Development of technical guidelines for visual drive recorders (VDRs)

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ABSTRACT

In 2006, Transport Policy Council, an advisory group of Japan Ministry of Land, Infrastructure and Transport (JMLIT) consisting of vehicle safety experts, submitted a report on future vehicle safety measures to the Minister of JMLIT.
The projections in this report indicate that the number of traffic fatalities and injuries will dramatically decrease until 2010. This report also sets "zero fatalities" as the ultimate target.

To achieve this aim, however, it is necessary to identify and promote new active safety measures. Therefore, near-miss situation data as well as accident data, which would be recorded by an on-board VDR, should be analyzed and evaluated.
In October 2006, JMLIT organized a panel of experts to discuss and develop technical guidelines for such VDRs.

Introduction (The Japanese Government's Stance on Measuring Transport Safety)

In 2006, the number of Japan's road traffic accident fatalities was registered at 6,352, approaching the 6,000 mark for the first time in 51 years. Moreover, the number of road traffic accidents and injuries both declined slightly compared to 2005. However, the number of road traffic accidents and injuries both remained at levels higher than one million throughout this time.

To improve this situation, the Japanese government has set goals for transport safety over the 5 year period from 2006 to 2010 in its '18th Fundamental Traffic Safety Program' as follows:

- To reduce the number of road traffic fatalities to below 5,500 by 2010, and to establish the safest road traffic in the world.
- To build a society having no traffic accidents as an ultimate goal.

In this report, road construction, road maintenance and driver's education are listed as some of the safety measures needed to achieve these goals.

In addition to these principles, the Transport Policy Council, an advisory group within the Ministry of Land, Infrastructure and Transport that consists of vehicle safety measurement experts, submitted the report entitled 'Vehicle Safety Measures for Building

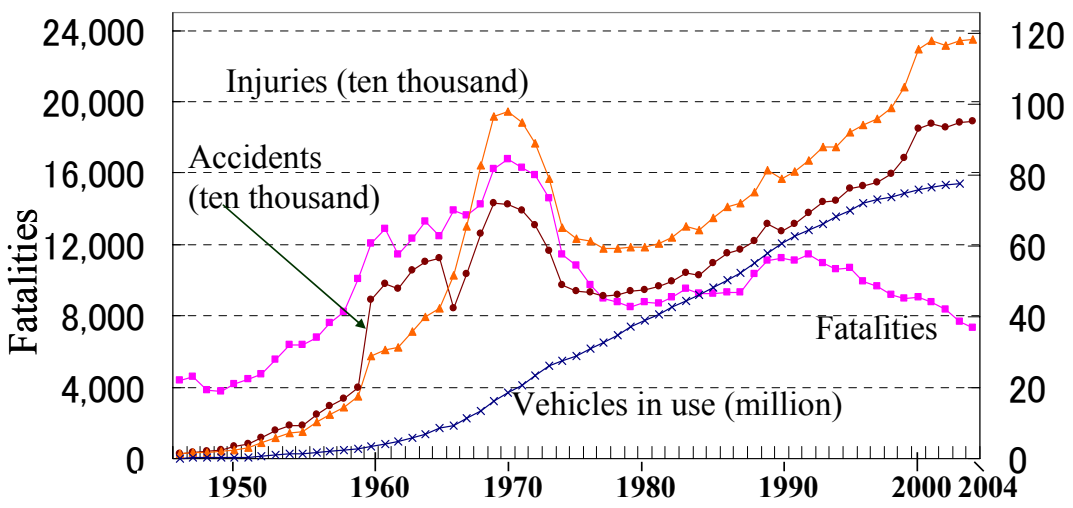

Figure1. Traffic Accident in Japan

a Society Free from Road Traffic Accidents' to the Minister of Land, Infrastructure and Transport last June.

This report indicates an objective to achieve a 750 annual fatality reduction in terms of fatalities that occur within 30 days of an accident injury ("within-30-day fatalities") and a 25,000 annual injury reduction in 2010 from the 2005 baseline.

To continue fatality reductions into 2010 and beyond, efforts will be exerted to enhance active safety measures.

Moreover, this report indicates that in view of future developments, such as the advancement of information technology and the diminishing youth population, the following measures need to be undertaken jointly by industry, academia and government.

- To promote vehicle safety measures specifically designed to increase the safety of heavy duty vehicles;
- To introduce vehicle safety measures intended to build a motor society friendly to pedestrians and elders;
- To formulate vehicle safety measures for reducing serious injuries and disabilities in addition to the reduction of fatalities and injuries in general.

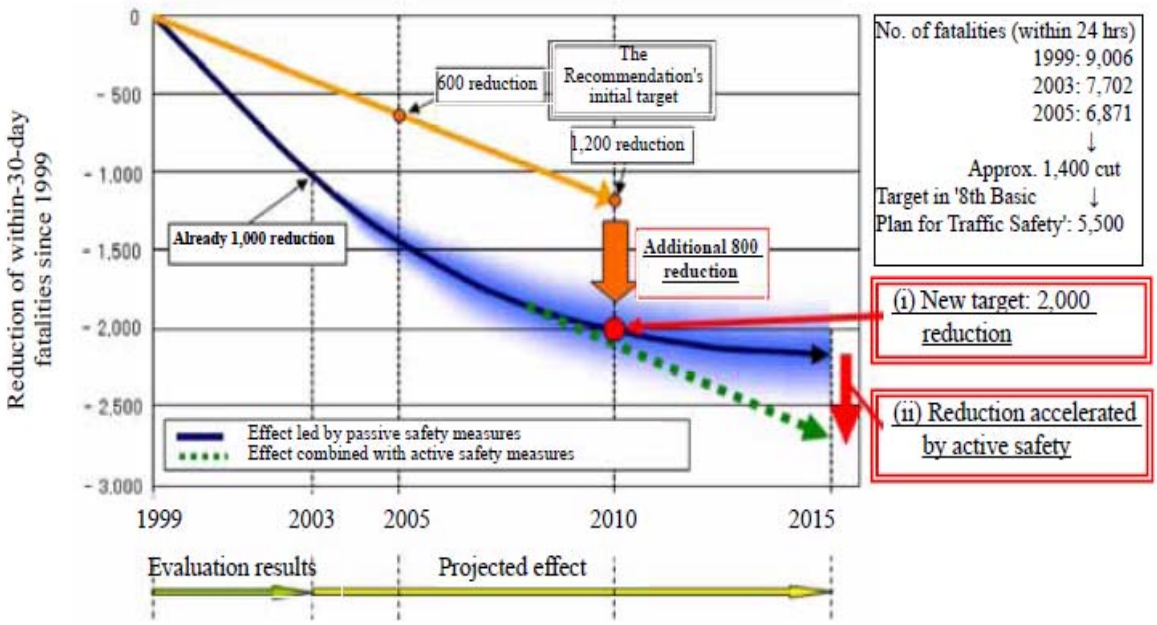

Figure 2. Schematic of New Target Setting

Overview of Current Vehicle Safety Measures

The Japanese government has promoted vehicle safety by establishing vehicle safety regulations, promoting the ASV (Advanced Safety Vehicle) project and improving safety assessment tests.

As a first issue, establishing vehicle safety standards has been promoted by analyzing accidents and evaluating the effect of some vehicle safety devices based on a cycle of setting a target, implementing safety measures, and evaluating the effect.

ASV technology and driver assistance technologies such as the adaptive cruise control system, damage mitigation braking system, night vision and so on have been introduced and commercialized in the Japanese market over the past several years. The variety of automobile assessment tests has expanded, now including the pedestrian protection test and the child restraint test. Regarding collision test results, the results of full-lap frontal crash, offset frontal crash and side crash tests have been integrated to facilitate the comparison of safe vehicle models in relation to collision configurations.

Thanks to the vehicle safety measures in effect, a 1,250 fatality reduction by 2010 as compared to the 1999 baseline is likely to be reached. Since the number of vehicles incorporating these safety technologies will further increase and because new safety measures will be added, a further reduction in fatalities will be possible.

However, effective vehicle safety promotion is mostly limited to passive safety measures. Because active safety technologies aren't understood well enough by users, these technologies don't spread widely. Passive safety technologies, however, are commercialized rapidly and widely.

In order to evaluate active safety technologies quantitatively, it is necessary to calculate how many accidents are prevented by this technology. However, the existing accident investigation techniques cannot

collect data on how dangers have been evaded in near miss situations.

Therefore, the promotion of active safety technologies must be supported by the quantitative evaluation of their effects, which will necessitate further improvements in accident analysis and the establishment of performance evaluation techniques for new technologies.

Table1. Commercialized Technologies from ASV Project

No.	ASV technology	Status		
		1996	2001	2004
1	High-speed adaptive cruise control (ACC)	★	★★★	★★★
2	Low-speed adaptive cruise control	★	★★	★★★
3	Lane keep	★	★★★	★★★
4	Damage mitigation brake	★	★	★★★
5	Drowsiness warning	★	★★★	★★★
6	Rear & side obstacle warning	★	★★★	★★★
7	Curve warning	★	★	★★★
8	Night vision	★	★	★★★
9	Parking assist	★	★	★★★

★: In-company test, ★★: Road running test, ★★★: Commercial use

* Damage mitigation brake ····· Using radars or other onboard sensors, this system rapidly anticipates front crash risks and controls the brakes to mitigate crash damage.

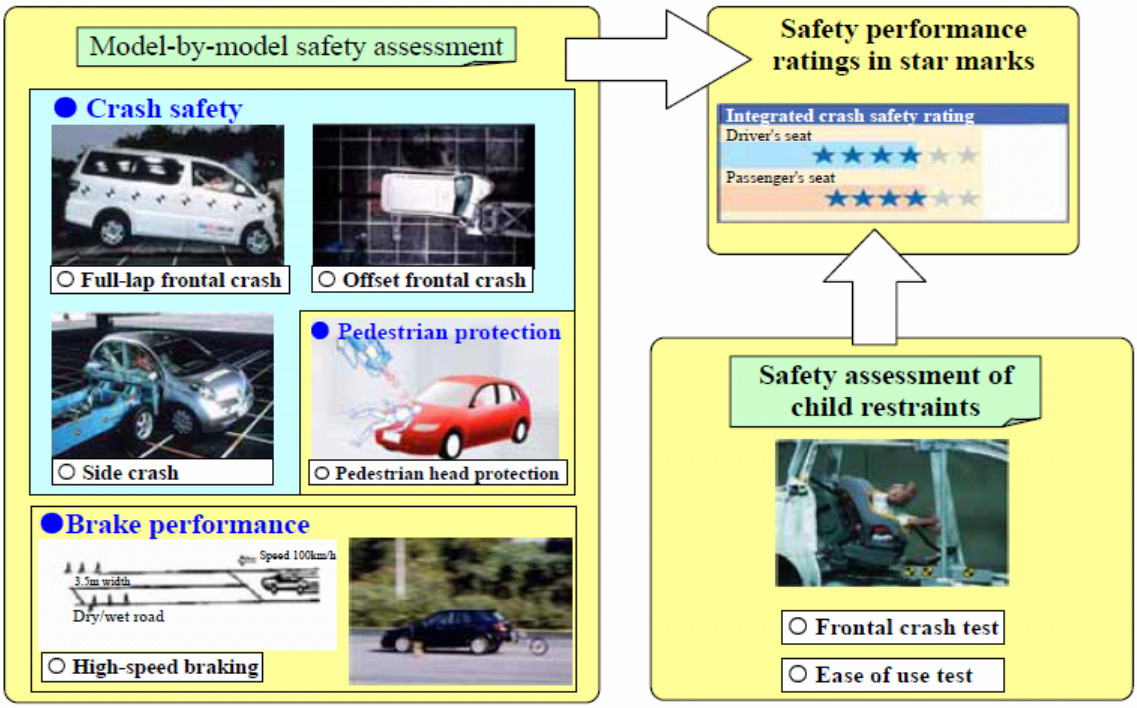

Figure3. Profile of Japan's Automobile Assessment

Table2. Fatality Reduction Effects of Vehicle Safety Measures (estimates of within-30-day fatalities)

	2003	2005	2010
Full-lap frontal crash	715	900	1,150
Side crash	288	350	600
Offset frontal crash & pedestrian head protection	-	0	50
Future measures	-	-	200
Total	1,003	1,250	2,000

* Recorded numbers for 2003 fatalities

The Necessity of VDRs

After proving substantially effective, it is disconcerting that the passive safety technologies in use are predicted to near their maximum potential after 2010.

Also, it is necessary to reduce the number of injuries and road traffic accidents by promoting active safety technology, instead of passive safety, which isn't expected to reduce the number of these well after 2010.

To spread the active safety technologies:

- As a short-term target, expansion of the use of ASV technology such as damage mitigation braking systems is promoted.
- As middle- and long-term targets, the effect of active safety technologies should be clarified, and if some technologies are effective, these technologies should be promoted in the market.

As the above mentioned, to expand the use and accelerate the development of active safety technologies, it is necessary to increase vehicle users' knowledge of safety technologies.

Therefore, the use of visual drive recorders (VDRs) is being considered. The VDRs, installed onboard, are designed to record the vehicle conditions (speed, acceleration, etc.) and the driver-occupant conditions (driving operation, seatbelt use, etc.) during an accident or in a near miss situation.

The VDRs are designed to record, at a certain frequency, vehicle behavior in an accident or rapid deceleration through video images of the inside and outside of the vehicle, as well as deceleration data from the ten seconds before and after the point of impact..

The VDRs' data will enable quantitative assessment of safety technologies for the promotion of truly effective active safety technologies, to enable in-depth accident analysis using visual data.

So that MLIT will pay attention to this point, we decided to organize a panel of experts as soon as possible to establish a technical guideline on the basic performance requirements of drive recorders and to determine the following:

- Examination of data items and specifications for drive recorders;
- Method of collecting the data recorded by drive recorders in widespread use;

Method of analyzing the collected data

Establishment of Performance Evaluation Techniques with VDRs

(1) The spreading situation of VDRs

In March 2006, 230,000 taxies were in use in the Japanese market. Of those vehicles, 34,000 have mounted VDRs and this number is increasing continuously.

Some taxi companies exert some effort to maintain transport safety, through educating their drivers and by using recorded data of VDRs.

Based on the above situation, to decide the specification of VDRs, we refer to the present VDR specification that is circulated in the market and that has more than ten kinds of different specifications.

(2) Configuration of road traffic accidents should be analyzed by VDRs

In Japan, rear-end collisions account for about 30% of total injury-inducing accidents. The proportion of crossing collisions and rear-end collisions to total accidents is more than 50%.

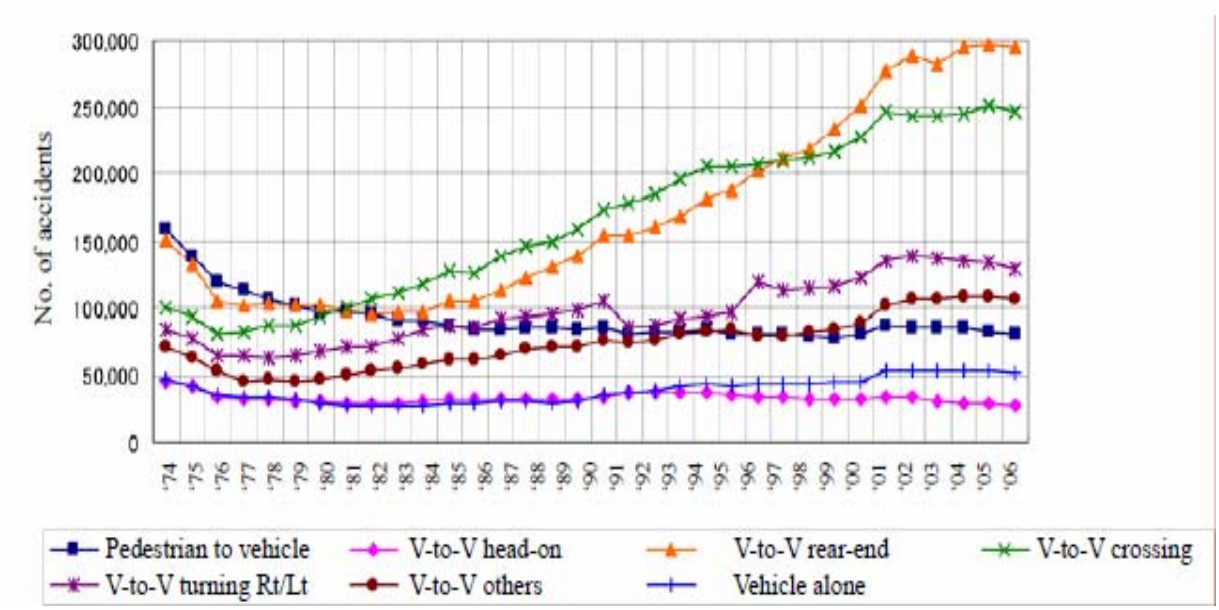

Figure4. Road Traffic Accidents by Configuration

Therefore, using VDRs, we think that it is important to evaluate safety devices in relation to rear-end collisions and crossing collisions. As a first step, we plan to evaluate safety devices in relation to rear-end collisions. Specifically, we plan to evaluate braking assist systems, damage mitigation braking systems, high-mounted stop lamps and so on, as safety devices prevent rear-end collisions. The following VDR specifications will be evaluated through experiments reproducing accidents and so on.

① Specification concerning image quality and horizontal visual angle

Using visual data of VDRs, we have conducted an experiment to establish the specification concerning image quality and horizontal angles that would make it possible to calculate the distance to the vehicle ahead and the relative speed of the vehicle ahead.

In general, when the horizontal visual angle becomes wider, it becomes easier to understand the outline of the accident. On the other hand, the image quality becomes poor, and detailed accident analysis becomes difficult. Therefore we have to look for the optimal VDR image specification.

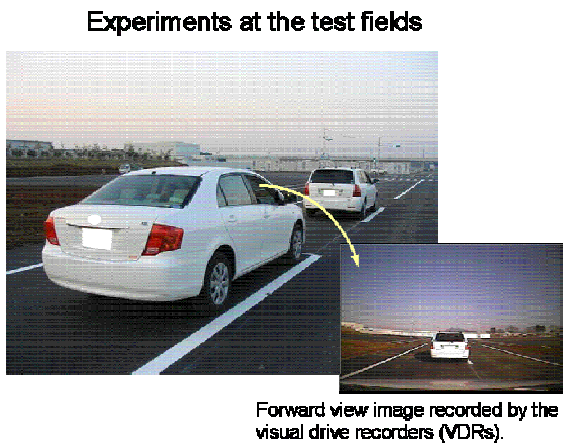

Figure5 Experimental situation (car-following).

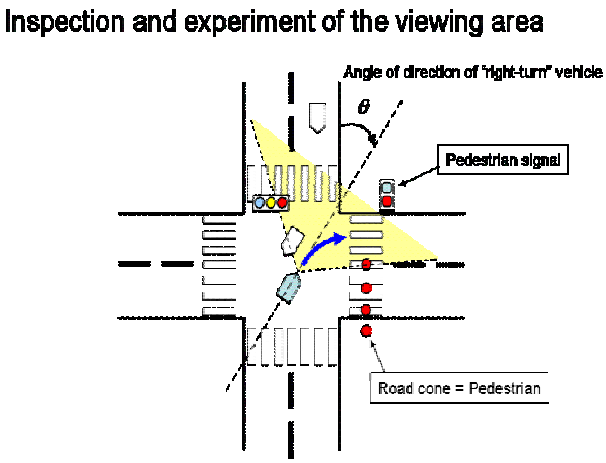

Fig.6 An example of the experimental geometry of "right-turn" at the intersection without "right-turn" lanes.

② Specification concerning sampling frequency of image and deceleration data

It is necessary to understand in detail the VDR data of rear-end collisions and near miss situations exactly. It is therefore necessary to adjust the sampling frequency of image and deceleration data.

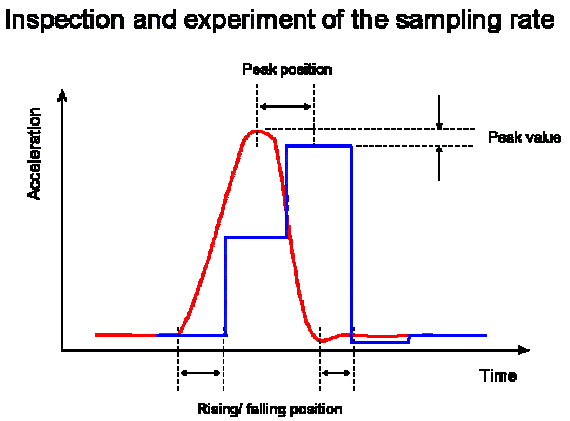

Figure7 Difference between the "true" curve and the recorded one by the visual drive recorders (VDRs).

Future Issues

The above investigation will be finished by this summer. After that, we will start to evaluate safety technologies for rear-end collisions. However, it is necessary to develop effective active safety technologies by further utilizing the data from VDRs. To achieve this goal, we need to discuss the follows items.

(1) Method of collecting the data recorded by VDRs in widespread use

If we promote evaluation of active safety technologies with VDRs, it is necessary for drivers who attached VDRs to cooperate voluntarily. In order to conduct this investigation practically, we need sampling data of vehicles that have active safety devices such as a braking assist system or a damage mitigation braking system. However, it is very difficult to collect the data, because the number of vehicles with mounted active safety devices is very small. Therefore we need to discuss the method of collecting the data efficiently.

(2) Method of analyzing the collected data

The data collected by VDRs occupies huge memory space for the included visual data. Moreover, each VDR manufacturer formats the visual data differently. Therefore we need to discuss the method of analyzing the collected data easily. Whether the format of every manufacturer's data should be unified will be addressed in this discussion.

(3) Sustainable analysis by using the collected data

We need to discuss the overall framework for sustainable analysis by using the collected data, as well as for the above implementation, examination, collection and analysis.

Actually, we intend to utilize VDR data to analyze traffic accidents at ITARDA (Institute for Traffic Accident Research and Data Analysis).

Conclusion (Summary)

We should expand the use and accelerate the development of active safety technologies, to promote the measurement of traffic accidents by vehicle safety technologies.

However, it is difficult to show quantitative effects of active safety technologies, which differ from the effects of passive safety technologies.

Recently, given the rapid advancement of electronic information technology and the development of new technologies such as VDRs, the establishment of quantitative methods for measuring the effect of active safety technologies is expected.

By the middle of this year we will decide the specification of VDRs; after that we will promote this project.

REFERENCES

1. The Road Transport Subcommittee of Land Transport Committee of Transport Policy Council ,June 12, 2006 "Vehicle Safety Measures for Building a Society Free from Road Traffic Accidents (REPORT)"
2. ITARDA - Institute for Traffic Accident Research and Data Analysis "Traffic Statistics"