

MARKET RESPONSE TO ADAPTIVE CRUISE CONTROL

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ABSTRACT

A great deal of research and development work has been carried out on ITS technology in recent years, and some commercial productions of these systems are now underway. Above all, adaptive cruise control (ACC) attracts a great deal of public attention as a fundamental driving control system.

Nissan started introducing ACC in 1999, and the number of Nissan's ACC vehicles in operation in various markets has grown. Especially, at the market in Japan, it has been installed in a variety of vehicles, from luxury to the medium-size segments. This broad range of vehicle types enable a more in-depth study of factors related to ACC use and operation.

As we work to make ACC more prevalent, it is increasingly important to determine the actual market response to ACC. In order to determine that, we conducted a survey of Japanese ACC customers, and received not only very high evaluations of our system in terms of overall satisfaction and future purchase intention, but also valuable feedback to use as a reference for future development.

This paper explains the survey, summarizes the results, and discusses areas for additional study and consideration in the field of ACC.

OUTLINE OF THE MARKETING SURVEY

Based on the Japanese survey mentioned above,

we made up the following survey plan.

Target

This survey was conducted in June 2001, by which time Nissan had introduced five vehicle models equipped with ACC.

- Vehicle A, B (luxury sedan);
 - With a millimeter wave radar and an electrical controlled brake booster
- Vehicle C (station wagon), D (mini van);
 - With an infrared sensor and no brake actuation
- Vehicle E (medium-size sedan);
 - With an infrared sensor and an electrical controlled brake booster

We then selected 400 vehicles owners at random, and sent them questionnaires.

Questionnaire Areas

The questionnaire was designed not only to evaluate ACC performance, but also to find out more about customers' expectations of ACC, purchase motives, etc. And it covered the following five areas.

- Vehicle usage
- Purchase motives
- Patterns of ACC use
- Satisfaction with ACC performance
- Future purchase intention

MAJOR FINDINGS OF THE SURVEY

Customer Profiles

Respondents

Responses were received from 60% of the owners

surveyed. The following figure shows the sex and age of the respondents as well as the type of vehicles they own.

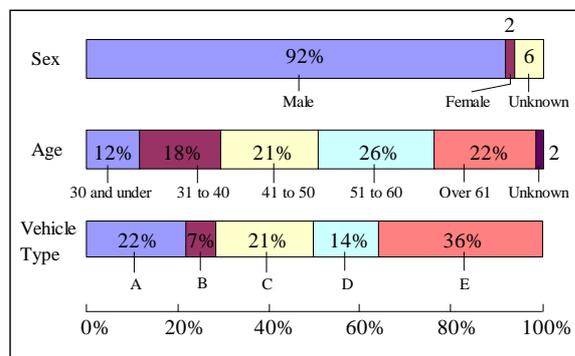


Figure1. Respondents.

Primary Usage of Vehicles

The respondents placed high importance on the following items, when they purchased their vehicles.

- I enjoy driving itself: 85%
- I take small trips together with my family or friends: 79%
- I go for drives together with my family or friends: 77%

(These scores are the sum of “important” and “slightly important”.)

In addition, these ACC customers’ scores are about 10%-20% higher than those of baseline owners. And their mileage of an average 1000-1200 km per month is also approximately 10-20% higher than ordinary customers’.

Purchase Motives

How Respondents Learned of ACC

Altogether, 39% of the respondents stated that they had learned of ACC from a brochure, 20% had heard about it from a salesperson, and 10% had read about it in the article of magazine.

For A and B vehicles (luxury sedan), 33% of owners had heard about it from the salesperson, which is approximately the same percentage as those

who received their information from a brochure.

For D vehicle (minivan), 15% of respondents stated that they had seen information about it on the Internet, and for E vehicle (medium-size sedan), 14% had read about it in the article of magazine. These values are the same percentages as those who learned from a salesperson.

Expectations Prior to Purchase

Approximately 80% of the respondents stated that they had the following expectations related to comfort (reduction of the driver’s workload and the smooth speed control by ACC).

These results indicate that there is no dissociation between the reduction of the driver’s workload, which is one of the main development purposes of ACC, and customer’s expectations for ACC.

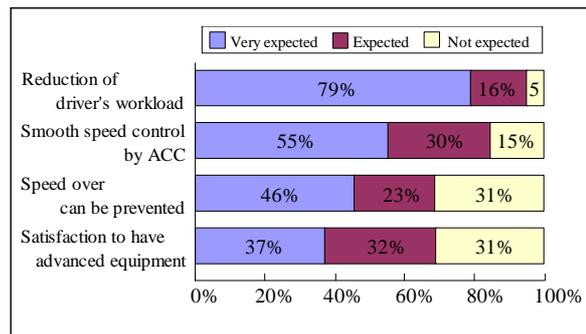


Figure2. Expectations prior to purchase

The Use Situation of ACC

Frequency of ACC Use

60% of A and B vehicle owners used the system often. Among C, D, and E vehicle owners, 80% used it frequently. In these vehicles (C, D and E), ACC was an optional item. Therefore ACC was used frequently by those customers who choose to have it.

The Main Usage of ACC

Vehicles and ACC are mainly used in the following situations;

- I use it for taking small trips or going for drives with my family or friends: 70%
- I use it to enjoy driving: 55%

Place of Use

95% of the respondents who used ACC stated they usually or often used it on the freeway, and 56% usually or often used it on city roads.

Satisfaction with ACC Performance

Overall Satisfaction

Overall, approximately 80% of the respondents stated that they were either very satisfied or satisfied. The rate of overall satisfaction to ACC is very high.

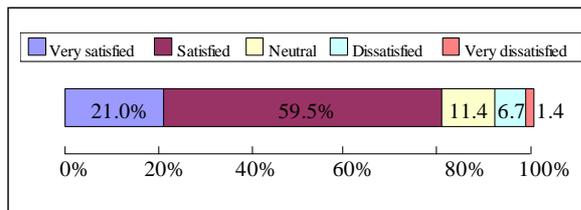


Figure3. Overall satisfaction.

Satisfaction to Expectations Before Purchasing

Regarding expectations that the respondents had before purchasing their vehicles, approximately 60–80% stated that they were either very satisfied or satisfied after making their purchase.

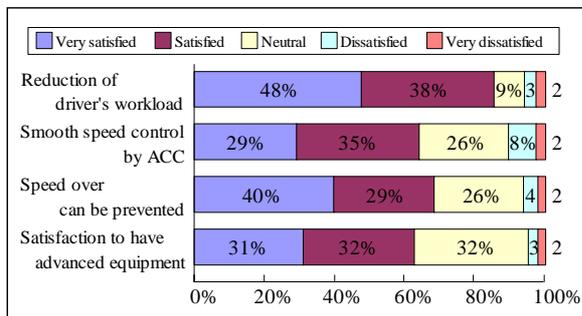


Figure4. Satisfactions after purchase

Satisfaction with ACC Control Performance

Satisfaction was high (over 70%) in each of the following survey categories: “distance from the

vehicle ahead is adequate” and “ACC display is easy to understand”. However, the level of satisfaction was lower in the categories of “There are a lot of situations to use ACC” (27%) and “the controllable speed range of ACC is sufficient” (42%).

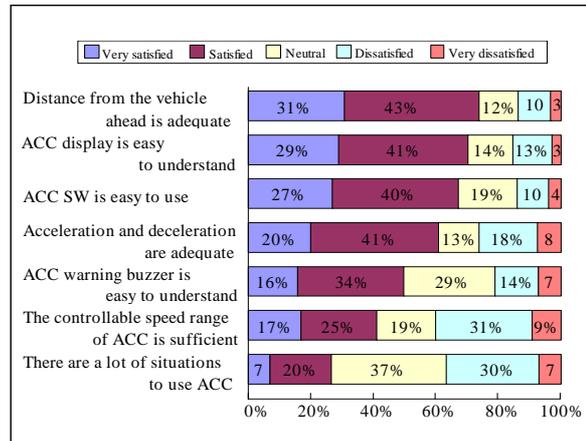


Figure5. Satisfaction with ACC control performance.

The following provides more information about the above-mentioned responses to ACC control performance.

Time gap (Following distance)

Nissan’s ACC allows three stages of time gap. In the results of this questionnaire, 40% of the respondents had used “long” and 30% each had used “middle” and “short”. It seems that the time gap between two vehicles, which are divided almost equally in this survey, are determined by the individual preference of the driver.

However, some comments cancelled each other out. For example “I can relax because the distance between two vehicles is comparatively long” and “other vehicles cut into my lane because the set distance is too long; I want to shorten it more”.

Therefore we believe that the time gap settings may require further examination.

Display

There were many comments that the display of the ACC is simple and easy to understand. However, some owners commented that it would be easier to read if the size of the display were slightly larger.

Switches

Drivers, who had never used cruise control before, reported that it took them some time to familiarize with the ACC system. However, comments that "it is easy to use because all switches are concentrated on the steering wheel" and "there is no confusion since it operates the same as cruise control" were in the majority.

Controllable speed range and where it can be used

Regarding ACC control, respondents' satisfaction to the two items above was rated comparatively low. An analysis of the comments showed that the dissatisfaction is roughly divided into the following two opinions.

- The opinions that desire an expansion of the speed range in which ACC can be used
- The opinions that desire an expansion of the situations in which ACC can be used

Expansion of the controllable speed range

There were demands at both ends of the range, some owners stating: "I want to use ACC at lower speeds" and "I want to use ACC at higher speeds."

A typical reason given for wanting an expansion of the high-speed side was "If ACC can be set a little higher while driving on the freeway, it will be even more practical." This demand arises from the slight difference between the ACC upper limit speed (same as legal speed limit on Japanese freeways) and the actual travel speeds on the freeway.

Therefore, there is nothing inherently dissatisfying

about the control of ACC itself.

The request for expanding the low-speed limit is discussed later since it overlaps with the request to expand the situations in which ACC can be used.

Expansion of the situations in which ACC can be used

The majority of the comments were that "I want to use ACC when there is congestion on the freeway" and "I also want to use ACC in some places other than the freeway." Most of these statements were followed by a request to expand the lower speed side.

This result shows the large potential demand of the STOP & GO system currently under development.

Moreover, there were comments such as; "I also want to use ACC on rainy days" and "I want to use ACC on winding roads," etc. All of these comments relate to the recognition performance of the sensor. Thus, further improvement of the sensor performance is needed.

Future Purchase Intention

Cost Performance

43% of respondents thought that cost performance was either "wonderful" or "good". If the category of "price is appropriate" were added, this figure would be as high as 80%.

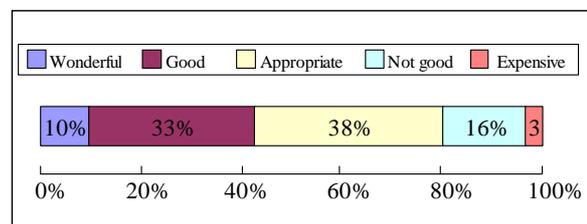


Figure6. Cost performance.

Future Purchase Intention

Approximately 80% of all respondents stated that in the future they would either "definitely purchase" or "probably purchase" an ACC-equipped vehicle

again.

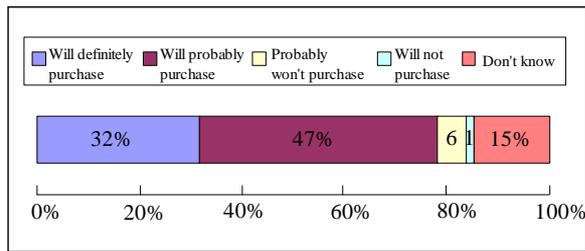


Figure7. Future purchase intention.

CONCLUSION

As the results of this survey show, the level of overall satisfaction to the Nissan ACC system is very high. It can also be seen that there is a tendency for customers interest in advanced technology.

In terms of improved driver comfort with the use of ACC, both the expectations before purchase and satisfaction after purchase are high. This indicates that the ACC may actually reduce the driver's workload in some situations, which was one of the development objectives of the system.

Regarding the control performance, there were mixed results. The rate of satisfaction seems to be quite low for "situations to use ACC" and "controllable speed range". However, it can be assumed that these comments result from external factors other than control performance. Some of these factors may include the system cancellation caused by a traffic congestion on Japanese freeways, and the slight difference between the ACC maximum speed (same as legal speed limit) and the speed the customer expects to travel on the freeway. In fact, some respondents even requested an expansion of the operation speed range in the comment section of the questionnaire

Finally, an important comment was that 80% of respondents intend to purchase another ACC-equipped vehicle in the future. This shows that

ACC is becoming more accepted by customers, and owners who become accustomed to its convenience wouldn't consider buying a vehicle without it. Therefore, we expect the proliferation of ACC systems to increase in the near-future.

The introduction of autonomous driving control systems, including ACC, is still in its early stages. We will be pleased if the results attained through our survey can serve as a reference for our colleagues involved in the development of these systems.