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NAVIGATION TECHNOLOGIES MARKET VALIDATION STUDY

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NAVIGATION TECHNOLOGIES MARKET VALIDATION STUDY

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Background and Objectives

Navigation Technologies, Inc. (NavTech) produces mapping database software used in vehicle navigation systems. Although in-vehicle navigation systems have been available for some time in some commercial fleets and even on Avis rental cars in selected markets, the U.S. consumer market is in its very eariy stages. As such, NavTech commissioned J.D. Power and Associates (JDP&A) to conduct research which would explore the marketing dynamics among potential *purchasers* of such systems, specifically end-use consumers who would purchase systems as optional or aftermarket equipment on their personal vehicles. This marketing information will be used to support demand creation by consumers for in.-vehicle navigation systems, and to improve NavTech's database products and services.

- NavTech's specific objectives for this research were to:

  - explore consumer awareness and image of in-vehicle navigation systems prior to exposure to the actual system

  - compare consumer attitudes toward and acceptance of the systems before and after extended use (i.e., two days) of the system

  - test consumer price sensitivity for in-vehicle navigation systems

  - determine the relative importance consumers place on various features/functions of the system

  - assess end-user support service requirements

  - assess the market potential for in-vehicle navigation systems among end-use consumers

  - determine if and how results may differ by region and by various demographic market segments

INTRODUCTION

Research Design

Overview

J.D. Power and Associates conducted 170 test drives over 30 test periods during July and August, 1995. The test drives were conducted in Whittier, California, Garden City, New York, and Chicago, Illinois. Study participants supplied information before driving the system-equipped cars, just after a ten-minute test drive, and after driving the car for two days. For more information on the activities involved in this research, please see Appendix A: Test Plan,

Sample

The sample source for the Navigation Technologies Market Validation was Survey Sampling's national database. Initial sample requirements included in the sample selection process were:

- 1994 household income of at least $50,000

- Cellular phone ownership and usage

- From 25 to 59 years old

- Home zip code within a 60-mile radius of the zip code for the respective NavTech office test site

The recruiting questionnaire further screened participants for the following qualifications:

- Average monthly cellular phone bill of $50 or more

- Spend an average of two or more hours per day in vehicle on business travel, excluding normal commute time

- No experience actually driving a vehicle equipped with a navigation system

A total of 300 participants were recruited for the test drives, of which 170 actually completed test drives. For additional sample information please see Appendix B: Sample and Methodology.

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INTRODUCTION

Research Design

Methodology

Participants were recruited by phone and screened to ensure they met the pre-established criteria (listed on the previous page) which classifies them as high-potential purchasers for in-vehicle navigation systems. After participants were qualified and agreed to participate, recruiters explained the purpose of the study, how it would work, and scheduled a test drive date.

Test drives were conducted over a seven week period beginning on July 6, 1995 and ending August 16, 1995. For more detailed test procedures and test date schedules please see Appendix B: Sample and Methodology.

Weighting Of Data

Data in this Study have been weighted to bring all three cities to a common sample size. This is done so that each city represents an equal share in the total sample, and those with a greater number of participants (i.e., Chicago and New York) are not disproportionately reflected in the total.

Factor and Regression Analysis

Factor and regression analysis was used to identify and prioritize the critical elements of satisfaction among end-users of in-vehicle navigation systems. Factor analysis was performed on a list of system attributes, a process which grouped the attributes into five factors. These five factors summarize areas that are critical, in varying degree, to the satisfaction of end-users of in-vehicle navigation systems. A statistical regression was then run for each factor against the dependent variable, overall satisfaction with the system. This step quantifies each factor's importance in determining overall satisfaction with in-vehicle navigation systems.

Perhaps the greatest benefit of this two-step analysis (the results of which appear in the Detailed Findings section of this Report) is the identification of what is truly important in satisfying customers. With an eye toward what matters most, manufacturers can focus scarce resources on those areas that impact customer satisfaction most, or those areas that provide the greatest return on investment.

INTRODUCTION

Organization of Report

Findings and conclusions from the Navigation Technologies Market Validation Study are presented in this Management Report, which is divided into four main sections:

Introduction: Provides background and objectives of the Study, and an overview of the sample and methodology

Executive Summary: Highlights the Study's key findings and recommendations

Detailed Findings: Presents detailed results that support the key findings - in graphical and text format

Appendices: Provide greater detail on the Study's test plan and sample and methodology, as well as copies of the three questionnaires

The Management Report is accompanied by a set of *Data Tables,* where an extensive set of cross-tabulations has been applied to the data.

EXECUTIVE SUMMARY

NAVIGATION TECHNOLOGIES MARKET VALIDATION STUDY

EXECUTIVE SUMMARY

Background

Navigation Technologies (NavTech) commissioned J.D. Power and Associates (JDP&A) to conduct a quantitative study with the primary objective being to gather information to support demand creation for in-vehicle navigation systems among consumers for their personal-use vehicles.

To survey people considered as high potential purchasers for systems, sample was defined by:

- Cellular phone owners who spend an average $50 per month on their cellular phone bills
- From 25 to 59 years old and living in households with a 1994 income of at least $50,000
- Spend an average two hours or more per day in vehicle (excluding normal commute)

Participants meeting these qualifications, and living within a 60-mile radius of one of the test sites (NavTech offices in Whittier, CA, Garden City, NY, Rosemont, IL) were recruited. A $50 incentive was offered. The Study centered around a two-day test drive of a navigation system-equipped Oldsmobile, and involved respondents completing three questionnaires:

- *Recruiting Questionnaire* #I: Phone survey completed by respondents when they were recruited
- *Vehicle Pick-Up Questionnaire* #2: Completed after a 1 O-minute test drive of system-equipped car
- *Vehicle Return Questionnaire* #3: Completed after a two-day test drive of system-equipped car

Summary of Findings

Awareness, Image of Navigation Systems Prior To The Initial Test Drive

Prior to the test, almost all respondents had heard about vehicle navigation systems, primarily via published material or television. Most recalled the system's features and/or benefits, but relatively few knew of voice prompts, knew "GPS" or "global positioning" terms, or about systems being available in rental cars. Statements about navigation systems in the Recruiting Questionnaire (to which respondents rated their agreement) support that most knew about system features and benefits, with ease of use and convenience-related statements receiving the highest agreement ratings. Cost-related statements elicited the least agreement, due to considerable lack of knowledge or confusion on these issues.

Effects of Initial Test Drive

Comparing agreement ratings from Questionnaire #l to #2 shows that the *IO-minute test drive* enhanced respondent agreement of the system's ease of use and its provision of valuable information. Respondent confusion about per-destination usage charges and concern about having to constantly view the screen were also somewhat allayed (presumably because they now knew about voice prompts). The short test drive, though, produced lower agreement ratings regarding accurate and up-to-date POI information.

EXECUTIVE SUMMARY

Summary of Findings (continued)

Effects of Two-Day Test Drive

The two-day *test drive* further enhanced respondent perceptions of ease of use, and resulted in high marks for system ergonomics. The two-day test appeared to somewhat allay concerns about theft/break-ins, but also further dropped agreement ratings about POI information being accurate and current. Perceptions of the system enhancing productivity in business and personal travel, and enabling drivers to reach their destination faster, also declined with longer exposure to the system.

Note that several respondents alluded to database "problems" in calculating the shortest route - a perception which likely negatively impacted agreement that the system enhances productivity in business and personal travel, and enables drivers to reach their destination faster. While not actually a database problem, this finding does suggest that it will be important for potential purchasers to understand how the system maps routes (i.e., algorithms which determine the shortest route will generally favor-right turns over left turns, and do not account for varying traffic flow patterns).

Likelihood to Recommend System/Overall Satisfaction with System

Despite these declines, likelihood to *recommend* the system was extremely high before and after the two-day test, with longer exposure moving a proportion of "somewhat likely" respondents to "very likely" to recommend. Similarly, overall satisfaction scores after the two-day test were particularly high (8.43 score of a possible 10). Comments in follow-up focus groups suggest that almost all participants believe the system to be ideal for certain occupations - whether or not it is ideal for them.

Key Drivers of Satisfaction with Navigation System as Tested

Statistical analysis was performed to identify and prioritize the key factors of customer satisfaction with navigation systems. This analysis revealed five factors driving customer satisfaction, with two accounting for 76% of satisfaction: Utility/Value (53%); and POI Variety (23%). Three other factors, "User Interface," "Theft Potential," and "Distraction Potential," together account for 24% of overall satisfaction. The "Theft Potential" and "Distraction Potential" factors consist of statements that might be considered "negative" in terms of evaluating satisfaction with the system. These statements were included because it was important to determine their impact on overall satisfaction. Their relatively low weights (9% and 5%, respectively) suggest that concerns about potential theft and/or driver distraction are less impactful on satisfaction than the system's usefulness, content, and operation.

- "Utility/Value" includes statements related to productivity, convenience, and the sense of safety provided by the system, as well as the system's ease of use and accuracy.

- "POI Variety" includes POI category variety and selection of listings within POI categories

EXECUTIVE SUMMARY

Summary of Findings (continued)

Key Drivers of Satisfaction with Navigation System as Tested (continued)

Manufacturers can thus enhance customer satisfaction by improving the accuracy, productivity, and convenience afforded by the system. Also key to customer satisfaction will be a variety of POI categories, with accurate and complete listings within each category.

Factory-Installed In-Dash versus Aftermarket Navigation Systems

By four to one, respondents preferred a factory-installed navigation system (i.e., in-dash) over an aftermarket system (i.e., a unit as tested), primarily due to perceived better quality and system reliability for the factory-installed unit. It should be noted that respondents had not actually seen an in-dash unit (unless they had seen pictures of one before the test); respondents did see and use the "aftermarket" design. Primary reasons for preferring aftermarket were perceived transportability of the system and lower price. Preference for either configuration changed little from pre- to post-test drive, indicating that the segment preferring aftermarket could represent a smaller, but viable market. This, along with estimated prices (discussed later) could suggest a strategy of offering both configurations, with factory-installed systems costing more than aftermarket.

Those preferring aftermarket indicated a "specialty aftermarket store" (i.e., outlets specializing in selling and installing alarms, audio systems, cellular telephones in vehicles) as the preferred purchase/installation source. It was felt that these outlets offer more professional installation and can service customers quicker and at lower prices than car dealers.

Asked their expected price for both factory-installed and aftermarket systems, respondents in all three markets underestimated the $2,000 price tag by around $1,000, both before and after the two-day test. Median expected prices were generally slightly lower for aftermarket systems.

About 74% of participants expressed Some likelihood (i.e., "somewhat likely" plus "very likely") to purchase a factory-installed system at their estimated prices, compared to 55% for aftermarket. For both configurations, the two-day test drive moved a proportion of "somewhat likely" respondents to "very likely," although the two combined responses remained constant from pre- to post-test drive. This suggests the need for longer exposure to close a deal among those who are interested, but not quite sure.

Looking at ratings of "very likely" to purchase for both configurations by different price ranges is perhaps most appropriate to estimating initial demand. This analysis shows that:

- Those "very likely" to purchase decline with increasing expected prices, *even though the respondent actually estimated the price himself/herself*

- "Very likely" percentages generally increased after the two-day test drive.

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Summary of Findings (continued)

Factory-Installed In-Dash versus Aftermarket Navigation Systems (continued)

· Across all price ranges, the percentage of "very likely" purchasers is substantially higher for factory-installed systems than aftermarket, when comparing pre-test and post-test ratings.

• The relatively lower percentages of "very likely" purchasers *in the pre-test* measure - for factory-installed or aftermarket - reinforces that longer exposure to the system is an important ingredient in cinching early sales of navigation systems.

Advantages/Disadvantages of Owning and Using a Navigation System

Prior to the two-day test, respondents identified the major *advantages* of navigation systems as convenience, saves time, ability to replace maps, and eliminating the need to ask for directions. Ease of use, safety, and stress reduction were mentioned less often. The two-day test generally reinforced previously-held assumptions, although more participants noted lower stress and higher driving confidence. These are valuable advantages that become more obvious with increased use of the system, but that will be difficult to communicate to prospective buyers.

Primary *disadvantages* identified in the pre-test phase were system expense, followed by theft potential, driver distraction, and system operational issues. After the two-day test, expense and driver distraction concerns were cited less often, and operational issues, particularly database limitations, were mentioned more often (which could have strong implications for NavTech's guarantee of database accuracy). Theft/break-in concerns stayed about the same from pre- to post-test.

Product Enhancements/Features Used Most

Participants suggested several product enhancements, including:

• expanded POI listings (especially restaurant and shopping)
• more information about roads and routes (e.g., toll booth information)
• larger screen/ability to better view the screen in direct sunlight
• alpha-numeric keys for faster access to information and route selection
• greater volume for the voice prompts
• more lead time/advance notice of turns and exits
• a radio-interrupt feature
• ability to program routes incorporating multiple destinations
• ability to permanently store frequently-visited destinations in memory

Although not cited frequently in the question dealing with product enhancements, participants were asked specifically about system transportability, or the ability to remove the system from a vehicle and reinstall it in a different vehicle. Four in ten respondents said this aspect would be "very important." This is supported by focus group comments.

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EXECUTIVE SUMMARY

Summary of Findings (continued)

Product Enhancements/Features Used Most (continued)

Respondents most often cited six features they felt they would use most often:

- shortest time route
- selection by street address
- voice prompt on
- route display
- map display
- destination memory

Problems Encountered and Their Impact

Respondents most often cited problems related to incomplete and/or inaccurate database information and routing problems (illegal turns, not the shortest route, etc.). (Again, it should be noted that perceptions of the system not providing the shortest/fastest route may be related to misunderstandings about how the system calculates routes. While not actually a database problem, this perception could impact consumer judgments about the system's usefulness and accuracy.) Fewer than one if five experienced mechanical malfunctions of the system or lack of depth in the POI listings. Of all types of problems experienced, geographical areas not being in the database was most impactful on the system's usefulness and convenience. It should be noted that database "problems" alluded to by respondents, particularly with respect to comments regarding the system not calculating the shortest route,

Points of Interest (POIs)

Although use of certain POI categories varies by individual user, data suggest that some categories appeal to most everyone (i.e., shopping, entertainment, banks, and business facilities), while others appeal to limited numbers (i.e., government offices, education facilities). Although they may not often be used, emergency assistance categories were rated most valuable by respondents, followed by POI categories that are most frequently used.

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Summary of Findings (continued)

Points of interest (POIs) (continued)

Focus group participants suggested that NavTech offer "specialized" POI databases to be sold separately. Most envisioned the "base unit" offering emergency services, with "add-on" databases covering listings for less popular categories. Others suggested that even some of the more popular categories like restaurants could be offered separately, if greater depth and breadth of listings appeared within that category. Any idea of limiting POI categories to emergency and roadside services should be carefully reviewed, however, as two-thirds of respondents said that a limited database would be an important factor in deciding whether or not to purchase a system. The idea of unbundling certain POI categories and selling them separately may be a longer-term strategy, especially since more time could then be devoted to programming a greater selection of listings within each POI category, something that surely would be needed if POI category databases were offered at additional cost. Of course, categories would have to have fairly wide appeal to support the additional cost required to expand and keep current the listings therein.

Overall, 58% of respondents said errors in POI data once every ten attempts would impact the system's usefulness, either "strongly" (19%) or "somewhat" (39%).

Updates/Upgrades of the System's Database

Most respondents felt the database would require updating once a year or more often, with the majority saying once every six to 12 months. Focus group discussions support the notion that participants living in older, more developed areas have less of a need for updates/upgrades than those living in newer, developing areas. Continuous road changes and construction in developing areas would thus be a selling point for updates/upgrades.

Most expected to pay no more than $100 for the update, with the median being $50. Some felt strongly that updates/upgrades during the first year of owning a navigation system should be included in the system purchase price. The more often participants feel updates/upgrades are needed, the lower they suggested the cost should be.

The area of updates/upgrades is one of significant consumer confusion and concern. Consumers will require precise information on updates, including what information is updated, cost of updates, and how updates will be obtained (focus group comments said it must be made convenient).

EXECUTIVE SUMMARY

Summary of Findings (continued)

Respondent Demographics

On average, participants to the Study were in their early to mid*40s, earning a 1994 household income of $83,500. Most tend to be in business-related occupations, primarily sales related and executive/administrative/managerial positions.

Participants spend an average 3.5 hours per day in their vehicles and took an average 18 out of town trips to unfamiliar areas in 1994. This was highest among New York and Los Angeles participants and lowest for Chicago.

Overall, respondents said they use maps for local business travel about 45% of the time. Respondents said they replace maps about once every 11 months, primarily because the information is out of date and/or because the maps are physically worn.

Navigation Systems in Rental Cars

Participants were asked how important it would be to *confirm* a navigation system. in a rental car. Almost all felt that this would be important, either "very" (63%) or "somewhat" (32%). Focus group discussion supports the notion that participants are very interested in renting cars with navigation systems when traveling out of town, and would pay $5 more per day for rental cars so equipped.

Current and Next Vehicle

Los Angeles respondents were more likely to drive an import vehicle (57%) than those in New York and Chicago (40% and 26%, respectively). More respondents reported driving a Ford than any other make, followed by Toyotas and Chevrolets.

Overall most participants (85%) drive personal vehicles for business rather than company cars, although nearly 20% of New York participants said they drive a company car.

Nearly half of respondents said their current vehicles have alarms and/or an AM/FM radios with CD. While CD players were almost exclusively factory-installed, about half with alarms purchased them as aftermarket items. About one-fourth have radar detectors and/or cellular phones installed in their vehicles; almost all of these options were purchased as aftermarket items.

A majority of participants carry portable cellular phones and daytimers/organizers in their vehicle for business. About two in five carry notebook computers. Respondents report that their employers are most likely to reimburse them for notebook computers and cellular phones. About 45% said their employer would be likely to pay for a navigation system (only 7% "very likely," though). Cost- and time-saving benefits will have to be proven before many employers will reimburse employees for a navigation system.

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Summary of Findings (continued)

Current and Next Vehicle (continued)

About half of participants drive vehicles that are five years of age or older. Based on internal JDP&A data, this means that these participants are in the near-market for a new vehicle. Asked specifically about their time frame for acquiring their next vehicle, 62% said it would be in two years or less, with nearly one-third saying it would be within one year.   Participants overwhelmingly plan to purchase their next vehicle new, while two-thirds plan to purchase (rather than lease) their next vehicle.

When asked which makes (multiple responses permitted) they would consider for their *next* vehicle, Ford received the highest percentage of mentions (28%), followed by Toyota (19%), Oldsmobile (19%), Chevrolet (18%), and Lexus (16%). The high number of mentions for Ford, Toyota, and Chevrolet may be expected, as these three make are the ones most often mentioned by respondents as their current vehicle makes. A caveat should be noted, however; despite what people say about their intentions to replace their current vehicle with one of the same make, internal JDP&A findings indicate that only one-third of new vehicle buyers *actually* replace a vehicle with one of the same make.

Respondent were asked - before and after the two-day test drive - to rate the importance of navigation system availability as a factor in their next vehicle acquisition.   In both measures, bver eight in ten respondents said system availability would be "important" in deciding on a particular make (where "important" is a subtotal of the percentages saying "very important" and "somewhat important"). While the two-day test drive did nothing to boost the "important" subtotal, longer exposure to the system did move a small proportion of respondents from "somewhat" to "very" important.

EXECUTIVE SUMMARY

Recommendations

The post-test measure revealed an expected median price of $1,000 for a factory-installed in-dash navigation system and $900 for an aftermarket (i.e., as tested) configuration. As such, the $2,000 price tag for the Oldsmobile GuideStar system must be justified in the prospective buyer's mind - through *convincing* messages and demonstrations of increased productivity, convenience afforded by the system, accuracy, safety, and increased driving confidence.

Because respondents expressed a preference for a factory-installed in-dash system (due to higher perceived quality and integration in the vehicle), a factory-installed unit could command a slightly higher price relative to an aftermarket design.

Sales and installation of aftermarket navigation systems should be via a "factory-authorized" or "manufacturer-authorized" center, preferably a specialty aftermarket store (i.e., an outlet specializing in selling and installing alarms, audio systems, and/or cellular telephones in vehicles). Respondents felt that these outlets offer more professional installation and can service customers quicker and at lower prices than car dealers.

Several recommendations were made by focus group participants regarding how to display the system to prospective buyers. Beyond a simple look at the system, most felt that 'potential buyers would need to test the system in order to feel assured that it actually works. Several suggested a kiosk display incorporating a navigation system capable of performing a route guidance exercise for a *tester-specified* location (as opposed to a preconfigured destination). Others suggested a mock-up of a vehicle interior featuring the system to let consumers know how the unit would look in the vehicle's interior. Supporting information on how the technology works would also be helpful in such a display. Still others felt the kiosk was a good idea, but must be coupled with a test drive, which would give consumers a chance to test the system in real conditions.

People are positive about the system, but many will think it is ideal for someone else. The challenge is to make consumers aware that the system holds advantages for everyone. Do this by hitting different consumer "hot buttons:"

- Reinforce already-held assumptions about the system's ease of use and the value of the information provided by the system.

- Stress the system's ability to improve productivity in both personal and business travel, and *demonstrate* how productivity is improved (e.g., time, gas saved). (This will be particularly important in convincing prospective customers that the system is worth $2,000.)

- Safety, driving confidence, and stress reduction are key advantages, but may be difficult to convey to prospective customers without some sort of longer exposure to the system under real driving conditions. However, stressing the system's ability to find your destination and guide you there, without any stress or second-guessing, could help in conveying these messages.

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Recommendations

- Other communication-related items of note include emphasizing that navigation systems include voice prompts (most are unaware of this feature), and being that "GPS" and "global positioning" are not familiar terms and must be explained if used.

- It will be very important to neutralize the perception that the system is useful only when you don't know where you're going.

- Tread carefully with respect to guarantees of database accuracy. Accuracy is a perception that could be difficult to define, and most people's views of database accuracy and currency - particularly with respect to the POI listings - declines with increased exposure to the system, Many respondents believed that the database had "problems" in calculating the shortest route - a perception which likely negatively affected perceived productivity and convenience. It will be important for potential purchasers to understand how routes are mapped by the system (i.e., the algorithm which determines the shortest route may not take into account traffic flow patterns which vary over the course of a day). Be aware that these issues may not be apparent among those who rent cars with navigation systems; these types of comments came primarily from people who knew the areas they were driving and who were challenging the system's accuracy.

- With respect to POIs:

  - A more complete database - even if some POI categories are sold separately - is a good selling feature and would address several of the problems experienced by test participants. Extensive breadth and depth of POI categories will be extremely important in satisfying early customers for navigation systems, and again would help justify a higher-than-expected price.

  - Carefully review ideas of limiting POIs to just emergency services. PO1 categories such as entertainment attractions, shopping, and business facilities are rated of high value.

  - Keeping all POIs together will allow initial buyers to spread the word about the breadth of information available, but this must be backed up with greater depth of listings in key categories like entertainment, shopping, and business facilities.

  - Focus group discussions revealed problems with determining which POI categories contain certain listings. It would be wise to address these problems with some approach that makes finding specific POI listings easier.

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Recommendations (continued)

- Database upgrades/updates are a confusing issues for most customers. Information on the cost, scope of the upgrade, the frequency with which it is issued, and how to obtain the upgrade must be clearly communicated to prospective buyers. Access to upgrades must be convenient for system owners, and "free" upgrades during the first year of ownership (rolled into the purchase price of the system) are suggested. If not rolled into the system cost, upgrades should cost no more than $50 and be available about every six to 12 months.

- With a $2,000 price tag for the Oldsmobile GuideStar system, one would suspect that early adopters may tend to drive luxury makes. While this may be true, it is also important to consider that the "road warriors" who may benefit most from having a navigation system (and whose employers may be most likely to pay for the system) may not tend to drive luxury makes. Again, Ford, followed by Toyota and Chevrolet, were the makes most often driven by respondents - respondents who spend two or more hours per day on average in their vehicles.

- Based on a comparison of ratings from pre- to post-test drive, longer exposure to the system may move some people from "somewhat likely" to "very likely" to purchase. Longer exposure to the system, though, appears to have little impact on perceived ease of use and on perceived value of the information provided by the system.

- Consider certain product enhancements, particular louder volume on the voice prompts, greater advance/lead time on notification of turns and exits, and the ability to disguise or remove the unit to prevent thefts. A transportable unit would be a winner.

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