products?
- What critical issues were addressed in each product/market?
- What market projections were made and how accurate were those projections?
- What lessons from these products/markets can be applied to ATIS?

Figure 1. Survey Research: Illustrative Studies and Pricing Parameters

Simple Mail	Moderately Complicated Mail	Complicated Mail
• 500 Completes • Easy-to-reach population • Appealing topic • 40 Questions • Basic tables • Summary report	• 800-1,000 Completes • Hard-to-reach population • 60+ Questions • Tables with extra banners • Limited advanced analysis • Summary report	• 800-1,000 Completes • Hard-to-reach population • Difficult sampling issues • 60+ Questions • Extensive tables • Extensive analysis • Summary report
Price Range: $20,000 - $35,000	Price Range: $35,000 - $65,000	Price Range: $65,000 - $175,000
Simple Telephone	**Moderately Complicated Telephone**	**Complicated Telephone**
• 500 Completes • Easy-to-reach population • Appealing topic • 20 Minutes · Basic tables · Summary report	• 800-1,000 Completes • Hard-to-reach population • 30 Minutes • Tables with extra banners • Limited advanced analysis • Summary report	• 800-1,000 Completes • Hard-to-reach population • Difficult sampling issues • 30 Minutes • Extensive tables • Extensive analysis • Summary report
Price Range: $25,000 - $45,000	Price Range: $45,000 - $80,000	Price Range: $80,000 - $200,000

Actual costs are determined by detailed specifications concerning issues such as number of completed interviews, sampling, population surveyed, cooperation rate, interview length and complexity, and analyses to be performed.

Introduction

Case Study Selection

Three products were selected for case study development:

- Electronic Toll Collection (ETC)
- Cellular Phones
- Automatic Vehicle Identification and Location (AVI/L)

The primary objective of the case study selection process was to identify those products/services that are analogous to emerging ATIS products and services, and therefore, could offer the most relevant lessons for ATIS. To meet this objective several selection criteria were used:

Service ***similarity*** to ***ATIS and related IVHS products*** - All of the selected products are closely aligned to ATIS in the characteristics of the service the provide:

- They all require that customers place a significant value on time, as in many ways the primary service is time saving.
- Communications plays a key role in all of the case study products.
- Improved traffic flow and logistics is an expected output of all of the case study products.
- All of the selected products require that users modify their behavior or change business processes in order to gain the full benefit of the service.
- In all cases, there was little user familiarity with the service prior to introduction.

Product applicability to ATIS - The products selected are all likely to play some role in providing ATIS services.

- Cellular phones are likely to be one source of delivery of traffic and other information.
- The automatic vehicle identification tags used for both ETC and AVI are likely to be used as a source of vehicle probes in providing traffic flow information.
- The vehicle to roadside communications that is a part of all three of these products will be a critical part of ATIS.

Infrastructure Requirements - All of the case study products require significant infrastructure development as will ATIS

In addition to offering direct product insight into the market for ATIS, the case studies were selected to offer examples of a range of different market characteristics such as:

Range of Customer FOCUS - ATIS services are likely to be aimed at a wide range of customer groups, from purely consumer to purely commercial. In selecting the case studies a balance was drawn between these basic market types:

- ETC has both consumer market and commercial market characteristics.
- Cellular phones are primarily a consumer market.
- AVI/L is a nearly pure commercial market.

Range of product/market maturity - The selected products represent a range of product/market maturity. This allows insight into what issues/problems might be expected at different points in the development of ATIS:

- The market for ETC is embryonic, with relatively few full scale applications. As a result this market is characterized by substantial variation in technology, with little standardization and little price competition.
- The market for cellular phones is mature. It is characterized by strong price competition and attempts to differentiate through product enhancements/upgrades.
- AVI/L is difficult to characterize. It has been in existence for a long time, but has never reached the level of technical or market success necessary to be characterized as a mature market.

Range of market success - The case study products were also chosen to provide a range of market success.

- ETC is too early to gage the likely success of the market, but all indications are favorable.
- Cellular phones represent a clear market success.
- AVI/L would have to be labeled a “limited” success to date. Its future success is still unclear.

Introduction

Report Organization

Following this introduction, the report will consist of two major sections; presentation of the case studies, and a discussion of the applicability to ATIS.

The individual case studies have been organized to be as consistent as possible in the issues addressed and the order in which those issues are addressed. However, due to the differences in the nature of several of the case study products/markets, there is some deviation from the common organizational structure.

For each of the products/services, the case study describes:

1) Market Background - This section provides a brief description of the products, a history of the market/technology development and the leadiig participants.

2) Market Assessment Methodology - The core of each case study is a description of the approaches used to assess the market. The subsections within this section follow a typical process used in market assessment, including:

- Customer Needs Assessment
- Assessment of Customer Willingness to Pay
- Assessment of Expected Market Size and Penetration Bates
- Evaluation of Market Segmentation Efforts
- Analysis of Expected Profitability
- Analysis of How Market Risks were Assessed.

3) Actual Market Development - This section provides an analysis of the actual path of market development and the differences from the expected development.

4) Lessons Learned - The lessons that were learned from analysis of the experiences of that product/service are discussed.

The report concludes with a discussion of how the lessons that were learned in each of the case studies can be applied to ATIS. This section will discuss not only the lessons learned from the three case studies, but also the additional insights that have been gained from the authors work in market research in other markets.

Electronic Toll Collection Case Study

Market/Product Background

Electronic Toll Collection (ETC) refers to technologies that allow automatic payment of tolls through a system consisting of three basic components:

- An electronic vehicle identification tag/transponder,
- A vehicle/roadside communications system (interrogator), and
- Logic/computing capability to calculate and deduct the required toll from a user account.

ETC is one of the fastest growing applications of IVHS technologies. According to a 1992 International Bridge, Tunnel & Turnpike Association survey at least seven ETC systems are operational in the U.S., along with three operating in Europe. The same survey cites 17 agencies that are planning ETC systems and four others that are "considering" systems (See Figure 2).

In the U.S., the Dallas North Tollway was one of the first applications of ETC, starting in July of 1989. This 17-mile tollway has 60 electronic toll lanes covering 14 toll collection stations. More than 19,000 "Tolltags" are in active use. Vehicles equipped with a "Tolltag" represent roughly 20% of vehicles served in peak commuting times. Over 30,000 electronic toll transactions (roughly 28%) are handled per day.

The pioneer developer of ETC applications was Amtech of Dallas, Texas. Amtech installed the first U.S. system in Dallas and remains the clear leader in installed base of ETC systems. Amtech was established as a commercial entity in 1983. The company was formed to commercialize an electronic radio frequency identification technology that was developed at Los Alamos National Lab from 1971 to 1983. The development work was supported by both the Department of Agriculture (to allow it to track and record information from livestock) and the Department of Energy (to provide an automated method of controlling vehicle access to secure facilities and to track vehicles hauling hazardous waste). The first tests of the auimal tracking system started in 1976. The first application of the vehicle identification system was installed in 1979. By 1980, the technology had been proven and successfully tested. At that point, the government began to reduce its funding in anticipation of commercialization, which occurred with the establishment of Amtech in 1983.

The first market addressed by Amtech was the transport industry where its technology is used to identify and track vehicles and containers in rail, shipping, and trucking applications. Amtech has been particularly successful in the rail industry, where its tags were selected as an industry standard by the American Association of Railroads. Amtech's first ETC application was the Dallas North Tollway mentioned above.

Figure 2. IBTTA ETC Survey Results

	Operational	Planning	Considering
U.S.	• E-470 Public Highway Authority • Greater New Orleans Expressway Commission • Louisiana Dept. of Trans. and Development • Maryland Transportation Authority • Oklahoma Turnpike Authority • The Port Authority of New York and New Jersey • Texas Turnpike Authority • Illinois State Toll Highway Authority • Massachusetts Port Authority	• Buffalo and Fort Erie Public Bridge Authority • California Dept. of Transportation • Delaware River and Bay Authority • Florida Dept. of Transportation • Golden Gate Bridge, Highway and Transportation District • Indiana Dept. of Transportation - Toll Road Division • The Turnpike Authority of Kentucky • New Hampshire Dept. of Transportation - Bureau of Turnpikes • Maryland Transportation Authority • New Jersey Expressway Authority • New Jersey Highway Authority • New York State Thruway Authority • Ohio Turnpike Commission • The Port Authority of New York and New Jersey • Transportation Corridor Agencies	• Kansas Turnpike Authority • Maine Turnpike Authority • Rhode Island Turnpike and Bridge Authority
Europe	**England** • Dartford River Crossing **Italy** • AUTOSTRADE S.p.A. **Portugal** • BRISA-Auto-Estradas de Portugal		**Ireland** • National Toll Roads - West Link - East Link **Scotland** • Forth Road Bridge Joint Board
Other		**Hong Kong** • The Cross-Harbour Tunnel Co., Ltd. - The Cross-Harbour Tunnel	**Australia** • The Gateway Bridge

Recently a number of other firms have entered (or plan to enter) the market for ETC applications (Figure 3). These range from small, single product companies, to divisions of large companies. In many cases the larger companies are defense contractors trying to use ETC specifically, and M-IS generally, as part of a defense conversion process.

The development of ETC systems has been primarily technology driven in the sense that Amtech (the market leader) and the other suppliers following it into the market have started with an existing technology, and then looked for appropriate applications for that technology. Through this process they were led to ETC applications as appropriate for their existing technology.

Figure 3: U.S. Companies Active in ETC

Products / Company	Transponders	Communications	Systems Integration
Amtech	✓	✓	✓
AT/Comm	✓	✓	✓
AT & T		✓	
Lockheed		✓	✓
Mark IV Vapor	✓	✓	
Texas Instruments	✓	✓	
Hughes	✓	✓	
Rockwell	✓	✓	✓
MFS Technologies			✓

ETC is an important component of more widespread applications of a range of IVHS technologies because it is likely to be one of the early broad uses of vehicle identification and communication. Thus ETC will provide a source of "tagged" vehicles that can form a foundation for other applications. Other potential applications of the basic ETC technology include:

- Advanced Traffic Management - The population of tagged vehicles will provide an information source for traffic information. The communication system can potentially be used to provide routing information to the driver.

- Automatic payment for parking, gasoline, or other services
- Emergency assistance calls (panic button)
- Enhanced vehicle security/theft prevention and recovery systems

From a market development and market research perspective, ETC provides a unique illustration of market structure and the complications that arise from the existence of two distinct levels of customer groups. While cellular phones are primarily a consumer product and AVI/L is a nearly pure commercial market, ETC has aspects of both. This dichotomy can create difficulties in both product development and marketing, as the different customer groups may have unique and in some cases conflicting requirements

- Commercial Aspect of ETC - The toll authorities are the primary customer for the system in total. They are certainly the customer for elements such as the toll plaza hardware, the communications system, and the accounting intelligence. They may also be the primary customer for the vehicle tags. The companies developing systems for this market must understand and respond to the requirements of the toll authorities. The requirements of the toll authorities will be driven primarily by their operational responsibilities and, therefore, will be similar in nature to the requirements of commercial customers in other markets.
- Consumer Aspect - While the toll authorities are the customer for many aspects of ETC, the consumer is the customer for the service provided and, in many cases, for the vehicle tag itself. Ensuring that the needs of the consumer are met is the joint responsibility of the toll authority and the system supplier. Ultimately, it is consumers who will determine the success of ETC through their acceptance or rejection of the characteristics of the service and equipment that is provided.

In addition to the toll authorities, which represent primarily commercial requirements, and the end-users which represent the consumer requirements, there is in fact a third group that must explicitly account for both sets of requirements. These customers are the future operators of private toll roads, such as the California SR-91 project and a similar project in Toronto. In this case, the companies that are funding and operating these roads must account for both the commercial and the consumer aspects in order to assure themselves that the use of ETC equipment does not inhibit their ability to meet their required traffic volume levels.

This characteristic of the ETC market makes the lessons learned and approaches taken in ETC particularly applicable to ATIS, as there is likely to be a similar situation of multiple levels of customers. The state D.O.T.s are likely to be the customer for the ATIS infrastructure and systems, while the consumer will be the customer for the service/information provided as well as any in-vehicle hardware that may be required.

In order to address this issue of multiple levels of customers we have reviewed market research activities that were undertaken by the toll authorities, the private companies supplying the systems to the toll authorities, and the companies that will operate private tollways.

Market Assessment Methodology

Overview

The results of our investigations indicate that the ETC market reflects what economic theory and rational business behavior would predict; i.e., that the market participants focused their market research efforts largely on understanding the requirements of the group that is their most direct customer. This section will provide an overview of the market research methodologies used to assess the ETC market. This will be followed by a section discussing the methods used to address specific issues.

Figure 4. Market Research Focus

	Toll Authority Operations Focus	Consumer Focus
Suppliers	Amtech Mark IV Texas Instruments Hughes Rockwell AT & T	AT/Comm MFS Technologies AT&T (Analogies to other Industries) California Private Transportation Corp.
Toll Authorities	Oklahoma Texas	EZ Pass Virginia Florida New England ETTM Illinois

Toll authority focused market research. Most of the hardware suppliers focused their market research on understanding the needs of the toll authorities, in order to allow them to develop and market their systems based on meeting the operational requirements of the toll authorities.

- Amtech - As mentioned above, Amtech was the pioneering company in this market. ETC was one of several transportation based markets that Amtech pursued as expansion opportunities for its identification technology. The search for other applications started with an in-house market assessment study to identify the range of markets that might require remote identification of objects and direct entry of the information into a computer. This project segmented the potential opportunities by assessing the market needs and potential market size represented by each industry. The result of the project was to identify shipping, trucking, railroads as the most attractive initial applications, with ETC identified as a focus for a second "wave" of applications. A key selection criteria was total market size. The target markets were selected largely because they were all quite large, thus, the opportunity for substantial volume existed even if Amtech could achieve only a relatively small market share.

  As it was one of the first suppliers in the market, Amtech was faced with the task of selling the concept of ETC as well as the performance of their particular product. Therefore it focused its marketing efforts on convincing the toll authorities of the potential to increase revenue through the use of these products. Amtech also spent a great deal of effort working with standards organizations, in an attempt to have its system established as a de facto standard. This last focus was an attempt to repeat a strategy that had been successful in the rail industry. Even today Amtech does no end-user research prior to contract awards, depending on the toll authorities and "peer pressure" to induce consumers to actually buy and use the tags.

- Texas Instruments/Mark IV Vapor /AT&T/Hughes/Rockwell - With Amtech having established the market and to a large degree the concept of ETC, a number of companies have attempted to enter the ETC market as an extension of existing products, technologies, or capabilities developed for other markets. In the case of Hughes and Rockwell, the movement into ETC and other IVHS technologies has been an attempt at diversification out of the defense industry. Few within this group of companies have much consumer product experience, consequently, they have largely addressed the market from the side of the toll authority. The efforts of Hughes and Rockwell are representative. Rather than speaking directly with the toll authorities, Hughes took the "expert" route. It hired a retired state transportation executive as a consultant to act as a proxy for, and provide input on the needs of the toll authorities. Rockwell took a more direct route, conducting au in-house telephone and in-person interview survey with "working level" people at the state D.O.T.s in order to understand their issues and requirements. MFS Technologies hired a market research firm to conduct a formal telephone survey of toll authorities, bridge authorities, and

state D.O.T.s to define their level of understanding of ETC and other IVHS technologies and directions that were likely to be taken at the various state D.O.T.'s.

- Toll Authorities - Two of the toll authorities surveyed looked primarily at their own internal operational requirements to determine whether they should invest in electronic toll collection systems. Both Oklahoma and the Texas Turnpike Authority did no significant end-user research. Oklahoma Turnpike Authority did run several focus groups to gauge the reception of the general concept of ETC, but did not explore operational details: The rationale was that the ETC systems would pay back at very low participation rates, therefore additional research was not required. This expectation was borne out in practice. Oklahoma set a goal of issuing 15,000 "PIKEPASSes" in the first year, and the objective was met even before the system was put into operation. At the end of the first year of operation Oklahoma had issued nearly 100,000 "PIKEPASSes."

The example provided by Oklahoma is a good illustration of a situation when market research is not needed. Market research is not an end in and of itself. The objective of market research is to lower the actual or perceived risk of entering a market by expanding one's understanding of the market. If, as in the case of Oklahoma, there is little or no perceived risk, then market research is unnecessary.

Consumer (end-user) focused market research. In contrast to most of the equipment suppliers, the primary focus of the market research done by the toll authorities was on defining the requirements of the end consumer and the characteristics of a system that would meet those needs. Of the toll authorities that we surveyed, EZ-Pass, Virginia, Florida, Mass Pike, and Illinois have all done direct end-user market research. Those toll authorities that did market research used a combination of mail surveys, focus groups, and conjoint analysis to define consumer response to their ETC Projects.

- EZ-Pass --The most comprehensive market research program was that done by the Port Authority of New York and New Jersey in support of the efforts to implement a common electronic toll system in the NY/NJ/PA area. This program consisted of four elements:

  1989: InformaI panel discussions with private and commercial users
  1990: Formal focus groups with private users
  1990: User survey (12,000 distributed, 900 returned)
  1991/2: Follow-up focus groups

  The user survey done for EZ-Pass included both a written questionnaire and a set of conjoint analysis cards to test consumer reactions to different combinations of features. An interesting feature of the EZ-Pass survey was the inclusion of a video tape to illustrate and explain the features of EZ-Pass. This is a good example of the need to help market research respondents better understand the product/service they are evaluating. The better the

product/service is understood by the respondents, the more reliable the results are likely to be.

In addition to the end-user market research work done by the public toll authorities, the private tollroad operators and several of the hardware suppliers also focused on understanding the end-use or consumer requirements. The two private companies that did the most significant end-user research were AT/Comm and the California Private Transportation Corporation.

- AT/Comm - AT/Comm is unique in that it is a single product company established solely to address the ETC market. While it plans to develop additional applications, the origins of the company are in ETC. The product concept was developed out of work performed in other communications areas. It is also unique in that it is the only example we found of a company that carried out end-use research prior to market development.

  The process used by AT/Comm is a textbook example of how to approach the product development and product planning process. Before any product development work was done, AT/Comm sought to establish the answers to two questions:

  Does a market opportunity exist based on consumer need? AT/Comm felt that if consumers did not yet see a strong need, the efforts of the toll authorities to implement ETC would either be unsuccessful, or at least require a lead time that would be too long to meet AT/Comm's requirements.

  Is there a disparity between what the toll authorities want and what the consumers want? If there was significant disparity between the needs of the consumers and the authorities, AT/Comm felt that a long term market was unlikely to emerge, as neither side would be satisfied with the systems.

  The first question was addressed using two market research studies. One involved a mail survey of 22,000 toll road users in the NY/NJ/PA area. Just over 5,000 of the surveys were returned for a 23% response rate. The mail surveys were then followed up by interviews with 600 randomly selected survey respondents. In addition to the NY/NJ/PA survey, AT/Comm conducted a mail survey of 10,000 users of several exits on Route 93 in New Hampshire.

  To address the second question, AT/Comm conducted a phone survey of toll authority officials.

  The answers to the first two questions provided a basis for developing the functional specification for a product that would meet the needs of both end users and toll authorities, and therefore had the opportunity for market success. AT/Comm used this information to modify its original product concept. The

functional specification also provided the basis for conducting an assessment of AT/Comm's competitive position by comparing the functionality of competitive products to the needs of both end users and toll authorities. The company felt that its product concept offered significant advantage over competing products and therefore went ahead with the program.

- California Private Transportation Corporation - CPTC is the organization that will build and operate the private tollway that will operate in the median of SR91 in Orange County California. While they are a private company, for purposes of this investigation they can be thought of as similar to the toll authorities as they will have operational responsibilities. The **SR91** project offers a unique perspective on consumer price sensitivity because of the presence of a direct competitor (the adjacent freeway) offering the same service. This is not true in most circumstances where the toll road is often the only, or at least only convenient, alternative. Despite the size of this project ($125 million), there was relatively little market research supporting it. A survey of 400 users of SR91 was the only market research done. Because of the presence of the freeway, the primary issue that CPTC explored was how consumers valued time, and therefore how they would be likely to use the tollway and how that use would be impacted by pricing. These issues were addressed using a survey of existing users of the freeway. They were asked to select among a choice of commuting times, cost, and number of passengers, using an interactive, computer-based system that provides a variation of conjoint analysis.

Assessment of Specific Issues

Most of the market research on ETC has addressed six specific issues. These are covered individually below and include:

- Needs assessment
- Willingness to pay
- Market size and penetration
- Market segmentation
- Profitability
- Risk assessment

Needs Assessment. ETC addresses several fundamental needs. These needs are well established and (depending on the specific application site) almost universally recognized by all of the market participants. The role of market research is to identify, quantify, and rank the needs of the various customer groups. The degree to which market research is needed and the type of market research that is needed depends on the expected variation in the results -- i.e. how strong is the need and are the specific needs very different between groups -- and the part of the market that is being addressed.

Toll Authority Needs - The most basic need of the toll authorities that ETC addresses is to increase throughput and reduce congestion. These needs are, however, derivative

from more basic requirements that include both strict business/operational elements and "public good" elements. Examples of needs that fall into the first category include:

- Increased Revenue - Via greater throughput and the ability to do congestion pricing
- Operational Improvement - Reduced administrative cost, potentially lower labor costs, reduced fraud, reduced cash handling

Examples of the public good benefits include:

- Reduced pollution from reduced congestion
- Improved fuel economy
- More efficient use of road infrastructure
- Reduced accident rates

The market research done by the ETC hardware suppliers concentrated on the first set of needs, those that focus on the business/operational issues. This was done for several reasons, the primary one being that such needs can be quantified and addressed using standard methods for evaluating the attractiveness of any commercial investment, such as analysis of pay back period, internal rate of return and others. Competing products may meet these needs to a greater or lesser degree, and the ability to meet those needs can form a bases of competition and selection among competing systems. The public good elements of the toll authority needs are more difficult to quantify and are largely "non-competitive" in the sense that they would be provided by most competing systems.

As a result, the suppliers of ETC systems focused their market research on understanding and demonstrating the ability of their systems to meet the operational needs of the toll authorities. In this mode, the distinction between market research and ***sales*** breaks down somewhat. Market research that is focused on understanding commercial customer requirements often comes down to activities as fundamental as simply meeting with the decision makers to customize your product to their specific needs, and demonstrate that your product is cost effective and has superior features for the price. This is essentially the same as the early stages of a sales campaign. The initial phase of this process typically involves determining a set of common requirements. Following this, the efforts focus on establishing a few "leading" sales that will (in the case of a new product) demonstrate the viability of the overall concept (e.g., ETC). Once the concept is established, the process is driven to a more traditional sales process of demonstrating the superior price/performance characteristics of your product.

Consumer Needs - From the consumer perspective, the most fundamental need being addressed by ETC is the need to increase available time. This need is met by reduced waiting time, increased convenience of not having to have cash available for tolls, and in some instances, time saved in accounting for tolls.

The need for time saving was tested by most of the market research, and the results offered no surprises.

* The EZ-Pass survey found that the two primary benefits of electronic tolls were:
  "Speeds Trip" - 52.1% of respondents; and
  "Easy to Pay Tolls" - 34.8% of respondents.

· AT/Comm survey of Route 93 users indicated that the "most appealing aspect of the proposed ETC system" was:
  "Saves Time" - 45.5%; and
  "No cash/tickets/tokens" - 38.1%.

For this and other markets, the most common approach to generating a list of "other" consumer needs is the use of focus groups. EZ-Pass, Florida, MFS Technologies, and others used this approach in the case of ETC. Although not statistically significant, the informal nature of focus groups allows consumer needs and concerns to be stated in an open, free flowing, unprompted way. The interaction between focus group participants will often surface needs or issues that may not have emerged otherwise. The needs generated by the focus groups are then tested in the broader, statistically significant consumer surveys to ensure that they are commonly shared needs. In the case of ETC, a number of common issues were found in several of the focus group studies. None of these were viewed by consumers as truly fundamental to the expected use or non-use of ETC, but rather "desired" product features:

- Payment method and amount of prepayment
- "Perks" available to ETC users such as dedicated lanes
- Availability of other uses such as payment for parking, gasoline, etc.
- Transponder safety from theft
- Transponder mobility between vehicles
- Privacy

The EZ-Pass research used a subset of these "other "issues, together with the pricing issues, to defme the variables for their conjoint analysis.

Willingness to **Pay.** Assuming that the research to analyze market needs is successful in identifying at least one unmet need, the core of any market analysis is in understanding the price that customers are willing to pay to have those needs met. Almost any product/service will have a certain amount of value -- either to the consumer or to commercial users -- the issue is whether that value is commensurate with the cost of providing the product/service.

Toll Authorities - In a pure commercial market, determining willingness to pay is relatively straight forward. Most commercial decisions are based on rational assessments of whether the product will increase profitability. Different measures may be used, payback, return on investment, return on assets, etc. -- but the principle is the same.

In the case of toll authorities the issue is clouded somewhat by the presence of the potential for consideration of the "public good" elements that were discussed above. If consideration of these elements is included, the authority could choose to invest in an ETC system regardless of whether it meets some of the strict financial measures. In practice, however, our research determined that the ETC hardware suppliers did not have to rely on the public good elements -- ETC systems could be shown to be cost effective on a straight financial basis. AT/Comm estimated that toll authorities could recover their costs in a maximum of 10-12 months based primarily on higher throughput and greater road utilization.

End users - Determining consumer willingness to pay is generally much more difficult, particularly with a new product concept. Consumer choices take into account a wide range of variables, and the willingness to pay will differ depending on the variables considered. Estimating the demand for ETC is further complicated by the fact that there are two elements -- the price of the transponder (tag) and the price of the tolls. The generally accepted procedure for estimating consumer willingness to pay is some type of consumer choice analysis, the most familiar of which is conjoint analysis. Conjoint analysis asks consumers to select from a range of scenarios that define options for price and other product features. The relative impact of price and other product features can then be deduced from the rankings that consumers place on the different scenarios.

Our research indicates that conjoint analysis and its variations were the primary tools used to estimate consumer willingness to pay for ETC. EZ-Pass, California Private Transportation Corporation, and Florida all used this technique.

The primary drawback of conjoint analysis is that it is relatively expensive to administer, as it is time consuming and labor intensive. AT/Comm used a method that, while less robust, provides a less expensive option. Three groups of survey respondents were established with similar demographic and other characteristics. Each group was given the same product description, but with different price levels. A demand curve was then estimated by calculating the percentage of each group that would buy the product, knowing the price associated with each group.

Market Segmentation. The objective of market segmentation is to group customers that have similar needs/wants. The needs and wants can then be translated to product features which are used to guide the product development process. For example, in the auto industry, the most fundamental market segmentation is based on price and vehicle size. While this gross segmentation will not pick up many subtleties, it is a useful starting point.

Toll Authority Segments - Commercial market segmentation is typically done along operational lines because operational characteristics frequently correlate well with needs. An example of this was seen in the AVI/L market where the initial segmentation was along industry lines (trucking, shipping, etc.). Within the trucking segment, companies were primarily segmented by size (number of trucks) and type of operation (Truckload, Less-than-Truckload).

The suppliers that we surveyed have segmented the market for ETC similarly, with two primary segmentation variables:

- Type of toll system -- either a single toll location and/or price (such as a bridge) or a system with multiple toll locations and/or prices (such as a turnpike).
- Size or volume of the toll system -- The number of vehicles that are served per day, or the total number of toll stations.

The first segmentation impacts functional requirements such as the need for a read-only system or a read/write system. The second segmentation impacts the scale of the ETC system required and the ability to capture additional revenue from the ETC system. According to AT/Comm, although size/volume is a relevant segmentation, in fact any size toll system can profitably use ETC. Therefore, it considers its target market to be all toll authorities.

Several of the ETC suppliers also use "source of congestion" as a segmentation variable. Those toll authorities where the toll booths themselves are the primary source of congestion offer better opportunities for the sale of ETC systems than toll authorities where the source of congestion is downstream of the toll booths. This is because the primary service of an ETC system is reduction of driving time. If introduction of an ETC system does not reduce total driving time due to downstream congestion, then the value of the ETC system is significantly reduced.

Consumer Segments - In pure consumer markets, market segmentation is often a rather involved process. Segmentation typically involves some combination of demographic factors (age, family size, income level) that are relatively easily determined, and psychographic factors (life styles, interests, mind set) that are more difficult to define.

The research done on ETC indicates that there is one primary segmentation variable: trip frequency on the road or roads covered by the ETC system. Commuters are more likely to buy ETC services than infrequent users. This result was found in work done by EZ-Pass, AT/Comm, and Amtech. AT/Comm found a significant break in the likelihood of participation at four or five trips per week.

The survey done by the Virginia D.O.T. for the Dulles Toll Road investigated possible segmentation based on sex, occupation and age. Of these, only age showed any strong differentiation; the under 35 group was the most likely to participate, while the over 54 group was the least likely.

One interesting market segmentation investigated by EZ-Pass is the difference in interest in ETC between people that consider themselves to be "innovators" or "opinion leaders." EZ-Pass found roughly 5% more interest in ETC among both of these groups.

The other segmentation that has some predictive value is commercial versus private users. Commercial users are generally more receptive to the use of ETC because:

- It is easier to quantify the monetary value of the time saved through the use of ETC.
- Commercial users have a greater need for some of the ETC features such as toll tracking and accounting.
- Commercial users have additional uses for the tags such as fleet management and tracking.

Market size and expected penetration. The market research on ETC does not result in any clear general conclusions about the expected penetration rates of the use of ETC at the consumer/end-user level. The forecast penetration rate is dependent on the details of how the specific ETC system was described, the present commuting environment, and numerous other factors. However, each of the studies for which we obtained detailed results have indicated a very substantial interest in participating in an ETC system.

- EZ-Pass respondents were asked to rate their interest in subscribing to EZ-Pass. The number of respondents that gave their interest the highest rating (10) ranged from 23% to 30%, depending on location.

- The Dulles Toll Road survey showed 37% of users would "definitely join" with no incentives on the tolls or the tag. 59% would "definitely join" with a $10 incentive.

- AT/Comm's survey of Route 93 users found that nearly 50% of users would use an ETC system with a $15 charge for the tag and no discount **on the** toll. Slightly greater than 80% would buy a tag if it were $15 and had a 25% discount on tolls.

These results must be tempered by the fact that in market research, consumers will often overstate their willingness to try a new product.

At the toll authority level, because most of the ETC systems are completely modular and can be applied profitably to even a single toll booth, the potential market is essentially the entire universe of toll facilities. In the U.S. this amounts to 55 authorities, with a likely minimum of at least 1,000 individual toll booths.

Profitability assessment. The market for ETC systems can still be characterized as embryonic. As a result, the hardware suppliers that we spoke to did not have much input on profitability. Amtech and AT/Comm both said that several factors result in toll authorities being relatively price insensitive for ETC systems. Therefore profitability is not typically a limiting factor.

- Where the objective of installing an ETC system is to increase traffic capacity, often the only alternative is to build a new or expanded road, which may be impossible and at a minimum is expensive.

- The potential financial and operating gains to the toll authorities is sufficiently high to quickly cover the costs of the ETC systems.

At this point in the development of ETC markets, profitability is less important than efforts to expand the total market in order to expand the revenue base of the hardware suppliers. The hardware suppliers' primary profit source is on sales of the systems to the toll authorities rather than on the sale of the tags to the driving public, therefore, the focus of the hardware and systems suppliers has been on competitive assessment -- i.e. how well does my system meet the bases of competition relative to my competition. The bases of competition are fundamentally the toll authority customer needs discussed above.

Risk assessment. Based on our research, neither the toll authorities nor the suppliers indicated that there were very significant risk factors associated with the ETC market.

From the toll authority side, the only significant risk element is whether the ETC systems will perform as expected and be accepted by the public. Both of these risk elements are mitigated by fact that the ETC systems have a positive payback at relatively low participation rates. The toll authorities have managed the risk of low usage by the use of the market research and marketing programs that have been discussed in this paper.

On the supplier side, two significant risk factors were mentioned frequently.

- Standards - For each individual supplier, the absence of universal standards is both a risk and an opportunity. The risk clearly is that if a standard is established that is not compatible with the company's technology, that company may be effectively shut out of the market. The opportunity, in turn, is that if a company's technology is accepted as the standard, it will enjoy a very strong competitive position. The suppliers have attempted to manage this risk primarily through activities that amount to lobbying to have their technology established as the standard. One typical approach is to try to establish a strong market position and use a "market share" argument that your technology should be the standard. This appears to be the approach that Amtech has taken. Another potential approach to managing this risk is to develop technology that is compatible with a range of the competing technologies. This approach has not been used to date in the ETC market, as we see a range of competing approaches that are often mutually exclusive rather than compatible.

- "Over Promise" - A risk element that was mentioned in a number of instances was the potential risk of toll authorities "over promising" (i.e. promoting ETC too heavily and developing expectations in the buying public that cannot be met). This can result in a backlash that can potentially slow the market development from what it would have been if expectations were set more reasonably. Examples of this risk can be seen in the attempts to introduce Antilock Brakes (ABS) in the truck market in the early 1970s. The technology was not sufficiently developed, and the resulting failures left truckers with a

bias against ABS that remains today. The primary approach taken to manage this risk has been careful work with the toll authorities to educate them and set reasonable expectations within the buying public.

Actual Market Development

Because the ETC market is in the early development stages, there is little evidence on how accurately the market research performed to date will predict the path of actual market development. However, there are several indicators that the market potential is quite strong for these products:

- For those systems that are in place, the participation rates have generally been high As indicated above, the Oklahoma system sold several times the expected number of tags. Participation in the Dallas North Tollway has increased steadily.

- There is increasing interest in ETC systems as indicated by the results of the IBTTA survey presented in Figure 2.

- An increasing number of complementary products are being developed and introduced into the market. These include the use of vehicle tagging and communications for parking garage payment, fleet management, vehicle theft recovery, and private vehicle tracking and location services.

Lessons Learned

Of the numerous potential lessons that can be drawn from ETC market research and market development, five are most critical and relevant to the market for ATIS.

1) Multi-level customer base - It is important to understand the market structure and recognize that there are fundamentally different levels of customers with fundamentally different needs. The needs of each level of customer must be understood using the appropriate market research methods for that customer level. When this type of multi-level customer market structure exists (as it will for ATIS) the market will not develop fully until the needs of all customer levels are met. In the case of ATIS, the multiple levels are likely to be at least:
   - The driving public
   - State D.O.T.s, and
   - Private companies that may collect and/or vend the traffic information.

2) When market research is not needed - Market research is needed only to reduce the risk of investing in a new product. Where little or no risk is perceived (as was the case with Oklahoma) there is no need to conduct market research, and doing so would be inefficient. It appears unlikely that this would be the case in evaluating ATIS, but the possibility should be kept in mind.

3) Importance of accurately representing the product in market research - One of the difficulties in conducting market research is to ensure that the product being tested is as similar as possible to the actual product that will be offered. The environment in which market research is conducted is inherently artificial and anything that can be done to improve the accuracy of the product representation should be considered. Several of the methods seen in the ETC market (the EZ-Pass use of video tapes and California Private Transportation Corporation's use of computer-generated trade-off analysis) are illustrative of the types of innovative solutions to this problem that exist. Because ATIS products are likely to be quite new to most consumers, this issue is particularly important.

4) Consumer willingness to pay for time savings - The development of a market for ATIS products will largely depend on the willingness of consumers to pay for time saved in commuting. Several of the studies done for the ETC market indicate that consumers will in fact pay for time savings. This should be explored further but is an optimistic sign for the development of ATIS.

5) Risk of "over promising" - This risk identified by a number of the participants in the ETC market is particularly applicable to the ATIS market. Consumer expectations must be carefully managed to ensure that they do not expect more of ATIS products than can actually be delivered. Products that offer real value can may prove unsuccessful if consumers expect them to offer even more value than they can deliver.

Cellular Communications Case Study

Market Background

The concept for cellular communications was developed by AT&T's Bell Laboratories in 1947, however, it wasn't until 1962 that the first real tests were conducted to explore commercial applications. Another eight years passed before the Federal Communications Commission set aside new radio frequencies for "land mobile communications" (824 - 849 MHz frequency range for mobile to base communications and the 869 - 894 MHz frequency range for base to mobile communications). Finally, on October 13, 1983, after a lengthy licensing process, the first commercial cellular system began operating in Chicago, with the second system activated a short time later in Washington, D.C.

Licenses to operate cellular services were issued based on Metropolitan Statistical Areas (MSAs) and Rural Service Areas (RSAs). Each MSA/RSA is divided into a number of "cells," usually ranging from 1 to 15 miles in radius. A Mobile Telephone Switch Office (MTSO) acts as the interface between the ceil sites and the public switched telephone network. Two independent licenses were granted in each MSA/RSA, one to the wireline company (local RBOC) and one to a non-wireline company. The two operators in each area have independent and separate infrastructure, with each individual operator being responsible for infrastructure investment, service operation, and subscriber acquisition. The average infrastructure investment in a major city or MSA averages about $50 million, with about a five-to-seven-year payback.

While the concept of "cellular" phones was new, there were several existing systems for providing mobile communications. The existing systems provided an indication of the potential of cellular phones, as technical features that limited the volume of mobile phones that could be served, resulted in long waiting lists three to ten years in some cases.

Cellular service differs from landline telephone service mainly by virtue of its not having a tethered line connecting each subscriber to a central office switch. Cellular subscribers are connected to cell sites via radio frequency over the air waves. The cell site locations are connected to the MTSO via private microwave, copper, or fiber facilities. In a traditional landline telephone architecture, each individual subscriber is connected via a physical line (whether it be twisted pair, copper or fiber) to the closest central office location.

By the end of 1984, there were approximately 9 1,600 subscribers in the United States, spread among 26 cellular markets. Most major cellular carriers entered the market during this time frame (1984-85) Today the cellular communications industry has grown to a total subscriber base of over 13 million, annual revenues of about $10 billion, and a total employee base of over 35,000 jobs.

Figure 5. Major Cellular Participants - 1994

Carriers	Infrastructure Equipment	Subscriber Equipment
Ameritech Mobile Comms.	AT&T	Audiovox
Bell Atlantic Mobile Systems	Astronet	Ericcson-GE
Bell Cellular, Inc.	LM Ericcson	Fujitsu
BellSouth Mobility	Hughes Network Systems	Mitsubishi (Diamond Tel)
Cantel, Inc.	International Mobile Machines	Motorola
GTE/Mobilenet/Contel Cellular	Motorola	NEC
McCaw Cellular/LIN Broadcasting	NEC	Nokia
NYNEX Mobile Communications	Northern Telecom	Novatel
PacTel Cellular	Novatel	Oki
Southwestern Bell Mobile Systems	Plexys Corporation	Panasonic
US West New Vector Group	Qualcomm	Qualcomm
		Sony Corporation of America
		Tandy
		Technophone
		Uniden

Cellular Communications Case Study

Market Assessment Methodology

Overview

When cellular service was initially being rolled out by carriers in the early 1980s, many organizations attempted to forecast demand for the service. The following chart details several of the forecasts that were developed in the late 1970s and early 1980s.

Figure **6. Forecast of Cellular Subscribers**

Company	Year Forecast Conducted	1990 Forecasted # of Subscribers	Research Technique Utilized
AT&T	Late 1970's	1,000,000	
Motorola	Late 1970's	10,000,000	
Frost & Sullivan	1983	720,000*	Primary & Secondary Research
Arthur D. Little, Inc.	1983	2,750,000**	Primary Research
Arthur Anderson & Co	1985	7,000,000	Delphi Study
Herschel Shosteck Assoc., Ltd.	1985	590,000	Economic Analysis
Solomon Wolff Assoc.	1985	784,000	
Resource Developments, Inc.	1985	3,190,000	
Telocator Network of America	1985	2,250,000	
Shearson Lehman Brothers, Inc.	1985	2,000,000	
The Yankee Group	1985	600,000	Market Survey
PREDCT (CTIA)	1986	2,435,134	Computer Spreadsheet Model
Booz Allen	1988	6,000,000	Consumer Telephone Survey
1990 Actual number of subscribers		5,188,055	

* 1988 Forecast
** 1994 Forecast

Sources: Telephony, December 9, 1985, p. 49-50
Cellular Business, July, 1989, p. 46-50; January, 1 988, p. 50-52
Mr. Uifford Bean, Arthur D. Little, Inc.

Detailed information was gathered on the techniques and methods utilized by four major organizations to forecast cellular demand. The four groups' methods profiled are: 1) Frost & Sullivan, 2) Arthur D. Little, Inc., 3) Cellular Telecommunications Industry Association (CTIA), and 4) Booz Allen.

1) Frost & Sullivan Methodology. In 1983, Frost & Sullivan developed a cellular industry forecast. The primary methodology used in the research for this report included extensive interviews with industry executives, suppliers, salespeople, common carriers, and potential end users. The interview data was supplemented by an extensive review and analysis of available literature, including:

- Annual reports, 10Ks, and investment house research reports
- Company product literature describing services and products appropriate to the cellular market
- Press releases regarding new products and service offerings
- Articles from various industry publications

The Frost & Sullivan study only projected out for a five-year period. The forecasted number of subscribers for 1988 was 720,000.

2) Arthur D. Little, Inc. Methodology. Throughout the early 1980s, a number of cellular forecasts were conducted by Arthur D. Little. The forecasts were conducted mainly for potential cellular service providers that were submitting license applications to the FCC and were attempting to gauge the amount of infrastructure and plant to put in place to serve the expected demand. In fact, at the time, most cellular service providers looked to outside consultants to help them forecast demand. Arthur D. Little performed the following activities in developing its cellular demand forecasts:

1) Focus groups
2) Detailed consumer surveys
3) Analysis of demographic and economic characteristics
4) Extrapolation and forecast

ADL determined that this primary, "bottom-up" research methodology would provide the most complete and accurate forecast possible within a reasonable time frame and budget. The activities undertaken to forecast demand are explained further in the report.

3) PREDCT Cellular Forecasting Methodology (sponsored by the CTIA). The Penetration-Related, Econometrically Driven Cellular Telephone (PREDCT) forecasting model is a personal computer-based model developed to forecast the demand for cellular service in any defined market area or group of areas. The model was developed in 1986-1987 by an industry consultant1 for the Cellular Telecommunications Industry Association (CTIA). PREDCT was designed to be a quick, easy to use, and simple to understand model that combines existing penetration rates (no matter how minimal) with the foresight of experts in a variety of fields.

1 Scott Goldman, president of the Goldman Group, a cellular marketing consulting firm in Calabasas, CA.

Cellular Communications Case Study

4) Booz Allen Methodology. In May 1988, Booz Allen conducted a cellular telephone demand survey for the Cellular Telecommunications Industry Association (CTIA). The survey was conducted via telephone among 3,100 randomly selected households. The methodology employed by Booz Allen is detailed further in the report.

Needs Assessment

In the environment of ten years ago -- prior to the widespread use of mobile communications, cordless phones or paging services -- the concept of cellular service was new and different from what the general public was familiar with.1 Therefore, one of the requirements of market research was to provide **a** detailed explanation of the service and its benefits to potential users. Because cellular technology had to be described, and did not lend itself to being easily displayed, potential users and survey respondents had difficulty in understanding the service and its capabilities.

Arthur D. Little's approach was to conduct a series of initial focus groups in order to better understand the potential needs and characteristics of the cellular market. The focus groups provided insight into the occupational and industry segments most likely to initially subscribe to cellular service. Results of the focus groups were also helpful in refining the survey questionnaires to be used in each geographic market area. Detailed market research studies were then conducted in several of the top 35 markets.

Willingness to Pay

Cellular service and products were expensive and their prices were unstable. Potential users, for the most part, had only traditional, land-line telephone service rates to compare to cellular rates. As a result, it was difficult to gauge consumer willingness to pay.

In its forecasting work, Arthur D. Little tested consumer willingness to pay by determining the level of interest in cellular service at various price points. Respondents were asked how interested or likely they would be to purchase cellular service at a particular price level and with a particular pricing option. Two pricing options and three different price levels were tested in each study. Study participants were asked to comment on only one of the three different price levels (each third of the participants were assigned one of the three pricing levels). The pricing options were as follows:

1) Pay one rate for basic service and equipment rental, plus 50 cents per local one-minute call, with toll calls as an extra charge; or

2) Buy the cellular phone and pay only half of the basic monthly charge.

The rates tested were $65, $80, and $100 per month for basic service and equipment rental as the first pricing option. The rates tested for the second pricing option were

$32.50, $40, and $50 per month for basic service plus $2,200 to purchase the cellular phone.

The survey results varied slightly, but the majority of respondents to "pricing option one" were price insensitive. In fact, in many of the studies, it was found that the "medium priced" service option received a higher percentage of respondents likely to purchase service than the "lower priced" service option. It is likely that this price insensitivity was partially due to the "pent-up" demand for cellular service as well as the fact that potential consumers were unable to reasonably judge a fair price for cellular service, as they had little with which to compare it.

In its forecasting work, Booz Allen tested cellular service price sensitivity. Price sensitivity was becoming more of an issue a couple of years after cellular service was rolled out and companies were curious to get more updated price sensitivity data. Price sensitivity was tested by randomly exposing potential buyers to one of three price points based on the reasonable range of prices expected over the next five-year time period.

The three price points tested in the Booz Allen survey were:

1.) $15 per month for equipment and service, and 15 cents per minute of usage;

2.) $50 per month for equipment and service, and 50 cents per minute of usage; and

3.) $100 per month for equipment and service, and 95 cents per minute of usage.

The "take" rates varied modestly, but growth slopes over the next two-year time period were approximately the same regardless of price. The forecast based its projections on a base of 2 million cellular subscribers. Booz Allen predicted a range of just under 6 million to just over 7 million cellular subscribers by 1990, depending upon the price point.

After 1990, Booz Allen's survey data depicted a flattening of the growth rate at the high and medium price points. However, the study predicted that growth would continue even if prices remained high. Approximately 10 million subscribers were expected by the end of 1993 at the high price point. If prices dropped to the low end, the number of subscribers was expected to reach as high as 18 million by the end of 1993. More optimistic forecasting was beginning to recognize the growing popularity of cellular service in the late 1980s.

Cellular Communications Case Study

Market Segmentation

The market for cellular service was segmented different ways by different organizations. Arthur D. Little determined its segmentation via focus groups, where groups of individuals were brought together and asked what types of occupations they thought would subscribe to cellular service. Based on the results of the focus groups, the following list was compiled.

Figure 7. Occupations of Interest

Architects	Computer Specialists	Chemical Engineers
Civil Engineers	Industrial Engineers	Mechanical Engineers
Life & Physical Scientists	Writers	Artists
Entertainers	Physicians	Dentists
Health Practitioners	Health Technicians	Teachers
Lawyers	Social Workers	Other Professionals
Managers	Administrators	Electricians
Foremen	Plumbers	Pipe Fitters
Delivery Personnel	Truck Drivers	Transport Equip Operators
Guards	Watchmen	Sales

Telephone interviews were conducted with individuals from the "occupations of interest" list. A questionnaire was specifically developed and tested to obtain the data needed for each study. The interviewers working on these projects were instructed to carry out a rigorous screening among potential respondents to the surveys in order to identify and interview only those people who spend a good portion of their day away from the office.

Market Size and Expected Penetration

Expected penetration rates and market sizes were determined in various ways by different organizations. While the level of effort and detail varied in each market area studied, Arthur D. Little typically employed a methodology based partly on analysis of demographic, employment, and local travelling characteristics of the area, **and** partly on application of results from a telephone survey conducted among a representative sample of potential users of cellular service in the area.

The demand forecasts were based primarily on population patterns and growth, with adjustments made for projected population movement, traffic patterns, income patterns, and centers of employment (industrial parks), shopping (malls), or entertainment (arenas). Demographic and economic data for the area were culled from federal, state, and local data collected through library research, phone calls, local interviews, and first hand observations. Population and employment forecasts were developed

judgementally based on current information and comparisons with available forecasts, as well as with inputs received from interviews with local government planning offkials. Demographic and economic conditions were expected to greatly impact the demand for cellular service. The assumption was that the more affluent, better educated and higher employment levels of a particular area, the more likely that the penetration rates of cellular subscribers would be greater as well.

Arthur D. Little applied likely penetration rates, based on the percentage of survey respondents who responded favorably, to projected employment levels of the pre-selected "occupations of interest" from which total demand by year was estimated. A "discount" factor was then applied to the surveyed demand levels to provide a more "realistic" forecast. The discount factor was applied because previous studies carried out in the telecommunications field involving acceptance and utilization of new products and services had indicated that survey results of demand levels do not materialize immediately. Not everyone who expresses interest in subscribing to a new service in fact does so at the outset. The experiences of products such as radio pagers, subscriber terminal equipment, and many forms of business terminals, was that it takes five years for surveyed demand levels to become reality. Thus the following discount factors were used:

1) In the first year of availability, a new service will capture and serve 25% of estimated demand at the price levels indicated.

2) During the second year of availability, the service will capture 33% of potential demand.

3) During the third year of availability, capture will reach 50% of potential demand.

4) During the fourth year, capture will reach 75% of potential demand.

5) By the fifth year, capture will reach 100% of potential demand at the stated price level.

6) Thereafter, capture will equal potential demand and will grow as a function of population and employment growth.

Although the surveys conducted included only individuals in selected occupations of interest, allowance was made for additional demand to materialize from other sectors- Since penetration within other sectors is not likely to be initially significant, it was assumed that at the outset of the service's availability, approximately one-half of one percent (.005) of the employment base other than the selected occupations of interest will be potential subscribers. Thereafter, it was assumed that this penetration would increase each year by one-tenth of one percent (.001) throughout the forecast period.

Overall demand therefore was determined by combining results of the described calculations for the two sectors – the discounted employment in the "occupations of interest" and employment in industry sectors outside of the "occupations of interest."

The CTIA's PREDCT model also predicts cellular's future penetration rate. This penetration rate is then used to calculate future demand based on market population. The assumption is made that the penetration rate is affected by a number of factors ranging from price reductions to technology improvements. A list of factors was carefully compiled so as to include elements that would likely have the most impact on the future penetration of cellular service.

Figure 8. PREDCT Model Impacting Factors

- Data Transmission: Ability to transmit data via cellular service
- Digital & Narrowband: Digital technology versus analog narrowband
- Spectrum Allocation: Increased allocation will improve coverage
- **Increased** Awareness: As more people learn about cellular, more will demand the *service*
- Consumer Use: When viewed as more than just a business tool, consumer usage will increase
- Equipment Price Reduction: As prices decline, demand will increase
- New Manufacturers: Expansion of market to include new hardware manufacturers
- Upgrades Yielding Used Equipment: A secondary market will develop for used equipment that will spur growth
- New Systems On-line: As system coverage increases, so too will penetration
- Fixed Use: Usage patterns of fixed telephone users may affect cellular usage
- Bandwagon Factor: Behavior is influenced by peer groups
- Factory-installed Availabiity: As more automobile manufacturers make cars with cellular phones as a built-in option, penetration will increase

A number of experts were contacted for their insights into each of these factors. Since cellular service was so new, experts' opinions were thought to provide more reasonable and realistic study results. The experts were first asked to input a "weight" for each factor.The weights were assigned to reflect the factor' s relative impact and importance to actual cellular sales. For example, the effect of price reduction will be stronger than the effect of readily available data transmission services. Consequently, 'equipment price reduction' was assigned a weight of "9" and 'data transmission' a weight of "4."

Each weighted factor is then independently rated for each year in the forecast. The year that a factor has its greatest influence is rated "10." All of the other years in the forecast have ratings for that factor relative to 10. For example, the effect of data transmission is estimated to begin about 1989 - 1990. However, the full effect is unlikely to be truly realized until several years later, perhaps as late as the year 2000. So the ratings for data transmission would steadily increase from 1989 until reaching " 10" in the year 2000.

The model then calculates the number of index points for each factor by multiplying its weight times the rating for each particular year. An annual penetration rate index is determined from the sum of each factor's index points.

New cellular service penetration rates are calculated by increasing the previous year's rate by the percentage rate increase in the penetration rate index. A sample of the model is displayed in Appendix B. The PREDCT model forecasted just under 2.5 million subscribers nationally for 1990.

Risk Assessment

Cellular infrastructure investment was considered a risk for cellular service carriers, but much less so for carriers operating in large cities where greater demand was expected. This was the primary reason for initial roll-out of cellular service in the largest MSAs.

In very large cities, prior to cellular service, IMTS (Improved Mobile Telephone Service) was being offered to a very limited number of subscribers. The service was plagued with tremendous customer complaints ranging from horrible service quality and difficulty in getting a free channel, to clumsy and expensive equipment. Even with the terrible service being provided via IMTS, huge waiting lists existed for the service. Based upon this information, it is likely that carriers in the largest cities felt that their risk was somewhat mitigated.

Financial infrastructure risk also existed, but could be managed by the number of cellular sites initially designed and built into a system. As a system grew in the number of subscribers, capacity could be increased by splitting cells or adding new cells to the system. The cost of building a new cell site or sites could be justified once the demand materialized.

Wireline carriers felt less pressure to be successful quickly as they were backed by huge corporations versus the non-wireline carriers that were usually backed by venture capitalists and private investors who often demanded quicker returns.

Cellular had a number of technical issues that were still being sorted out and left questions in the minds of potential subscribers and survey respondents:

- coverage areas/"black holes"
- equipment and service compatibility
- billing issues
- roaming ability
- security and privacy of conversations

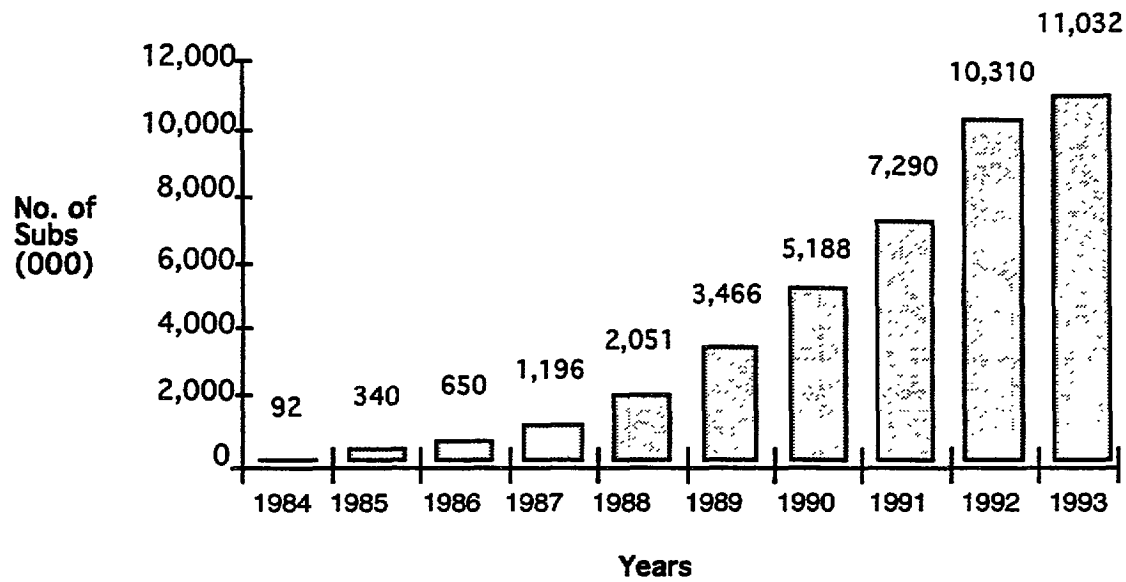
Cellular Communications Case Study

Actual Market Development

The majority of cellular service demand forecasts were considerably lower than the actual demand. With the exception of Motorola and Arthur Andersen, Inc., the early forecasts (1985 and before) were 40-90% lower than actual demand for the year 1990. It is possible that Motorola predicted an overly optimistic forecast to spur sales of its cellular handsets. The surveys conducted in the late 1980s, however, were generally more optimistic and therefore closer to the actual number of cellular subscribers in 1990. These forecasts had the advantage of monitoring and building on the initial market development.

Cellular service was initially targeted at two broad populations: the business market and affluent gadget lovers or early adopters. Market positioning focused on business-related needs (as an efficiency and productivity-enhancing tool). However, consumer acceptance of cellular progressed at a faster pace than expected, somewhat driven by the large decline in overall cellular phone hardware costs and airtime fees. The following chart depicts the actual number of cellular subscribers over the period of 1984 to the present.

Figure 9. Total U.S. Cellular Subscribers



Cellular Communications Case Study

By 1986, many cellular operators were unable to provide service to all the customers who were demanding cellular service. The systems were based on analog radio technology which posed serious limitations to the total number of subscribers that could use the system at any one time. By the early 1990s, several operators in large MSAs were converting to or adding digital radio technology to their systems to allow a much greater number of subscribers to utilize their systems. Digital radio technology requires that subscribers acquire new handsets (either fully digital or dual mode). This conversion continues today in smaller MSAs/RSAs.

As cellular service developed and usage became more widespread, several events occurred whereby the market forced the cellular service providers to be more responsive:

Usage revenues per subscriber decreased as subscribers became more careful about their cellular phone usage. The high usage costs caused most subscribers to become much more efficient with their cellular phone conversations. Many carriers responded with new pricing plans, options, and pricing packages with peak and non-peak usage rates as well as lower rates in general

Subscribers began demanding services similar to the landline services to which they had become accustomed (e.g., call forwarding, voice mail). Carriers were again forced to respond to the market by providing services and prices comparable to landline services.

Customer turnover became a big issue. Previously, carriers seemed mostly concerned with getting new subscribers signed up for service, with little thought given to customer retention or development of customer loyalty. Many subscribers would "hop" back and forth between the wireline and non-wireline carrier depending upon who was providing the best deal. Only recently have carriers begun developing strategies to retain customers, including various incentive packages and improved customer service.

Indeed, a current popular trend among cellular service carriers is to provide enhanced features to the regular service offerings. Call forwarding, Busy/no answer transfer, Call waiting, Conferencing, Roaming, Voice mail, Paging, and access to information services are all offered by cellular service providers in metropolitan and rural areas at a minimal additional cost. Traffic information, weather information, and stock quotes are among the most popular information services provided. In some areas of the country, it is possible to obtain live route guidance, sports news, and a menu of financial services beyond just quotes. It is likely that continued technological developments will positively impact the cellular market.

Cellular Communications Case Study

Lessons Learned

Many lessons can be learned from the work that was done when cellular demand was initially forecast:

- Major price declines were underestimated. Over the first five-year period after cellular service was introduced, cellular phone equipment prices dropped dramatically. The average price of a cellular phone in 1984 was around $3,000-to-$3,500. By 1989, the price had dropped to under $500. In the early 1990s, cellular phones were being offered free of charge by some service providers to entice customers to sign-up for service. Basically there were three reasons for the price declines:

  1) Manufacturing economies and efficiencies were gained as volumes increased,

  2) Intense competition ensued as Japan, Korea, and Taiwan jumped into the market. At least 20 different cellular handset manufacturers competed with products in the U.S. in the 1980s; and

  3) Getting cellular phones into people's cars was necessary to stimulate service usage.

- Cellular phones and other consumer electronics have demonstrated that huge price reductions are possible as production volume increases. Future demand forecasting for consumer electronic equipment (such as ATIS) should test potential demand at a wider range of potential prices to account for the possibility of future price reductions.

- Widespread consumer acceptance across income levels and industry segments was underestimated. It was assumed that only affluent, 40-year-old male executives would be the primary users of cellular telephone service. A wider range of occupations beyond just the "occupations of interest" should also have been considered. As the service evolved, it was found that user profiles were more diverse and heterogenous than initially assumed.

- Forecasting efforts should focus on both the short-term and long-term users of a new service as inclusion or exclusion of the long-term users will greatly impact demand forecasts.

- The full extent of the benefits provided by cellular phones was underestimated. Cellular service was initially expected to only be used for very important, not to be missed business issues (late for an appointment, etc.) or emergency situations. However, as cellular service became more widespread, it was found that cellular could provide a number of time-saving and efficiency producing benefits.

- Self-reported intentions by survey respondents are not always accurate indicators of future actions. Therefore, it is usually necessary to apply some type of discount factor to the forecasted demand to take into account the more realistic "take-up" of service and market acceptance. A danger in applying the discount factor is being overly conservative, which occurred with the use of discount factors in forecasting demand for cellular service.

- The cellular demand estimates that were made in the early 1980s were only valid under the economic and technological conditions at the time of the survey and did not reflect changes that occurred in the environment over time. Environmental changes occurred in the 1980s that were not anticipated in any of the forecasts. For example, users were willing to pay a premium for time savings devices, like cellular phones. When forecasting demand of this type, it is important to consider and incorporate alternative future scenarios that could either positively or negatively affect demand.

- When performing a consumer survey, it is important to conduct interviews with the individual that actually make the purchase decision or the primary cellular user who is responsible for the bill. Forecast accuracy is greatly improved if the buying source is surveyed.

- Attempts should be made to help survey respondents "visualize the technology" (especially with very new concepts) to fully appreciate the capabilities and benefits of the product or service being tested. The better the understanding of the product, the more accurate will be the responses. This is often accomplished using focus groups, and concentrating on the benefits that the product provides.

Many of these lessons should be useful in conducting future forecast work, especially for ATIS, whose concept has many similarities to cellular service.

Automatic Vehicle Identification/Location Case Study

Market Product Background

Automatic Vehicle Identification/ Location (AVI/L) refers to a group of technologies that locate and identify vehicles (see Figure 10). This service is generally provided to dispatchers of a fleet of vehicles, such as trucks, police cars, ambulances and such. In practice, the acronym AVI/L should have a C added for communications, as it is unusual to find an AVI/L service that does not also provide two-way communications to the vehicle. The primary use of AVI/L services is to improve fleet management by increasing the level and accuracy of information on the location of the fleet vehicles and improved communication with the vehicles. The pay back on improved information and communication is increased fleet productivity, which can allow a simultaneous improvement in customer service, and reduced costs.

As the name suggests, AVI/L systems are made up of component technologies to identify, locate, and communicate with a vehicle. Figure 11 shows the numerous firms that currently provide or are planning to provide AVI/L services in the U.S., and the range of technologies used for each function. Location and communication are often provided by the same technology, some of which are ground based, while others are satellite based (both geosynchronous and low-earth orbit). Ground-based location systems, such as Loran, cellular or radio frequency, are accurate to approximately 1000 feet. Satellite based location systems provide accuracy to approximately 300 feet. Identification is generally provided by associating the location/communication device with the vehicle in which it resides.

Firms that offer AVI/L, at least the pioneering ones, emerged to provide services that they thought the market needed. Their businesses were built to satisfy the largely latent need based on their observation that two-way radio was successfully being used for dispatching purposes in urban areas.

The real pioneer in this field is no longer in existence. Geostar, Inc., was founded in 1983 by the late visionary from Princeton, Jerry O'Neill, and went out of business in 1991. Geostar's original product provided location and communication information based on Radio Determination Satellite Service (RDSS). This was a new technology in which two satellite in geosynchronous orbit provided both location and communication services.

Geostar's ultimate failure in the market was based more on a lack of understanding of customer requirements (combined with some technical problems) than lack of customer acceptance of the basic service provided. The Geostar system required dedicated satellites, or at least dedicated telecommunications channels in a multipurpose satellite. This became a problem when one satellite failure delayed the introduction of the service. When the service was initiated following the launch of another satellite, problems emerged with the communications capacity which limited service to one-way communications only. This was found to be inadequate by the early buyers as it severely limited the functionality and usefulness of the service. This is an example of where Geostar could have used market research more effectively. Market research is

Figure 10. AVI/L Service Characteristics

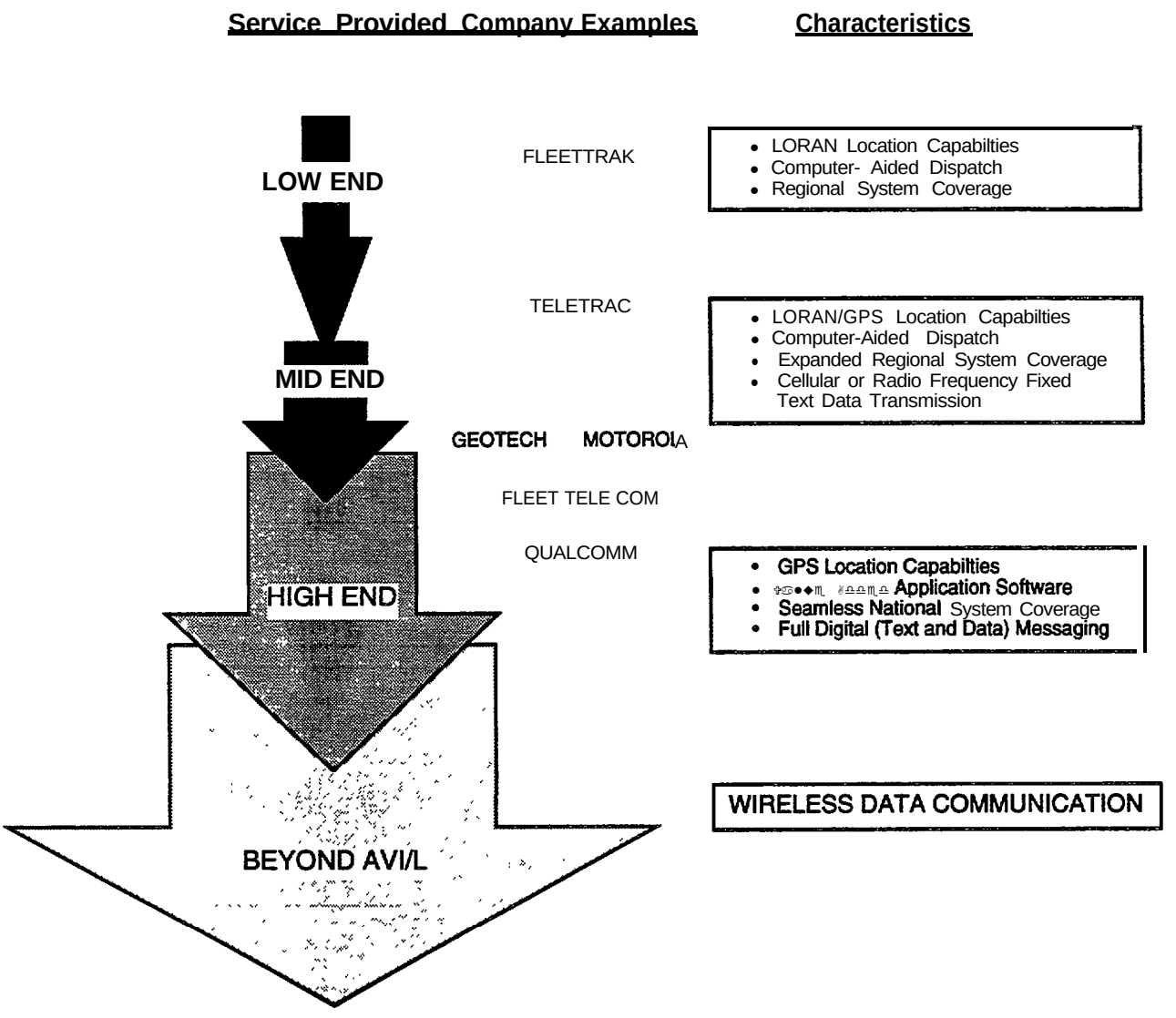


Figure 11: Providers of AVI/L Services in the U.S.

Firm	Service Name	Location Provide By	Communication By	Operational?
Qualcomm (San Diego, CA)	OmniTRACS	RDSS	Geosyn-chronous Satellite	Yes
Motorola (Shaumberg, IL)	Coverage PLUS	GPS	SMR	Yes
Pinpoint (Richardson, TX)	ARRAY	Ground-based RDS-IMDN	IMDN	No
Orbcomm (Fairfax, VA)	-	Satellite-based GPS	Low-earth Orbit Satellite	No
Geotechnology Dev. Inc. (Hernson, CA)	TRACKER	STARSYS Satellite Location	Satellite	Yes
Highway Master (Dallas, TX)	-	Ground-based RDS-Cellular Phone	"Smart" Cellular Phone	?
GTE (Atlanta, GA)	-	Proximity Sensors	Cellular Phone	?
KSI, Inc. (Annandale, VA)	DFLS	Ground-based RDS-Cellular Phone	Cellular Phone	No
PacTel Teletrac (Inglewood, CA)	Fleet Director	Ground-based RDS-Radio	Private Radio	Yes
II-Morrow (UPS) (Salem, OR)	-	Ground-based RDS	Private Radio	Yes
Navigational Data Systems (New Orleans, LA)	Fleet-Trak	User Selected	User Selected	Yes
Fleet Telecom (MCC) (Kent, WA)	-	GPS or Loran	Meteorburst	Yes
Trimble Navigation (Sunnyvale, CA)	-	GPS	Cellular or Private Radio	Yes

Note: RDSS: Radio Determination Satellite Service: A system that determines location through using two satellites in geosynchronous orbit and a stored map of terrestrial elevation.
RDS: Radio Determination Service: A system that determines location through triangulation using ground based wireless communication systems
GPS: Global Positioning System: A system that determines location through triangulation using 24 low earth orbit satellites
SMR: Specialized Mobile Radio: A multichannel, publicly shared trunked radio service used mostly for dispatching (e.g. taxis) fleets.
IMDN: Intelligent Mobile Data Network: Recently developed networks that combine AVI/L and mobile data communications
LORAN: Long Range Navigation: A government network of high powered transmitters used initially to provide marine location information, subsequently expanded to provide location to ground vehicles.

Source: Arthur D. Little

particularly appropriate for determining functional requirements and could have easily revealed the requirement for two-way communications. Geostar eventually offered a two-way communication service, but not before several competitors had established themselves and put Geostar at a significant competitive disadvantage. Geostar went out of business in 199 1.

Among the competitors that emerged, one was particularly important: Qualcomm, founded in 1986 by Irwin M. Jacobs, exploited the problems Geostar was having. Since the Qualcomm technology used existing satellite-based channels, there were no delays in providing service. While the accuracy and coverage of Qualcomm' s location and communications technology was not as high as that offered by Geostar, it was found to be acceptable by customers. Qualcomm's product had two other features that turned out to be important to customers: it was available and it was reliable. All of these issues -- accuracy, coverage, availability, and reliability requirements -- are again all areas that Geostar could have explored effectively through market research.

In establishing a market for new service, it is often necessary to land one key customer that will act as both a test bed and an indicator to the rest of the industry that the product is "real." Qualcomm used this strategy effectively through a large strategic sale to Schneider Trucking, recognized as an innovative carrier, in 1988. This one sale established Qualcomm and boosted it to the level of a mature service provider. A variation on this strategy was pursued by another early AVI/L provider, II-Morrow (pronounced as tomorrow). II-Morrow, founded in 1982, was bought in 1986 by UPS, which obviously recognized the potential of the technology.

The primary customer base for AVI/L services are trucking firms that tend to be:

- Large - Fleets of more than 100 trucks and revenue of more than $5 million that can afford the expense of the systems.
- National - National carriers have a greater need to be able to locate their vehicles on long (distance and time) hauls. Local operators tend to run shorter routes with less variability in the time required.
- Truckload service providers - Carry loads that are full truckloads, for a single customer, on a point-to-point basis.
- Special commodities haulers - Hazardous, refrigerated, or time sensitive materials for which monitoring of position and time to destination is critical.

The reasons most often cited for purchasing AVI/L services are:

- Improved customer service - AVI/L allows the trucker to tell the customer where their load is and provide more accurate forecasts of when it will arrive at the destination.
- Increased fleet productivity - More precise information on location and time to destination allows the dispatcher to schedule shorter turn-around times and improve the efficiency of scheduling "backhauls."
- Creating a barrier to entry - Having AVI/L raises both the capital cost required to enter the trucking market (which helps keep new entrants out) and can create a standard for customer service that must be met by existing competitors.

- Reducing communications cost - Prior to the use of AVI/L, long-haul truckers' primary form of communications with their base was telephone. Tbis required drivers to stop to call in, which created substantial amounts of downtime for the truck and added cost and time to each trip.
- Monitoring driver/vehicle performance - Recent AVI/L systems allow the communication of a wide range of vehicle performance information (average speed, fuel consumption, etc.) that is useful in ensuring that the driver is adhering to operating procedures. The communications function can also be used to monitor when the driver is out of the vehicle for unauthorized stops.
- Added capability for emergency communications - AVI/L provides quicker response time to breakdowns and could be used in the case of medical emergencies.

The development of the AVI/L market provides relevant insights into the potential market for ATIS because it uses similar technologies and provides similar benefits, i.e. information and increased efficiency/timesaving. It provides a lesson in the role of government, as the government played only a limited role in the market development of AVI/L services. Little of the risk or reward was shared with the public sector. Besides licensing for communications purposes, and being an occasional customer, the government in general did not participate in the creation of this segment of IVHS The government, in some cases, did support the development of products and services from which the AVI/L offerings were derived.

The following assessments of the market research activities and market development path is based on interviews with several providers of AVI/L services. Six firms from the list in Figure 11 were selected to provide a cross section of early and late entrants, and large and small firms. One of the large firms preferred to remain anonymous and will be referred to as "Company A" in the text.

Market Assessment Methodology

Overview

One of the key conclusions of our investigations is that the companies entering the AVI/L market did very little formal market research in terms of conducting surveys, focus groups etc. Because this is strictly a commercial product, the market research that was done tended to be informal, primarily through direct contact between company representatives and customers.

To the degree that formal market research was done, the level and type of market research that firms undertook in assessing the market for AVI/L services was determiued by two factors:

- Whether the firm was an early entrant, when the market was still undefined, or entered after the market had been established. Early entrants typically did a more extensive job of market research than did the later entrants.

- Whether the AVI/L product was the firm's only product, or was an extension of an existing product line. Because the risk for single product firms is higher, they tended to do more market research.

One general observation that can be made is that regardless of the level of effort and rigor put into the market assessments, they were almost universally inaccurate. Most market participants overestimated the market size by a wide margin. Some of the market segments initially considered to be lucrative, did not prove to be so. In addition, the one segment that is providing revenues, the heavy trucking industry, is developing more slowly than originally thought.

The following sections provide details of our market assessment findings. The discussion is divided into six sections:

. Needs assessment,
. Willingness to pay,
- Market size and penetration,
. Market segmentation,
- Profitability, and
- Risk assessment.

Needs assessment

Needs assessment was one area where the research tended to be quite informal. Determination of customer needs was made through contacts and information exchanged via executive meetings. Private research/consulting firms were also used to conduct interviews with potential customers to defme the range of potential needs.

Company A used its strong sales force and significant customer base in the two-way radio market to gain access to information on the changing needs of customers. Using the information gained, Company A used industry meetings/conferences as a forum for its marketing and sales programs which were designed to address the developing market needs.

Fleet Telecom conducted their market needs assessment in a two fold manner. First, prior market assessments by outside consulting groups (such as Watters, Inc., and the Gartner Group) were studied to get an initial "read" of the market. The firm then hired an executive from a transportation company to conduct interviews with industry executives to define their needs.

Qualcomm used a similar approach. The company founders themselves conducted numerous interviews with industry leaders to define the needs of their potential customers. The results of these interviews led them to the conclusion that the technology they bad previously developed for satellite communications could also be used effectively to address the perceived communication/location needs of the transportation industry.

In the early 1980s, when the development of the market for AVI/L products first began, the market could be characterized as "technology pull." The need for AVI/L was generally latent, meaning customers did not perceive a strong need, and there was no obvious market pull. Some trucking firms did grasp the potential advantages that combined tracking and communication systems could offer, but they were rare. Most potential customers had to be educated. The efforts of the early suppliers of AVI/L products therefore focused on *need development* in a sense, rather than *need assessment.* A central thrust of many of the marketing efforts was development of cost/benefit analyses that would demonstrate to potential customers the potential savings from use of AVI/L. This gave the sales force a tool to use with customers to demonstrate that they had a need, and concretely show the savings and efficiencies attainable through the use of AVI/L in general, and their product in particular.

The initial successes of AVI/L in the Truckload industry (often a technology leading segment) established the potential advantages of AVI/L technology and opened new markets in other transportation areas such as the Less-than-truckload business, rail (intermodal), marine, and public transit (bus and taxi). As the market matured and the customers came to realize the potential benefits of AVI/L generally, the marketing efforts of the later entrants into the market place focused on the more traditional marketing activities of identifying specific needs of the customer and demonstrating how their product met those needs in a more cost effective manner than their competitor's product.

Willingness to pay

Pricing of AVI/L services varies significantly depending on the level of service and functionality provided. As described earlier, these may range from basic two-way location and communication, primarily voice with some fixed text messages, to communication of significant amounts of vehicle operating data and flexible messaging capability. The customer willingness to pay depends, not surprisingly, on the perceived benefits, particularly the competitive advantages offered by the service. The benefit that a particular customer will derive from use of AVI/L hinges on a number of unique factors of that particular customer's operations. As a result, the approaches that suppliers of AVI/L products used to assess customer willingness to pay basically were an extension of the payback analyses that were used to market the systems in the first place. These models were used to derive the expected benefits and then assign a price that would be palatable to that customer.

All of the firms that we interviewed settled on using a client-specific approach for packaging and selling the service. Operational complexities vary from customer to customer, therefore, the products are tailored for each saies call. The hardware for each system is the same, but the level of system development and how the tracking software may interact with the client's pre-existing applications varies. For example, Fleet Trak purposely designs its product to be transparent of the communication software the client may have, and Company A's system is designed to interface with the dispatch software already being used by the potential customers. At the other extreme, there is Qualcomm, which sells fully integrated tracking and data communication services. In

services. In all cases however, post-sale client evaluation and subsequent system adjustments are the norm.

Market Size and penetration

Our research indicates that many early suppliers of AVI/L products made no explicit attempt to determine what the total potential market for their products would be, nor did they make any rigorous attempt to segment the market.

For firms that did spend some effort in sizing the market, two methods were used:

- II-Morrow and Motorola - These firms followed a "top down" market assessment approach. They considered the size of the entire market, and, by applying assumptions relating to percent capture and levels of competition, calculated the potential market size.

- Qualcomm - This company followed a "bottom up" approach. It matched the product's potential benefits to the specific needs of receptive market segments. Adding together the number of potential sales to each market segment yielded overall market size.

Using the "bottom up" approach as practiced by Qualcomm, the present day market for AVI/L services in the trucking industry is generally considered to be approximately 850,000.

* The trucking industry is the primary end user.

- Within the entire trucking industry, operators of Classes 6, 7 and 8 trucks are the prime target segment. The capabilities offered by AVI/L services are best suited to this market because these operators tend to run relatively large fleets, with 9 1% being owned and operated as fleets of five or more trucks (See Figure 12 -- Note: The data shown is representative of 1991 data, but industry ownership and operational characteristics have not varied greatly over time.)

The 2,875,000 class 6, 7 and 8 trucks on the road today are further reduced by eliminating:

- The 40% that are primarily local operators and therefore do not require the wide area location and communication capabilities of AVI/L products.

Of the remaining 60%, or approximately 1,725,000 trucks that operate on a national, regional, and intrastate basis, the final market estimate was derived by eliminating:

- The 50% that are primarily fixed or mixed route operators. These firms have less variability in where a vehicle might be, and correspondingly less need for location and communication.

Figure 12: Commercial Truck Market Characterization

THE COMMERCIAL TRUCK MARKET FOR CLASS 6, 7 & 8 TRUCKS																
	Class 6 Trucks				Class 7 Trucks				Class 8 Trucks				Summary			
	Fleets & Operators of 1 to 4 Vehicles		Class 6 Trucks		Fleets & Operators of 1 to 4 Vehicles		Class 7 Trucks		Fleets & Operators of 1 to 4 Vehicles		Class 8 Trucks		Fleets & Operators of 1 to 4 Vehicles		Class 6, 7 & 8 Trucks	
	Number Operating	% of Total	Number Operating	% of Total	Number Operating	% of Total	Number Operating	% of Total	Number Operating	% of Total	Number Operating	% of Total	Number Operating	% of Total	Number Operating	% of Total
Fleets																
25 or More Vehicles	32,500	24%	575,000	78%	32,500	25%	625,000	78%	40,000	18%	1,275,000	80%	48,000	13%	2,475,000	78%
5 to 24 Vehicles	33,500	24%	95,000	13%	27,500	22%	100,000	13%	60,000	28%	205,000	13%	72,000	19%	400,000	13%
Sub-Total	66,000	48%	670,000	89%	60,000	47%	725,000	91%	100,000	46%	1,480,000	93%	120,000	32%	2,875,000	91%
Operators of 1 to 4 Vehicles																
For-Hire One Truck Operators	10,000	7%	10,000	2%	10,000	8%	10,000	1%	80,000	37%	80,000	5%	100,000	27%	100,000	3%
Businesses Operating 1 to 4 vehicles	61,000	45%	70,000	9%	57,000	45%	65,000	8%	37,000	17%	40,000	2%	150,000	41%	175,000	6%
Sub-Total	71,000	52%	80,000	11%	67,000	53%	75,000	9%	117,000	54%	120,000	7%	250,000	68%	275,000	9%
The Total Commercial Truck Market	137,000	100%	750,000	100%	127,000	100%	800,000	100%	217,000	100%	1,600,000	100%	370,000	100%	3,150,000	100%

Source: "Fleet Owner: Market Report Number Nine." Intertech Publishing, 1991.

The remaining 50% (850,000 trucks) are primarily variable route operators. These operators are the primary target market because they are the least likely to be able to pinpoint with any level of accuracy where their trucks are at any given time and therefore will benefit the most from the use of AVI/L services.

Market segmentation

The above section illustrates the type of market segmentation that most of the firms we interviewed used in analyzing the market for AVI/L. The objective of market segmentation is to break down the population of potential customers into smaller groups/segments that have similar needs. In the case of the trucking market, the most effective way to do this is along operational lines. As illustrated above, the segmentation variables that are typically used include:

- Fleet Size - Larger fleets are more likely to have a need for, and be able to afford, AVI/L services.

- Range of Operation - Truck fleets that operate on a regional or national basis are more likely to require AVI/L services. For fleets that operate on a local basis there are lower cost local communications products available that meet the needs of these users.

- Variability of Route - Fleets that operate over variable routes are more likely to require AVI/L services. Dispatchers for variable route operators can benefit from the location part of AVI/L as they are less likely to know at any given time where a particular truck is.

In addition to this operational segmentation, the early suppliers of AVI/L services investigated several other possible segmentations:

- Trailers (e.g., those carrying hazardous materials)
- Buses (e.g., inter-city, local)
- Rail (e.g., locomotives, rail cars)
- Water transportation (e.g., barges, tow boats, fishing boats)
- Aviation (e.g., commercial, commuter, general aviation)
- Personal communications
- Government agencies (Sate D.O.T.'s, Police, Fire)
- Recreation/consumer (e.g., boating, auto clubs)
- Fixed sites
- Car fleets (e.g., business, rental)

These segments generally did not develop, either because there was insufficient need for this type of service or a more cost effective alternative was available to meet the need.

Profitability

The level of profitability that a supplier can expect depends, obviously, on two factors:

- The cost of providing service, and
- The revenues that the service generates.

The most critical cost factor is whether the AVI/L product requires a new/dedicated infrastructure or uses a preestablished infrastructure. The technology selected by Geostar required a new telecommunications infrastructure using dedicated satellites. The cost of this infrastructure played a large role in the failure of Geostar. Qualcomm, which has been a greater commercial success, based its service on an existing infrastructure, significantly reducing the cost and allowing higher margins.

The revenue aspects of AVI/L are quite similar to cellular phone services in the sense that there are two potential revenue streams:

- Sale of the initial hardware and installation, and
- The subsequent service and network usage fees.

Most of the firms that we interviewed have established a pricing strategy that discounts the hardware costs so as to generate consistent revenues from service and network usage. A similar approach has been taken in cellular phones and is typical in cases where high fixed costs (such as the infrastructure) must be borne. Examples of AVI/L suppliers that have taken this approach include Company A, Qualcomm, and Fleet Telecom. The one exception that we found to this rule was Fleet Trak, which prices the hardware at cost.

Actual profitability is difficult to assess as most of the suppliers of AVI/L products are either relatively small, privately held companies that do not report financial results, or are divisions of large companies where the individual results are not broken out. The firms we interviewed were not willing to share the details of their profitability. However, the fact that even a firm offering only this offering (such as Qualcomm) is still in business indicates that it is a reasonably profitable business, providing important benefit to at least some customers.

Risk assessment

The level of perceived risk and efforts to manage that risk is most directly related to the diversity of a company's product portfolio and the level of investment required to enter the AVI/L market. Those companies that had existing applicable technologies perceived less risk in entering the AVI/L market and thus expended less energy on market research and market assessment than did the companies that developed products specifically for this application.

For many of the AVI/L suppliers, this market was an expansion from other areas.

- Fleet Trak began product development in the avionics field through a seven year joint effort with the FAA. Some public sector work was generated from the success of the initial project. However, it was the contractual arrangements with the FAA

and the enhancement that the government demanded that provided the initial driving force in the advancement of the technology that so easily lent itself to terrestrial tracking.

- For Fleet Telecom, the Department of Defense gave $10-$20MM a year from 1983 to 1989 for the development of the technology to be used for the secure communication of classified military information. Three years ago, as defense conversion became a reality, the company moved toward the private sector with a near fully developed product. Thus, this firm also did not assume a major risk.

- Company A's perceived risks were in the areas of hardware upgrades and interface development. The firm already had a network of Special Mobile Radio transmitters it used for its two-way radio products. However, these had to be upgraded at significant cost. As mentioned above, Company A's product is designed to integrate the client's pre-existing dispatching software. This approach mandated legal contractual agreements with multiple software providers. The level of effort spent in developing these interface agreements had to be balanced with the size of the customer base potentially served.

For companies that embarked on a path of product development specific to the AVI/L market, the risks were perceived to be extremely high and had to be managed.

- Geotech views production and capital costs as risks. It is not able to set prices based on recovery of all investment costs, as this could result in prices higher than the market would accept.

- Qualcomm is another example of a company managing product development risk. Success has been attained by satisfying the customers explicit and implicit demands by adding significant value-added applications and systems. But staying ahead of the benchmark market offerings means significantly higher costs associated with redesign and marketing.

Actual Market Development

The actual market acceptance of AVI/L services has generally been lower than the projections of most of the companies that we interviewed. Actual market returns ranged from 95% to 25% below expectations. One firm, II-Morrow, has achieved acceptance that exceeds projections by 10%. But this is best explained by overly conservative projections than by outstanding levels of sales.

Those companies whose projections were the least accurate followed a "top down" market assessment approach. The companies that followed a "bottom up" market assessment approach have fared better, with deviations in these cases being attributable more to unexpected market conditions (i.e., new competitors, latent buyers) and the national economy than to poor forecasting methods..

- Qualcomm is by far the most successful in terms of both number of units sold and in generating operational profits.
- Company A has had significant unit sales but has yet to turn a profit.
- Later entrants, such as Fleet Telecom and Geotech, have developmental technologies and are still in the process of obtaining adequate financing.

Most firms are not willing to divulge market projections, with the exception of Geotech, which expects sales to approach 300,000 units in 1998. Other research reveals that Qualcomm, the industry leader, has shipped upwards of 40,000 units since 1989. This is a relatively small number compared to the potential market size of 850,000 trucks..

The poor sales performance relative to the potential market can be at least partially explained by the fact that customers have yet to be fully convinced of the cost effectiveness of AVI/L products. The costs associated with operating one truck over a five-year basis are quite high2:

- $40,000 for a cellular-based system, such as the type offered by Company A,
- $15,000 to $95,000 (based on levels of operational complexity) for a satellite-based system, such as Qualcomm produces,
- Approximately $8,000 for other technologies, such as that offered by Fleet Telecom.

Given these prices, customers must realize significant operational savings to justify a purchase.

In addition, customers have concerns regarding AVI/L system capability, longevity and flexibility. These concerns have required suppliers to make wholesale infrastructure changes and expand application capabilities. Several examples of these issues include:

. Compatibility problems with customer MIS - II-Morrow's earlier products were designed for mainframe application. However, situations developed where mainframe incompatibility rendered system installation or upgrade impossible. The result was a significant product shift toward a personal computer application. For Company A, the computer-aided dispatching software interfaces were a stumbling block. If a potential client made use of a dispatching software with which Company A did not have a pre-designed interface, the cost of the system became prohibitive.

2 (Source: Rupert Welsch. "Communications System for Trucks Awaits Approval" New Technology Week. June 1, 1992.)

- Concern with infrastructure availability - For the satellite service companies such as Qualcomm and Geotech, there is still marked concern over satellite networks. Third-party firms are responsible for the development and subsequent launch of the satellites. Due to the poor track record of the United States satellite industry, satellite availability remains an issue. Similar large scale infrastructure variables affect Fleet Telecom. The company is still in the process of coordinating financing to build a nationwide network.

- Requirement for more value-added applications - Potential customers also demand that the data made available through AVI/L services be suitable for more productive use. High-end service providers, such as Qualcomm and Company A, have created value-added system extensions. Qualcomm is looking into OEM agreements that may eventually tie in engine, cab, and trailer safety/operational information to the data network. This will allow for more efficient repair and servicing. Company A has upgraded its in-cab computer console to accept multiple peripherals, such as lap tops, bar code readers, and fax machines, which is an industry first. These advances may allow for immediate invoice delivery. These wireless data advances have spurred Company A to begin marketing an "off-the-shelf" system to low-end users through its preexisting retail network, a move that has met with marginal success. Although Company A is joined by other providers such as Qualcomm and Geotech in the belief that AVI/L has consumer potential, most producers feel the cost is too prohibitive to justify offering service at a consumer level.

As this substantial product evolution demonstrates, AVI/L without mobile data communications offers little value to the market because it cannot address most real-world mobile applications. Furthermore, the continued market latency demonstrates that the present methods of combining navigational/location applications with separate data communication links are still considered too expensive. The technological responses to market demands for information richness, efficiency, and cost effectiveness will continue to reshape the industry.

Lessons Learned

The AVI/L market development offers several potentially useful lessons for how to approach the ATIS market. One unique aspect of this market is that it has not been particularly successful, and many of the factors that have contributed to the lack of success could potentially be present in ATIS as well.

- It is important to get the product "right" the first time out. Geostar, the first company into the market, had significant troubles with its early product. Geostar never really recovered from those problems. It is also possible that the difficulties experienced by Geostar have contributed to the slow development of the market, as potential customers are wary of similar problems with other suppliers.

- Marketing effort should be proportional to the risk being taken. There is a demonstrated higher level of risk for firms that offer only one product as opposed

to firms for which the AVI/L product is just one in a larger portfolio of products. Risk is correspondingly high for those firms that are the first to enter the market.

- Marketing messages change as the industry evolves. Strategies changed from convincing the buyer to buy the product through a payback analysis, to convincing the buyer to buy your product through a price-for-feature comparison. This duality of approach is apparent during the development cycle of a latent market.

  Overestimating customer needs and willingness to pay can lead to overestimates of the market size. The "bottom up" approach to market estimates produced better results as it forced a closer examination of customer benefits. The "top down" approach consistently resulted in overly optimistic forecasts. However, most of the estimates of AVI/L market size were excessive, irrespective of the approach Explanations for the over blown market estimates include the pervasive effects of excessive optimism as well as delays in service offerings and/or product roll-outs resulting in time shifts for market projections.

- Pricing seems to be based largely on cost. Generating a reasonable rate of return is the most significant contributing factor to pricing. Many firms have committed no significant capital expense in creating new infrastructure and risks have been low. Therefore sustained profits are expected. Attention, of course, is paid to the customers' willingness to pay as well as competitive factors. The pricing strategy makes a careful distinction in willingness to pay upfront versus on an ongoing basis. Cost recovery is achieved by balancing low up-front costs for purchasing the unit hardware with a significant service charge.

- To be successful, careful attention to what customers really need is required. Just providing data (e.g., the truck's location coordinates) does not help the customers as much as giving value-added-information (e.g., status of driver and vehicle, ETA to delivery point) that the client needs to run the business.

Application To Advanced Traveler Information Systems

The overall objective of this study is to assist the FHWA in understanding how market research is used in the private sector to predict consumer and market response to new and innovative products. The above sections have provided illustrations and examples of market development and market research used by existing products/services that are analogous to ATIS.

The specific objective of this section is to apply the lessons learned in the case studies to possible future market research activities for ATIS, and identify particular caveats and opportunities for those activities.

As noted in the introduction to this report, the primary objective of market research is to better understand the potential customers for a given product. Before applying the lessons derived from the case studies, a brief outline of ATIS and some of the expected characteristics and benefits of ATIS will be presented. This will provide the necessary base to analyze the lessons derived from the case studies and the implications of these lessons for ATIS.

What is ATIS?

The IVHS strategic plans defines ATIS as:

> *"Advanced Traveller Information Systems (ATIS) acquire, analyze, communicate and present information to assist surface transportation travelers in moving* from *a starting location (origin) to their desired destination."*

Clearly this leaves a wide range of potential products that could fit into this definition. Before moving into market research on ATIS, the specific products and services must be more precisely defined. In order to effectively define customer needs/wants (one of the main objectives of market research) the main features of a product must be defined as well as the range that is available in each of those features. This allows the market research to be designed to test relative importance of each features and what level of each feature is required.

As an example of this process, ATIS services can be well defined by three key features:

i) Level of **"Intelligence" -** In order to clarify this feature it is useful to make a distinction between "data" and "information." "Data" is an item to which no value has been added. "Information" is a piece of "data" that has been processed in some way to provide added value. In the context of ATIS, a map (whether displayed on paper or electronically) is "data," no value added has been provided to assist the driver in their task. Route guidance, on the other hand, is "information," as the data in the map has been processed to assist the driver reach their desired location.

A minimum of three levels of "intelligence" can be defined:

- Data Only - This includes maps, most signs, timetables and information on location of services.

- Static Information - Route guidance and other types of assistance that does not include connection to traffic information.
- Dynamic Information - Route guidance and other types of assistance that is combined with traffic information.

2) Update Frequency - How often is the data updated. While there is a wide range of update frequencies, three ranges appear reasonable:
   - Periodic - Several years (Maps) to several months (statistical time-of-day and day-of-week traffic information).
   - Frequent - 15 to 45 minute updates similar to the frequency of present traffic helicopter services.
   - Real Time - 0 to 15 minute updates.

3) Delivery Point - Where the data/information is provided. Here again, at least three possibilities are available:
   - Fixed Point - In home, Kiosk, Signs.
   - Dedicated In-Vehicle - Navigation and other systems built into the vehicle.
   - Transportable - The advent of Personal Digital Assistants (PDA's) is likely to give rise to a set of products that are fully mobile.

When the product features and ranges are correctly selected, the entire universe of potential products cau be defined through combinations of those features. Within each product feature, the options imply increasing levels of complexity and cost.

Benefits of ATIS

Returning again to the definition of ATIS in the strategic plan, an indication of the expected benefits from ATIS are given by the statement that ATIS systems will:

> *"provide such assistance in a manner that best satisfies the travelers needs for safety efficiency and comfort. ""*

- Safety can be enhanced by ATIS through allowing the driver to concentrate on driving rather than navigating, avoidance of congested areas, avoidance of high crime areas etc.

- Efficiency can be improved by reducing the time required to locate and get to the desired location, avoiding trips entirely during congested times, etc. This is generally believed to be the primary individual benefit provided by ATIS.

- Comfort can be enhanced by reduced anxiety of not being certain of a given route.

In addition to the above individual benefits, ATIS has the potential to provide societal benefits such as reduced pollution and fuel consumption.

Lessons Learned and Application to ATIS

This section will present a summary of the "lessons learned" from one or more of the case studies, and a discussion of how those lessons can be applied to ATIS. This will be presented in the same categories used in the case studies (Needs Assessment, Willingness to Pay, Market Size, etc.).

The majority of the key "lessons learned" relate to the first two categories, needs assessment and willingness to pay. This is a reflection of the fact that these are the two key objectives of market research. Most of the other categories can be derived from the assessments of these two issues. For example:

- Market size can be derived from the combination of the needs assessment and the willingness to pay. Market size will be determined by the number of customers who indicate sufficient need aud willingness to pay.

- Market segmentation is a derivative of the needs assessment. Market segmentation is simply defining sub-sets of customers that have similar sets of needs.

Needs Assessment

An accurate assessment of customer needs is arguably the most critical market research task. The needs that are uncovered by market research are used to drive the product development process. They will determine what features are built into the product, which in turn, will play a major role in determining product cost. Cost obviously has a major impact on the ultimate market success or failure of the product.

For ATIS, there is evidence that travellers have at least a basic need for travel information -- they buy maps and guidebooks, they listen to radio traffic reports, etc. The objective of market research into ATIS should be to significantly refine the understanding of that need. Before undertaking market research, a set of hypotheses should be developed about what the expected needs are. In the case of ATIS the hypotheses should be formed around several basis questions:

- What types of traffic intelligence do travellers require?
  - How do the intelligence requirements vary by customer segment (private versus commercial, commuter versus infrequent user, etc.).

- What level of intelligence do travellers require?
  - Dataonly?
  - Value-added Information?
  - At what update frequency do travellers require that intelligence?

- Where and how do travellers want to receive that intelligence?

The case studies offer a number of lessons that can be used to guide the market research designed to answer these questions.

Don't underestimate the difficulty of accurately assessing customer needs. Two of the three case study markets were substantially mis-forecast, and in the case of ETC it is still too early to tell. The cellular phone market was under estimated, in part at least because the range of customer needs and the uses that customers would find for cellular phones was underestimated. The AVI/L market was over estimated in large part because the customer needs were over estimated.

Customer needs can be more accurately assessed by presenting realistic representations of the product/service. This was done in the ETC market through the use of videotapes and computer simulations. Operational tests are often used largely to get a real world product assessment. The difficulty with operational tests is that they are limited to the technology that is currently available, which computer simulation is not. The accuracy of assessing customer needs can also be increased by using several different assessment methods and "triangulating" (comparing results of several methods) the results to test the robustness of any one method.

Fiially, it should be recognized that even consumers themselves cannot always accurately predict what their future needs and potential uses for a product will be. To predict very long term needs, it is often more effective to use an "expert" approach (either an individual or a Delphi type survey) rather than go directly to the consumer. This approach was taken by several of the participants in the ETC market.

Recognize the existence and importance of multiple customers/stakeholders In almost all markets there are multiple customers, each of which has an influence on the buying process. The needs of each of those groups must be explicitly recognized and addressed to enhance the opportunity for market success.

In some cases the multiple customer groups are quite obvious. In the ETC market, the driving public and the toll authorities make two distinct and obvious customer groups. However, even for a product such as AVI/L, where the primary customer might be the Fleet Manager or Dispatcher, the needs of others impacted by the use of AVI/L products -- drivers, maintenance -- should be explored.

This type of customer chain can be defined for most products (see Figure 13), and is likely to be a very strong factor for ATIS. At a minimum, ATIS will have several levels of customers within the traveling public, as well as other stakeholders at the state D.O.T.'s, other government agencies and private firms providing ATIS services.

Figure 13: Chains of Customers

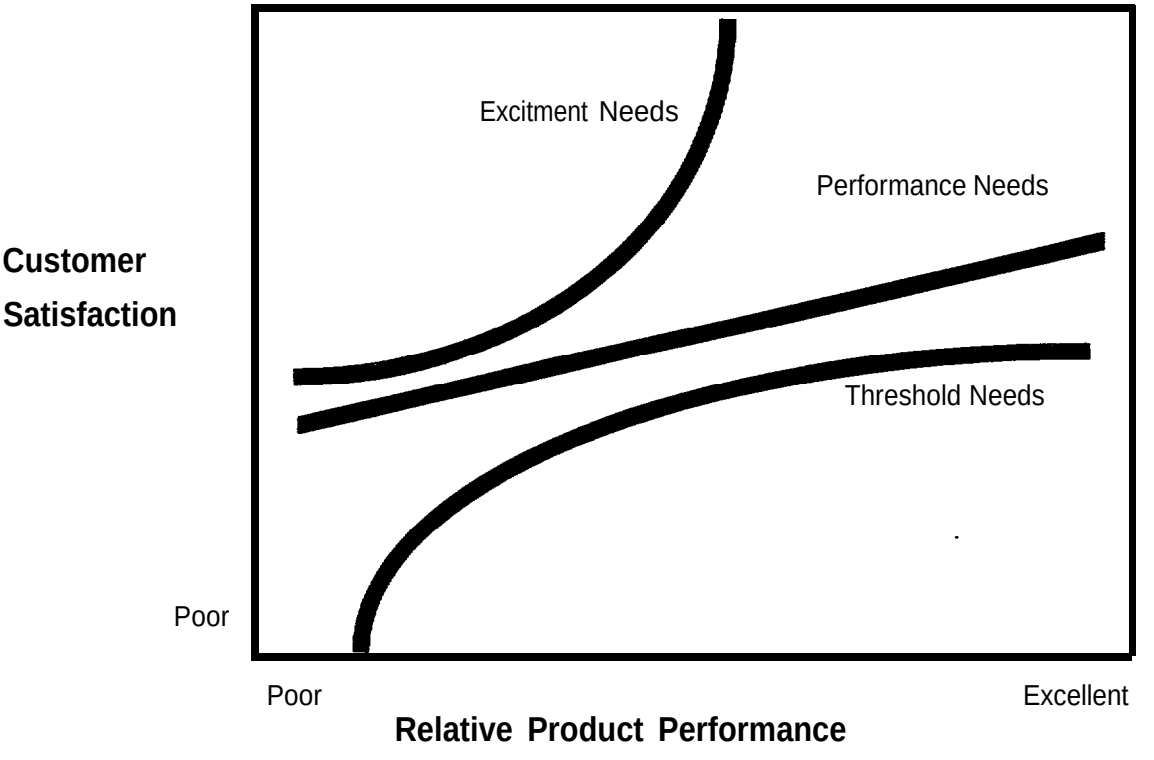
Kidney Treatment	Cars	Pharmaceuticals
Patient	Owner	Patient
Doctor	Dealer (New)	Doctor
Nurse	Dealer (Used)	Insurer
Family	Sevice Garage	Government
Insurer	Insurer	
Government	Government	

Recognize that all needs are not created equal. In the ETC market, it was clear the primary need was for time saving. For AVI/L the primary need may in fact be the missing 'C' for communications. A general need to "be in touch" was a strong need for cellular phone users. All of these are primary -- or threshold -- needs.These needs can be characterized as "must haves" and are the ones that must be among the first addressed by a product.

A 'Kano Diagram' (Figure 14) can be used to graphically represent these different levels of needs.Threshold needs are those that the customer expects to have met. Minimum performance on the threshold needs is required in order to achieve acceptable levels of customer satisfaction. However, excellent performance in **meeting** threshold needs does not significantly increase customer satisfaction. Performance needs are those that have a direct pay back in customer satisfaction, the better the performance on these needs the more customer satisfaction. Excitement needs are those that the customer does not really expect to get. Therefore, even minimal levels of performance in excitement needs generates a great deal of customer satisfaction.

Market research must be designed to uncover the threshold needs and be able to distinguish them from the less critical performance and excitement needs. A new product or service that meets an excitement ***need (e.g.*** extensive Yellow Page type local information), while leaving a threshold ***need (real time traffic*** information) unmet, is likely to fail in the market, particularly if competing products do meet the threshold need. A case in point is Geostar in the AVI/L market. It was able to provide more accurate location information than its competitors, but it did not meet the threshold need of providing two-way communication.This contributed to the company's failure.

Figure 14: Categories of Customer Needs



Determiuing the hierarchy of needs is best done by attempting to mimic the actual buying process to allow customers to select different "bundles" of product characteristics that meet different sets of needs. This requires precise questions regarding the specific timing and content of decisions consumers make during the buying process. Open ended or general questions about what customers want should be avoided as it gives little basis for ranking needs. Analysis of how customers trade-off one product characteristic against another can indicate what hierarchy they place on their needs. This is the essence of conjoint analysis and other similar analyses. Designing a choice analysis for ATIS customer needs requires a careful evaluation of the decision process used in making a transportation selection and the types of information that are required at each decision point.

A final point on different levels of needs. Consumers buy goods to satisfy personal needs, not public or societal needs. If consumers are questioned during market research regarding the value of a product/service from a social perspective, they may well attach a value to it, but their actions in the market place will not typically reflect that value. The success of ETC is based at least partially on the economics of ETC being positive without reference to a public good argument. ATIS services have a strong public good element. Market research for ATIS should avoid the emphasis of the public good aspect to avoid possibly overstating the level of consumer interest in ATIS.

Account for changing needs over time. Long term product planning can be facilitated by market research that results in a ranking of needs. As markets develop and external environments change, consumer needs also change. A typical progression is for needs to move down and to the right in the Kano diagram (Figure 14). Performance needs quickly become threshold needs as the consumer comes to expect them, excitement needs evolve into performance needs and new excitement needs are uncovered. Cellular phones provide an excellent example of this as the products moved from large, vehicle based units, to relatively large portable units to the "flip phones" available today.

Efficient long term product cycle planning requires that there be a rational plan to add features and upgrade the product. To do this, market research must provide some input as to the likely progression of needs. This will be particularly important to effective planning for ATIS, as there are natural extensions to the service that can be added as the technology becomes available, and as costs are reduced through increased market volume. The IVHS Strategic Plan has recognized this progression in the identification of three stages (information, advisory, and coordination) of development of ATIS.

Take care to avoid over promising Consumer expectations that are greater than what can actually be delivered can depress the market for products that in fact provide real value. Those expectations can come from a number of sources, but market research can in some cases inadvertently contribute to unrealistic expectations. If the "products" and "features" tested in market research are not ones that can feasibly be supplied, this can set expectations in the minds of those surveyed. In the ETC market research, the ranges for potential time savings and speed through the toll booths were generally kept understated to avoid this problem.

Willingness to Pay

Along with needs assessment, determining consumer willingness to pay is clearly a critical objective of market research. However, even willingness to pay could be considered to be derivative from the needs assessment, as it is essentially just a measure of the strength of the need.

Commercial customer willingness to pay is easier to define than consumer willingness to pay. Market research on products aimed at commercial customers is generally easier and more accurate than consumer market research. Commercial needs are generally clearer. Willingness to pay is based on relatively concrete financial assessments. Time has a clearer translation to money for commercial customers, therefore, products that offer time saving (all of the case study products as well as ATIS) are easier to justify in the commercial sector. Given this, a strategy for early applications of ATIS may be to target them at commercial customers where the benefits will be more clearly recognized.

Consumers are willing to pay for time saving. A critical issue in determining consumer willingness to pay for ATIS is determining their willingness to pay for time saving. Unlike the commercial sector, it is difficult for consumers to quantify how they are willing to trade off money for time. The case studies are encouraging for the ATIS outlook as they offer several indications that consumers are willing to pay for time saving.

In the ETC research, time saving was the major benefit perceived by potential customers. Time saving was given as the primary reason they would buy an ETC tag. Work done by the California Private Transportation Corporation also noted that consumer's willingness to pay for time savings depended on the time of day. People would pay a greater premium to get home from work quicker than they would pay to get to work quicker.

The ETC market illustrated one other important lesson, the willingness to pay for time savings depends on the certainty of the outcome. The acceptance of ETC was lower in those areas where there was significant congestion downstream of the toll facility, and therefore, there was less certainty that buying an ETC tag would actually save driving time.

While not explicitly addressed in the market research for cellular phones, time savings (or better use of time spent traveling) is clearly one of the benefits offered by that product. Using a revealed preference argument, the success of cellular phones is further indication that consumers will pay for time saving.

Examples of several different methods of detemining willingness to pay were used in the case studies. The most widely used is conjoint analysis or other choice analyses.

Research into willingness to pay for ATIS should initially focus on defining what factors determiue willingness to pay. Is time of day a factor as was found in ETC? Is update frequency the most critical factor? Update frequency may be a very significant issue because it addresses the outcome certainty issue discussed above, i.e. people use update frequency as a proxy for certainty that the information is correct and that acting on that information will actually save them time.

Accuracy of willingness to pay information is enhanced by conducting: research with the primary decision maker. In market research, consumers often overstate their willingness to pay for a product/service. This is because the market research environment is inherently artificial, and people are not spending "real " money. The closer market research can get to a "real" transaction, the greater the confidence in the results. The cellular phone case study provides several relevant examples of methods used to overcome this problem.

The first method is to ensure that the market research is conducted with the true decision maker in a given economic unit (household). Researching the willingness to pay of someone that is not likely to be the final decision maker moves the process further from a "real" transaction and will therefore reduce confidence in the results. For

ATIS, selecting the correct population to research should be relatively straight forward as the decision maker is likely to be the vehicle owner.

The second is to apply a discount factor to the willingness to pay and market size projections. The discount factor used would typically be derived from historical examples of similar products. The danger in this procedure is clear -- that an inappropriate discount factor will be used. In the case of cellular phones, the discount factor applied was apparently too high, at least partially explaining the under forecasting of the market size. The difficulty in applying this procedure to ATIS is finding relevant historical examples on which to base the discount factor.

This issue is also further argument for the value of operational tests. Operational tests allow for testing of "real" transactions and therefore potentially offer the strongest evidence. However, the pricing used in operational tests must be realistic (not discounted) to ensure accurate results.

Willingness to pay is influenced by economic and non-economic factors. The relative affluence of the 1980s, and the attitudes toward consumption spending in the 1980s no doubt had an impact on the success of cellular phones and a number of other consumer products. If those products were launched in the "frugal 90s" tbe results may have been quite different. In evaluating the future success of ATIS, one of the factors to consider is the influence of temporal social and economic values.

One method of dealing with this issue is to carefully "position" the market research participants by creating and describing in detail the expected environment of the time period that you want them to forecast. These efforts to put participants "into" the future environment are another example of the more general requirement that the market research environment should approximate reality as closely as possible. For ATIS this will mean carefully crafting the expected congestion levels, economic factors etc.

Customers appear to be comfortable with monthly charges rather than high up front costs. Cellular phones are a good example of this. Service companies heavily subsidize the cost of equipment in order to get people to sign up. A similar tact is taken in AVI/L. Another example outside of the case study industries is cable television.

On the hardware side, experts in automotive electronics see roughly $300 as the price point that is required to allow widespread acceptance. Cellular phone sales expanded rapidly when prices reached this level. Sales of in vehicle CD players have not reached high penetration levels, in part because prices are generally above $300.

The hardware price issue will be most important in the early stages of ATIS, when most of the products will be self contained route guidance products (as are available today). The monthly service price issue will become more important as ATIS reaches the point where availability and interaction with real time traffic information becomes a central need.

Customers are more likely to attach real value to something that they use frequently. Market research for ETC supports this conclusion. The drivers that were the most likely to participate in ETC programs were those that used the toll road frequently. Automotive electronics experts believe this is true in all automotive areas. This fact may limit the acceptance of some advanced electronic equipment such as enhanced vision systems because the usage would be too infrequent. The implication for pricing of ATIS services is that prices should be set so as to encourage frequent usage even if each usage is of relatively low value.

Market Size

Given the level of inaccuracy of market size forecasts that is evident in all of the case studies it is difficult to draw many firm conclusions in this area The companies that had greater forecast accuracy tended to use a "bottom up" approach to forecasting. This method defines a profile of those groups that are likely customers and then estimates the size of the population that has that profile. An advantage of this approach is that it is a natural extension of market research efforts to define and segment customer needs and requirements.

Risk Assessment

A clear conclusion from the case studies is that the need for market research is proportional to the perceived risk in entering a new market. Where little risk is perceived, there is little need to do market research. The perceived risk is influenced by a numerous factors including:

- Size of the required investment - Lower investment implies lower risk. Where product investment requirements are low, the size of the investment in market research will appear relatively higher, which would again discourage the use of market research.

- Product portfolio - Single product firms are likely to perceive greater levels of risk than multi-product firm. In the ETC market, AT/Comm, which was established specifically to produce an ETC product as their only product, conducted the most extensive market research.

- Level **of** consumer familiarity with the product/service - Market research efforts are often most extensive and varied where the product is one that is relatively new or unfamiliar to consumers. In this case several different methods are often undertaken to investigate the market. This allows "triangulation" to raise the confidence level in the overall results.

The perceived risk to entering the market for ATIS products will vary substantially depending on the specific product, but several factors will mitigate that risk:

- Investment - The initial public sector investment required for many of the early products will be relatively modest. These products will be stand-alone products that do not require a significant infrastructure, and in many cases will be derived from modifications of existing products. As ATIS moves from the information stage to the advisory and coordination stage, the public sector investment requirements will increase significantly. At this point there will be a strong need for credible, in depth market research that can be used to support that investment.

- Product portfolio - The majority of the companies that are likely to play a major role in ATIS will be large, diverse companies (AT&T, Hughes, Rockwell etc.). Most of the component technologies required for ATIS products are used in other products (wireless communications, vehicle identification, etc.) and the application to ATIS will be an extension of other products rather than an entirely new venture.

- Consumer familiarity - There is likely to be a slow evolution of the introduction of ATIS products. Consumers will be moved relatively slowly from the paper maps of today to electronic maps to voice output route guidance, with a similar progression occurring in other product areas. Therefore the "leap" that consumers will have to make to adjust to the use of each new product will be quite small, and the risk accordingly will be lower as well.

A final point on perceived risk to the ATIS market. Apart from some concerns raised in the ETC market, the participants in the case study industries did not see government involvement in their market as an important risk factor. It is unlikely, therefore, that the existence of the government as one of the expected stakeholders in ATIS will pose a significant impediment to companies entering that market.

Conclusion

This report has outlined the market research experiences of three transportation communications products that are analogous to ATIS products.

Many of the lessons learned through analysis of these case studies are quite positive for the outlook for ATIS:

- There are indications that both commercial and consumer customers have both explicit and latent needs for ATIS like services.

- Both commercial and consumer customers have indicated a willingness to pay for time saving products/services. Time saving will be a primary benefit of ATIS.

- There are several factors that may serve to mitigate the perceived risk in entering the market for ATIS products/services.

The caveats indicated by the case studies prelate primarily to one factor that can be taken as the key message for ATIS. That message is that the single most critical issue for market research is a careful, complete investigation of the true needs, and the relative importance of those needs, of all levels of customers. The focus of market research into ATIS should be in implementing and refining innovative methods of understanding the true customer needs. This will provide the greatest contribution to the successful development of the market for ATIS and all of the corresponding societal benefits that are possible from ATIS.

Memorandum

Date: January 20, 1994

To: John O'Donnell
CC:

From: Tom Parish
Loc: 35/245
Ext: 5416

Subject: Case Studies and Briefing Book Files
Re: 42936

Enclosed is the photo ready version of the ATIS Case Studies. We can still make whatever changes you want also.

I also put in the WordPerfect and Freelance files for Chapter 3 (Product Cycle Plans) of the Briefing Book. I know you wanted the Financial Section first, but those files are proving more elusive - but I am confident we will have them for you soon.