Technological Trends in North American Markets

Hideki HADA*

1. The significance of North American markets

North America has massive automobile markets in which nearly 20 million new vehicles are sold every year. The vastness of the continent and the diversity of its inhabitants give the North American automobile markets unique characteristics that set them apart from the Japanese and European markets (**Table 1**). Further, the Canadian market strongly resembles the United States (US) market but is steadily developing its own distinct characteristics. This paper gives an overview of current automobile-related technological trends in the US and Canadian markets.

2. Traffic safety measures taken by the US Department of Transportation

The US Department of Transportation (DOT) receives an annual budget in accordance with federal law. This budget is used to fund activities that include automotive safety research performed by the DOT and highway maintenance and construction performed by state governments under the auspices of the DOT. The federal government was implementing surface-transportation-related plans based on the Transportation Equity Act for the 21st Century (TEA-21) since 1998. This piece of federal legislation expired in September 2003, until when the federal government and the Congress had since 2002 been debating the content of legislation to succeed it. Thus far, the DOT has submitted the Safe, Accountable, Flexible, and Efficient Transportation Equity Act (SAFETEA), which calls for a total budget of $247.4 billion over a six-year period from 2004 to 2009.

The budget allocated for research by the National Highway Traffic Safety Administration (NHTSA), which is responsible for issues pertaining to vehicle safety, was approximately $80 million in fiscal 2003. The NHTSA's main activities include research into collision safety, collision prevention, and injury mechanisms and studies pertaining to intelligent transport systems (ITS) (**Table 2**).

Since 1978, the NHTSA has been assessing vehicles' safety performance through the New Car Assessment Program (NCAP). This program is currently being revised in terms of assessment objects and assessment criteria to accommodate changes in types of vehicle accidents occurring in the US and as a reflection of developments in similar assessment programs in other countries. Until recently, the only major revisions made to the program were the addition of static rollover crash indices and the addition of side impact tests. Encouraged by the Transportation Recall Enhancement, Accountability, and Documentation (TREAD) Act enacted in November 2000, however, the NHTSA is planning to apply more stringent assessment standards to a wider variety of test items: From 2003, dynamic rollover crash tests are to be incorporated into the program and the results of these tests are to be announced to the public. An assessment of the usability of child seats is to be mandatory. Plus, the number of assessment items for side impact tests is to be increased and an assessment of braking performance is to be added to the program.

Table 1 NAFTA automotive markets (2001 data)

	United States	Canada	Mexico
Vehicle production (million units)	11.4	2.5	1.9
New vehicle sales (million units)	17.1	1.6	0.7
Registered drivers (million persons)	221.5	17	–
Traffic fatalities (persons)	42,116	2,778	–

3. Traffic safety measures taken by Transport Canada

Transport Canada is currently running a program called Road Safety Vision 2010 with a view to achieving the highest level of road safety among Organisation for Economic Co-operation and Development member nations by 2010. The main objective of this program is to keep the total number of automobile-related deaths and injuries in the 2008 – 2010 period 30 % lower than the total recorded in the 1996 – 2001 period. If the program is successful, the number of automobile-related deaths in 2010 will be lower than 2100. Concrete numerical targets set by Transport Canada include raising the rate of seatbelt usage among vehicle occupants to at least 95 %, reducing the number of deaths and injuries resulting from drunk driving and non-fastening of seatbelts by 40 %, and reducing the number of deaths and injuries involving speeding, road intersections, and beginner drivers by 20 %.

4. An examination of data on traffic problems in the US

A project on which the NHTSA has placed the high-

* Mitsubishi Motors R&D of America Technical Information Group

Table 2 Main NHTSA projects

Collision safety	Collision prevention	Injury mechanism analysis	ITS
Alleviation of injury and damage in frontal collisions	Reduction of accidents involving rollovers	Clarification of measures for reducing injuries and damage	Operational testing of collision warning systems
Occupant protection in rollovers	Quantification of rollover performance	Clarification of injury and damage mechanisms	Accumulation of data on driving under normal conditions
Reduction of occupants thrown out of vehicles	Verification of effectiveness of antilock braking systems	Verification through simulations	Operational testing of driver monitors
Improvement of occupant protection performance in side impacts	Reduction of driver distraction	Establishment of method for estimating extents of injury and damage	Analysis of accidents occurring at intersections
Development of advanced occupant protection devices	Clarification of anti-glare measures	Establishment of assessment procedures for airbags	Examination of equipment for preventing drivers from ignoring traffic lights
Assessment of airbag-inflicted injuries	Examination of effects of aging on driving		Development of high-accuracy digital maps
Pedestrian protection			Assessment of workload quantification methods
Accumulation and assessment of pre-impact data			

Table 3 Data on Mitsubishi vehicles mentioned in NHTSA accident databases

Database	Content	Data on Mitsubishi vehicles (number of items)
FARS: Fatality Analysis Reporting System	Data on all fatal automobile accidents (approx. 40,000 cases/year)	2,552
NASS-CDS: National Automotive Sampling System – Crashworthiness Data System	Samples of accidents involving property damage or worse damage (5,000 cases/year)	513
SCI: Special Crash Investigation	Airbag-inflicted injuries and other special accident types (200 cases/year)	16
CIREN: Crash Injury Research & Engineering Network	Correlation between accidents and occupant injuries	2

est priority is the construction of accident databases. These databases are significant not only because they are used by the DOT for planning of programs and evaluation of program results but also because they are available to the public and are thus treated by a large number of traffic-safety-related parties as a common source of reliable information. The NHTSA is working to create a system that allows website-based access to various data such as total numbers of deaths caused by automobile accidents, sample data on accidents involving material (or worse) damage, investigation results for accidents classified by specific items such as airbag-inflicted injuries, and data on occupant injury mechanisms in accidents. **Table 3** shows the NHTSA accident database types and the numbers of database content items that correspond to Mitsubishi vehicles.

In 2002, there were 38,356 fatal automobile accidents in the United States; 42,850 victims died within 30 days of their respective accidents. The NHTSA estimates that, behind these figures, there were 1.93 million accidents resulting in personal injury, 4.31 million accidents involving property damage, and 8.90 million unreported accidents, making a total of 15.20 million accidents. This means that at least one in every 15 people with driving licenses was involved in an accident of some kind. Automobile accidents are currently the leading cause of death of people in the 1 – 34 age group.

Rollover accidents are a particularly serious concern. According to NHTSA figures, they represent only 8 % of all automobile accidents but account for 31 % of all deaths caused by automobile accidents. Notably, about 60 % of fatal accidents involving sport utility vehicles (SUVs) are rollover accidents. Of all fatal accidents involving SUVs, rollover crashes account for approximately 60 %. The occupant death rate in rollover accidents is also alarmingly high at a little less than 50 %. Further, rollover accidents often cause people to be thrown out of their vehicles. It is known that 90 % of people thrown out of their vehicles in rollover accidents were not wearing their seatbelts.

5. Driver distraction

Driver distraction (reduction of attention and decision-making ability) caused by the use of cellphones and navigation systems in vehicles has been a matter of growing concern in the last few years. Since cellphone usage during driving is banned only in limited areas such as New York state and Miami, Florida, it is not rare in the United States to see people using cellphones while driving. Navigation systems are not yet as widespread in the US market as they are in the Japanese market, but they are growing in popularity; 18 % of all vehicle models sold in the US market in 2002 were compatible with navigation systems, and the rate of original-equipment-manufacturer installation of navigation systems on new vehicles in California currently exceeds 3 %. Further, the number of subscribers to telematics services that provide motorists with information via cellphone networks already exceeds 2.3 million and the types and quantity of information available from such services are growing rapidly. Government and industry bodies recognize the importance of providing in-vehicle data terminals with interfaces that drivers can use safely and easily and are thus working to create interface standards and guidelines and to establish methods for assessing the safety of in-vehicle data terminals.

To enable quantitative assessment of the danger of driver distraction, 17 US states have since 2002 required

every accident report to indicate whether the driver was using a cellphone, fax machine, computer, navigation system, two-way radio, and/or head-up display at the time of the accident. According to the accumulated data, 949 accidents occurred during cellphone usage in 2002 alone.

The Alliance of Automobile Manufacturers (AAM) created voluntary guidelines concerning the interfaces of navigation systems and other in-vehicle information devices and submitted them to the NHTSA and Transport Canada in April 2002. Although these guidelines are broadly consistent with Japanese and European guidelines, certain aspects are specific to the United States. (For example, the AAM guidelines specify operations permitted during driving with reference to actual measurements of the time required for the driver to see and operate relevant devices.) All AAM member companies are required to design the interfaces of their in-vehicle information devices in accordance with these guidelines. The AAM revised the 2002 guidelines through the summer of 2003, by which it finalized the guidelines for additional items. Nevertheless, the AAM is continuing to develop guidelines as there are many items remaining unaddressed including voice interfaces.

The NHTSA acknowledges the AAM's contributions to vehicle safety but is reluctant to officially adopt the AAM's guidelines, instead showing a readiness to create its own regulations. Indeed, the NHTSA has officially announced that it plans to conduct an investigation from 2005 into the feasibility of establishing new regulations. It plans to publish the results in 2006. The investigation will focus on three main areas: standards on operations that are permissible during driving; standards related to workload manager technologies that automatically optimize the information processing workload borne by drivers; and standards related to operation of devices carried into vehicles from outside.

By contrast, Transport Canada, rather than legislating for safer use of in-vehicle telematics devices, advocates exercising administrative control over the development of telematics devices to ensure that such devices are designed in a way that prevents unsafe operation during driving. It is presently discussing this issue in detail with the Canadian Vehicle Manufacturers' Association and other relevant organizations. Since the beginning of 2003, Transport Canada has taken a further step in line with its policy by clearly showing its intent to ban reconfigurable interfaces and open-architecture designs that allow plug-and-play usage of devices. In addition, Transport Canada indicated to automobile manufacturers its readiness to establish an ISO9000-type process standard compelling all automobile manufacturers to provide reports showing that the safety of telematics devices is adequately verified at each stage of development.

The Safety and Human Factors Committee of the Society of Automotive Engineers (SAE) has, over the years, been developing a standard specifying the types of operation of navigation systems that are permitted during driving. The draft standard will be proposed to the ISO/TC22/SC13/WG8 upon approval by the committee. Like the moves of the US and Canadian governments, it is attracting much attention in the automotive industry.

6. Standardization of data recorders

When a vehicle crashes, its airbag controller records data on the impact and data on the vehicle. Provided these data are properly managed and are made conveniently retrievable, they are potentially useful in efforts to clarify accident mechanisms and in efforts to devise measures to minimize occupant injuries. The NHTSA has long stressed the importance of on-board data recorders as a means of improving the efficiency and reliability with which accident data are obtained and has issued a report on types and formats of recorded data.

General Motors and Ford have publicly acknowledged that every one of their production models carries a data recorder from which accident data can be downloaded using commercially available diagnostic tools. A number of other automobile manufacturers are expected to follow suit, so it has become necessary to create standards for data types and recording formats. As a continuation of the NHTSA's work on data recorders, the Institute of Electrical and Electronics Engineers (IEEE) has been working to create standards since January 2002. The IEEE's standardization activities encompass all types of vehicle platform (from passenger cars to heavy-duty trucks) and all types of accident. In parallel with these activities, the SAE began its own standardization project in February 2003. The SAE's project was limited to frontal impacts suffered by passenger cars and was completed in July 2003. The SAE committee responsible for the project has since announced plans to expand the project to include side-impact accidents, multiple-impact accidents, pre-impact driving records (obtained from drive recorders), and real-time data transmission (achieved by means of remote diagnosis devices).

7. The present state of ITS projects

ITS research and development in the United States began in earnest in the early 1990s and has been progressing even more rapidly since the beginning of the new century. The federal ITS budget for the next six years will be defined in detail in the new federal law that defines the surface transportation budgets for fiscal 2004 and onward. Over the next six years, the DOT is expected to be able to spend $121 million per year on ITS research and development and state governments are expected to be able to spend $135 million per year on the development of ITS infrastructure.

Under a vehicle-directed ITS program called the Intelligent Vehicle Initiative (IVI), the DOT has, since 1999, been equipping heavy-duty trucks and other vehicles with ITS technologies and using them to accumulate huge amounts of real-world road data (**Table 4**). In the next step of the program, the DOT will conduct ergonomic tests in passenger cars in order to gather a

Table 4 R&D missions for IVI program

Content	Participating companies
Development of human-machine interface (employing head-up display) for rear-impact warning	Ford, GM
Assessment of driver workload quantification methods	Ford, GM, Nissan, Toyota
Development of high-accuracy digital map database	DaimlerChrysler, Ford, GM, Navigation Technologies, Toyota
Establishment of optimum parameters for adaptive cruise control (ACC) and rear-impact warnings	GM, Delphi
Assessment of human-machine interface of lane departure warning systems	Visteon, AssistWare
Accumulation of data on driving under normal conditions	Virginia Tech University

large amount of data on drivers' responses to various types of ITS equipment. Related interface-evaluation tests will involve over 100 drivers and are expected to yield information that is unprecedented in terms of volume and potential usefulness. Another IVI mission is the Naturalistic Driving Data project led by Virginia Polytechnic Institute and State University, which focuses on the collection of data on normal driving. Here, vehicles carrying measuring equipment will be lent to 100 average drivers and used to gather a large amount of data on accident-free driving in normal circumstances. Comparison of the resulting data with data corresponding to crashes and near misses will, it is hoped, enable methods for detecting potentially dangerous driving to be devised.

The DOT is also active in efforts to realize ITS technologies that can be incorporated into the existing transportation infrastructure; the NHTSA and Federal Highway Administration (FHWA) have relevant programs under way. The NHTSA's program is called Vehicle Safety Communication (VSC) and is designed for technical verification of dedicated short-range communication (DSRC) systems and other technologies that enhance traffic safety by means of communication between vehicles and between vehicles and roadside devices. (The VSC program includes work on definitions of message sets transmitted between vehicles.) The FHWA's program is called Vehicle-Infrastructure Integration (VII). Under this program, state transportation agencies and several automobile manufacturers are pursuing the technical verification necessary to realize an intelligent transportation system through the use of various forms of communication between vehicles and roadside devices. The VII program encompasses not only technological issues but also organizational issues such as determination of the framework within which the common communications protocol for real-time transmission of traffic information to vehicles should be developed. A specific example of VII work is research on devices that work within the existing transportation infrastructure to prevent accidents on intersections (**Photo 1**). At the time of writing, an FHWA facility is testing a system that uses infrastructure-side

Photo 1 FHWA's intersection accident prevention system

equipment to detect vehicles entering an intersection and, when it determines that a vehicle is likely to suffer a frontal collision, issues a warning message outside the vehicle (by means of a roadside sign) and inside the vehicle (by means of DSRC).

The ITS industry is also playing an active role in the development of infrastructure-compatible intelligent transportation systems, using DSRC as a key to bring together vehicle-safety devices, telematics devices, transportation-infrastructure equipment, telecommunication-infrastructure equipment, and other elements whose development paths were previously quite separate. Whereas Japanese and European ITS efforts are showing signs of leveling off, ITS efforts in North America have, provided the public and private sectors continue to strengthen their cooperation, the potential to realize massive progress in the years ahead.

8. Conclusion

Although this paper gives only a limited view of technological trends in the North American automobile markets, it gives a sense of the diversity and multiplicity of automobile-related activities under way in the United States and Canada. The Mitsubishi Motors R&D of America Technical Information Group will work to continue functioning as a source of timely information not only on technological trends in the areas discussed in this paper but also on technological trends in other important fields such as environmental protection (a field where on-board diagnosis systems are a key focus). One of our offerings is the *NAFTA Technical Report*, which we publish twice a year (at March-end and September-end) as a source of up-to-date information on North American technological trends. We hope our work will continue to be of value.

Hideki HADA