An Overview on Establishing Safety Assessment Standard of Longitudinal Active Safety System in Korea

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ABSTRACT

Recently, each country's political efforts and nongovernmental researchs have been continued world widely to induce development and propagation of driver assist active safety system. In case of Korea's domestic situation, so far as technical development of the related systems is concerned, although it sounds like it's too late compared to other countries(European, Japan and US), Korea is now concentrating energies to enlarge market penetration and correspond to international trend through a assessment standard establishment.

As part of an this endeavor, a research was organized what is called 'Development of Safety Assessment Technology of Advanced Safety Vehicle' that is being carried out with 3-step approach(1st step : 2009~2012, 2nd step : 2012~2015, 3rd step : 2015~2018), and as the 1st step being closed, safety assessment requirement of a Commercial vehicle AEBS & LDWS including passenger vehicle ACC system was drawn, and the 2nd step is now being in progress.

Presently, in its 2nd step, a study to establish safety standard for passenger vehicle AEBS & LKAS is being carried out and, after 2015, assessment standard for the related items will be drawn with keeping pace with international test standard and guideline e.g. NCAP

This study considered, in addition to the technical development and standardization procedure of advanced active safety system, how it will be reflected to Korea's system, and such a political approach will lead domestic industries including customer to be interested with the active safety system and help the result to be utilized as an internal standard

INTRODUCTION

In the past, chassis stiffness and reliability of components were given priority in the development of cars and safety and convenience were main considerations as well. However, in recent years, accident prevention and casualties minimization efforts call for a more active and comprehensive concept of safety devices. In order to reduce fatigue due to long duration driving, advanced driver assist system(ADAS) was developed. Starting out as a mere convenience device, it is gradually being developed into an active safety system, targeted at accident prevention and mitigation. Representative examples of longitudinal control system such as ACC, AEBS and FCWS, with their excellent effectiveness in accident prevention and casualty reduction, are being developed under government sponsorship in countries like Japan, US and Europe. For example, e-Safety and PReVENT in Europe; Mobile 2000, PATH, IVI and VSCC in the US; and AHS and ASV in Japan. In particular, under the umbrella of the United Nations Economic Commission for Europe (UN/ECE), at the World Forum for Harmonization of Vehicle Regulations (WP29), the 2002 ITS Informal Group was created to review standards associated with the safety of vehicles, passengers and related active safety system[1]. Created in 2009, the AEBS (LDWS) informal group, submitted in Feb 2011 the AEBS Regulation draft for commercial vehicle which was approved and adopted in Nov 2012. In the case of Korea, apart from technology development in the industry, the government is making parallel efforts at institutionalizing early adoption of related technology and keeping pace with international standards and regulations.

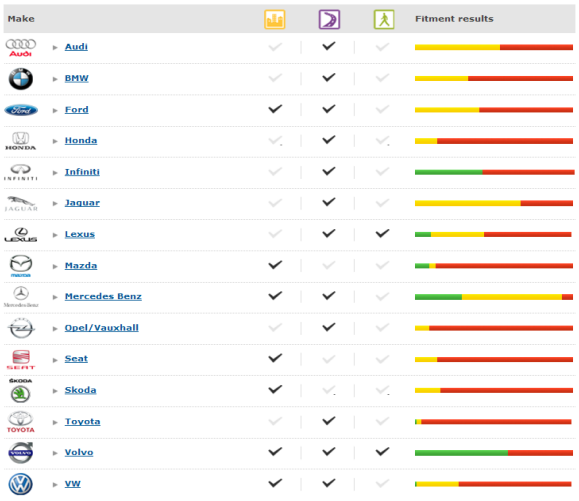
This paper reviews the status of national and international regulation and standards, and researches

performed to produce domestic safety standards and evaluation requirements. In addition, the author wishes to release a government policy guideline on active safety system for vehicle manufacturers and consumers, to encourage the production of safer vehicles.

Overseas Markets and Policy Trends

Active safety systems for preventing frontal and rear collisions, along with development of sensor technology, are spreading rapidly. According to the AEB fitment survey[2] conducted in 2012 at Euro NCAP, vehicle manufacturers in the Europen region are currently mounting AEB as a standard or optional feature.

Figure. 1
Euro NCAP AEB firment survey in 2012



Separately, GM is scheduled to release in 2013 three Cadillac models that come standard with Front and Rear Automatic Brake, ACC, LDWS and BSD. At Toyota, the PCS system, which has been improved to operate up to a relative vehicle speed of 60km/h, will now come standard with the Crown luxury sedan. Crash avoidance system that can automatically stop at 60km/h is scheduled to be fitted in Honda models this year. In addition, Continental Teves, a representative system manufacturer, forecasted that within the next 5 years, the proportion of state-of-the-art components in vehicles less than $35,000 will increase to 10-50% of production cost, and by 2015, car manufacturers in countries such as US, Japan and Korea will collaborate in more than 50 projects to develop advanced auto technology.

As the market for longitudinal active safety system expands and the resulting effect of actual reduction in forward collision gradually emerges, the associated institutional policy approach has also strengthened. The Decade of Action for Road Safety[3] 2011-2020 was officially proclaimed by the United Nations General Assembly in March 2010. Accordingly, research and development for collision avoidance and safety enhancement are being actively pursued, through the expansion of UN Regulation's International harmonization, the NCAP institution and active safety technology application.

Aside from this UN-wide effort, each member country is separately drawing up and implementing their own separate policies for the introduction of active safety system. In Germany, for example, the number of city and suburban rear collision accidents is approximately 20 million each year, with about 25% of drivers reporting it happening in totally unexpected condition. Subsequently, emergency brake assist(EBA) is scheduled to be installed in compact-sized vehicles as a standard feature. According to the German Road Safety Committee, EBA that automatically monitors its surroundings and brakes when necessary can prevent or mitigate the impact of rear collision accidents by up to 28%.

On the other hand, due to AEBS market expansion, testing requirement for assessing the safety of AEBS is becoming a necessity. At the end of a 2-year long study at UN's WP29, AEBS Regulation for November 2012 commercial vehicle was approved and awaiting enforcement by the EC Directive (General Safety Regulation) within the EU beginning November 2013. Ahead of this in Japan, replacing the AEBS Technical guidelines that were enacted and enforced since 2003, UN Regulation that mandates the installation of safety features targeted at heavy commercial vehicle is scheduled to be adopted from 2014 onwards. In the US, Confirmation Test standard[4] for 2006 FCW and LDW was made, and with the domestic introduction of NCAP, vehicles equipped with the appropriate devices are producing results.

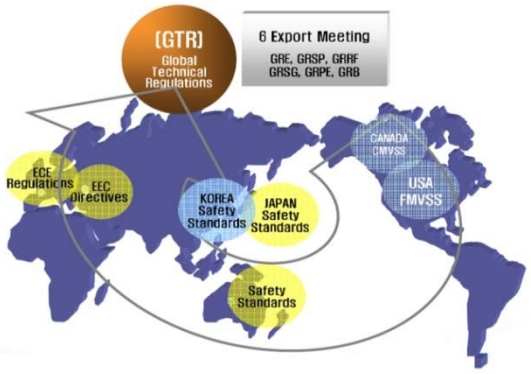
Figure. 2
Technologies for additional scoring in US NCAP and Euro NCAP[5]

In the EU, recognizing the potential for these AEB systems, insurers and other road safety stakeholders

are supervising research into the evaluation and rating of AEB conducted through the AEB group, of which results can be used by consumer test organizations such as the Euro NCAP, IIHS and Thatcham.

At the Beyond Euro NCAP, divided into the categories of warning system, active safety system and emergency call System, vehicles equipped with technology relevant to active safety system such as AEBS will be granted additional score based on test protocol derived from the AEB group. The 2012 Euro NCAP performed fitment survey on vehicles equipped with features like AEB and FCW according to the AEB assessment plan, and is scheduled to conduct evaluation test and assign an overall rating to Car-to-Car Rear Collision and Car-to-Pedestrian from 2014 and 2016 onwards respectively. Separately, depending on future market trends, AEB global technical regulation for small sized passenger vehicle is being reviewed for the revision of the EC directive after 2016[6].

Figure. 3
UN/WP.29 / 1998 Agreement configuration



Additionally, in Japan, research for the addition of ACC, ESC and such is being performed at JNCAP to encourage the expansion of active safety system. Similarly, the Australian NCAP has aimed for a 30% reduction in deaths and injuries by 2020 due to the high expectations in active safety system for transportation safety[7].

Table. 1
Introducing as active safety technology in each country's NCAP

Countries	Related active safety technology
Korea (KNCAP)	AEBS, FCW, ACC, LDWS, BSD, LKAS
Europe (Euro NCAP)	AEBS, ESC, SBR, SLD
USA (US NCAP)	FCWS, ESC, LDWS
Japan (JNCAP)	ACC, DMB, ESC
Austrailia (ANCAP)	AEBS, SBR, ESC

Domestic policy and institutional trends

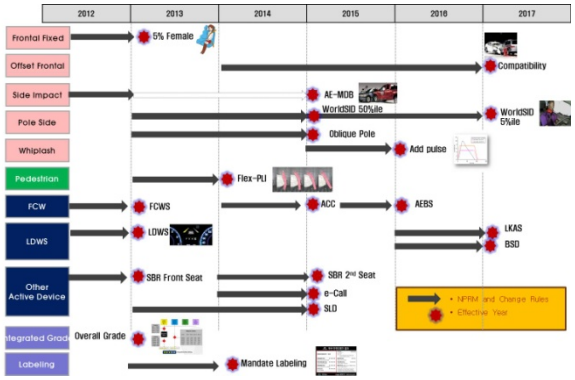
The National Policy statistics in Korea reported that the total number of deaths in 2010 caused by traffic accidents in Korea is 5,505, about 2.6 per 10,000 cars and twice the OECD average of 1.3.

According to the 7th General plan for Transportation Safety which has been enforced since 2012, the establisment of strategies to make full use of active safety system is the key project to reduce road casualty by 3,000 (40% 0f 2010's level) to achieve middle level ranking among OECD countries by 2016.

To this end, the government of Korea is urging the introduction of active safety system through proper obligation(Safety standard) and inducement (NCAP), first by participating in the enactment of UNECE/WP29's AEBS new Regulation as part UN WP29's agreement contracting country. The AEBS international standard will be introduced in this year(2013) through the establishment of Korea's safety standard and is mandatorily scheduled to be applied step-by-step to heavy commercial vehicles and buses after 2016.

According to future KNCAP strategy for inducing the production of safer vehicles, taking into consideration the domestic level of technology and NCAP roadmap of other major countries for active safety system, the sequential introduction of FCWS, ACC, AEBS, LDWS, LKAS, BSD, ASLD is currently under review.

Figure. 4
KNCAP Roadmap (2012-2017)



Specifically, with the introduction of KNCAP overall rating system in 2013, FCW and LDW, whose level of technology and market trends have matured to some extent, will first be granted additional score through evaluation. Thereafter, through international social trends and cooperation, expansion of ACC, AEBS and such is scheduled.

National standards Highlights

Forward Collision Warning System

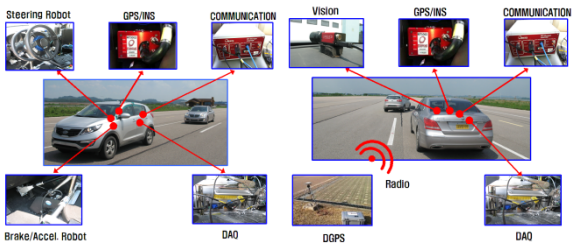
In th FCW testing, refers to the NHTSA's Confirmation Test Protocol.
The test is composed of 3 scenarios: target vehicle is stationary in front of driving lane, braking through constant deceleration and driving with slower speed in front.

Table. 2
FCW Assessment Requirement

Scenario	Test conditions	Requirement
Stationary target vehicle	· Speed : 72kph(SV)	Warning before TTC 2.1s
Delelerating target vehicle	· Speed : 72kph(SV&TV) · Initial clearance : 30m · TV decel.:0.3g	Warning before TTC 2.4s
Slower speed target vehicle	· Speed : 72kph(SV), 32.2kph(TV)	Warning before TTC 2.0s

System configuration for evaluating FCW is shown in the following figure.

Figure. 4
Test equipment for FCW Assessment



As evaluation criteria, similar to the NHTSA Confirmation Test, the FCW system must satisfy the time to collision(TTC) requirements for at least five of the seven test trials, and must not fail two consecutive trials to successfully pass. In this case, if the first five of the seven individual test trials satisfy the requirements, it is not necessary to perform additional trials to verify that two consecutive failures not take place.

Adaptive Cruise Control

ACC, an automatic follow control system to reduce driver fatigue based on the speed set by the driver and of the forward vehicle, along with convenience features, provides minimal safety feature that include some of FCW and AEB features.
Thus, in order to grant additional score for ACC equipped vehicle, first a minimal structural requirement draft is proposed to judge whether the ACC system is appropriate for the specification or not. Thereafter, performance evaluation requirements will be added step by step.
The ACC structural requirement draft referenced UNECE/WP29 ITS Informal group's HMI guideline, ISO 15622 & 22179, and the Japan Technical guideline.
The currently proposed ACC structural requirement draft includes mainly provisions for acceleration/deceleration control, stop lamp, HMI for the normal operational condition and failure condition, safety measure in the event of failure, user manual, and low speed following.
In the future, weighted value will be considered to be applied to hazard situation in real road-driving condition for various test scenario such as curve way, cut in, lane change and identification distance, and ACC rating is being reviewed through carring out assessment test.

Table. 3
Example of ACC Assessment Method(Draft)

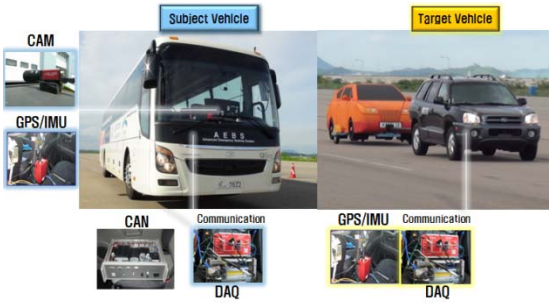
		Result fo Assessment Test									ACC System Grade
		Scenario					Subtotal	Weighting	Total	Record	
		(1)	(2)	(3)	(4)	(5)					
Test scenario	Test No. 1 Curve road	7.5	8.0	7.0	6.8	8.0	37.3/50	0.3(15%)	11.2/15	74.6%	★★★★☆
	Test No. 2 Cut In	6.5	7.0	7.2	-	-	20.7/30	0.8(24%)	16.7/24	69.0%	★★★★
	Test No. 3 Lane-Change	6.4	-	-	-	-	6.4/10	1.5(15%)	9.6/15	64.0%	★★★☆
	Test No. 4 Detecting range	9.2	-	-	-	-	9.2/10	0.6(6%)	5.5/6	92.0%	★★★★★
	Test No. 5 Clearance control	6.5	-	-	-	-	6.5/10	4(40%)	26/40	65.0%	★★★☆
Total record							86.7/120	-	69.0/100	69.0% (72.0%)	★★★★ (★★★★☆)

Record	~ 30%	30~35%	35~40%	40~45%	45~50%	50~55%	55~60%	60~65%	65~70%	70~75%	75%~
Rating	0★	0.5★	1★	1.5★	2★	2.5★	3★	3.5★	4★	4.5★	5★

Autonomous Emergency Braking System

For AEBS test requirement in commercial vehicle, as a WP29 1958 agreement contrancting party for the International technical standard harmonization, we are now in the process that the standards are being enacted with the same requirements as AEBS Regulations of the UN.

Figure. 5
AEBS Assessment Testing for Bus

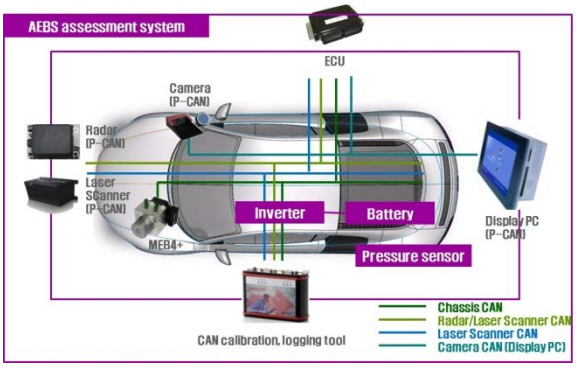


The same as US, domestic regulation certification system adopted self certification by car manufacturer. By that nature, through joint researches from a consortium of a domestic car manufacturer, an university, one of korean research institute and such, the KMVSS AEBS requirement draft that includes detailed specification draft relevant to current test procedure was made, with regulation enactment from early 2014 and step-by-step enforcement starting with heavy commercial vehicles from early 2016 targeted.

Unlike commercial vehicle, in the case of small size passenger vehicles, rather than forced installation from regulation enactment, future standardization and compulsory enforcement are under consideration after encouraging manufacturer's voluntary participation through raising consumer awareness with Euro NCAP.

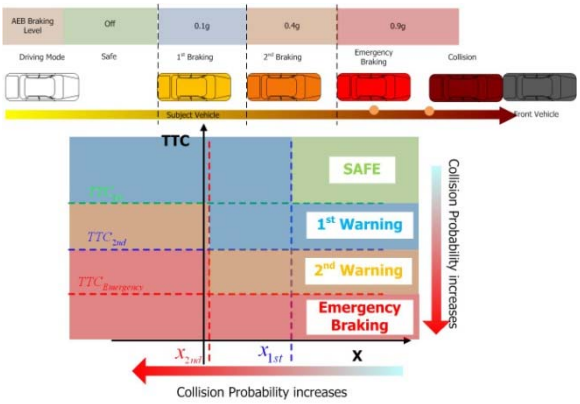
At this stage, for Car-to-Car Rear Collision scenarios currently under consideration in the Euro NCAP, measures and evaluation procedures for 2015 introduction into the KNCAP are under review. Through the hazard situation risk index in real road-driving condition, research is underway for granting AEBS grades.

Figure. 6
AEBS Assessment Test System



A clear assessment test protocol has yet been submitted for Car-to-Pedestrian. In this case, studies for pedestrian target selection is in progress, and for three years from 2012-2014, through self researches by national consortiums, assessment criteria that is right for domestic situations will be presented.

Figure. 7
Hazard situation index in driving



CONCLUSIONS

According to Korea's traffic accident statistics, when accidents caused by driver's condition are classified, nearly more than 60% was proved to be closely related to negligence in keeping the eyes forward[8]. Currently, among driver assist systems being actively developed and deployed, longitudinal active safety systems like FCW, ACC and AEBS are expected to greatly reduce accidents caused by negligence in keeping the eyes forward. In order to facilitate these systems, the government in many countries has been devoting a lot of effort into regulations and institutionalizations. By promoting enactment and research into regulation and notification draft for FCW, ACC and AEBS that are currently being promoted, Korea is also trying hard to achieve its government policy goal of reducing traffic casualties to 3,000 by 2016, to get within OECD's average.

ACKNOWLEDGEMENTS

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