Establishment of Korean KIDAS under the limited accident related data

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Abstract

Although, the annual traffic accident statistics published by the national police is available in public, but, the detailed traffic accident data has not been released in Korea. Recently, Ministry of Land, Infrastructure and Transport recognized the important of in-depth accident data to enhance road traffic safety and initiates research project for establishing collection of the detailed accident data. The main objective of the project is feasibility study for the establishing KIDAS. Under the project, three university hospitals which have located mid-size cities have been selected to collect accident data. Annually, approximately more than 500 cases of accidents have been collected from the in patients interview and diagnosis. Unlike GIDAS, on-site investigation can't be performed currently in Korea police policy. The only available data is patient medical records, patient description of accident circumstance and damaged vehicle at the garage. Occasionally the police provide the accident investigation reports which the information is very brief in terms of causation of accident as well as vehicle safety. In this study, as first attempt, the concept of KIDAS is to adopt format of iGLAD for harmonization. Since the current collected accident information is extremely limited compared with GIDAS, the other sources of data and calculations such as KNCAP vehicle data, pc-crash simulations, vehicle registration information, insurance company data and photomodeler are utilized to fill the blank part of iGLAD template. Results from the constructed KIDAS_iGLAD, the limited cases of assessment of active safety device such as AEBS, ESC, and LDWS will be evaluated.

NOTATION

E= the amount of absorbed energy by a car
L= width of crush
C= represents the crush depth
A, B = Coefficients
θ= force angle from perpendicular

INTRODUCTION

Economical point of view, Korea is now top 10 countries globally including of 7th ranking in export, 10th in trade volume, and 5th vehicle production volume. However, according to global statistics in road safety field, Korea is ranked in 29th of 32 OECD countries in 2011. The number of deaths per 100,000 populations was 10.5 (OECD average 6.8) persons and the number of deaths per 10,000 vehicles was 2.4 (OECD average 1.2) persons.

In road safety, the first step in the process is identifying significant safety enhancement areas and the mechanisms of accidents and/or injuries that govern the problem. Ministry of Land, Infrastructure and Transport of Korea also prescribed as a law for the establishment of the every 5 years national strategy plan to reduce traffic accident. In September 2011, the Ministry (MLIT) announced 'The 7th National Transport Safety Plan' for the period (2012-2016). The plan includes major safety issues for road, railway, aviation and marine transport. In the field of road safety, the plan aims at reducing fatalities to less than 3 000 by 2016 (almost a 40% reduction in comparison to 2010) in order to be ranked in the middle among OECD member countries as shown in Table 1.

Two main targets have been set for 2016:
1) Reducing by 40% the number of fatalities by 2016 in comparison to 2010 level.
2) Reducing the risk (calculated as the number of deaths / 10 000 vehicles) to 0.5, in order to reach the average level of OECD countries.

Table 1. National road fatality reduction target for 2016 and 2020

Category	2010	2016	2020
Annual traffic crash death	5 505	3000	1 200
Number of death per 10 000 vehicles	2.6	1.3	0.5

To meet the national target, the most effective tools or national resources for enhancing vehicle safety should be enhanced and expanded as shown in Table 2

Table 2. Strategies and main measures of national road safety plan

Strategies	Main Measures
User behaviour improvement	• Reinforce school road children traffic safety • Grope for change to children based traffic safety training • Reinforce aged drivers traffic safety measures • Reinforce punishment of important regulations violator such as drink and drive. • Advancement of automobile insurance system • Introduce operation hour limit for business use vehicle • Diversify traffic safety public relations and training
Build safer infrastructure	• Secure safe and fresh passing area • Expand safety aimed traffic safety facilities • Promote traffic safety improvement business of local unit • Prepare bicycle traffic safety measures • Revitalization of traffic safety information sharing
Operate smarter modes	• Expand automobile high technology safety device dissemination • Expand business use automobiles safety device dissemination
Reinforce safety management system	• Speed management based on human system change • Advancement of traffic accident cause investigation with high technology
Advanced emergency response system	• Build synthetic post disaster response system • Build weather information providing system

MLIT is the national government body responsible for road traffic safety planning, vehicle safety regulations, New Car Assessment Program of Korea (KNCAP) and management of road construction as well as built roadside infrastructures. In order to maximized road safety, it must be determined what types or patterns of accident and sever casualties were most frequently occurred in the real roads based on the statistical analysis of traffic accidents.

Figure 1. Trends towards national target

Meanwhile, in Korea, crash data are collected by the National Police Agency. There are two set of accident data available in Korea. One directly reported and collected by local police which injury involved accidents and others is collected through the insurance companies and traffic service associations. As a definition, Fatality data refer to deaths within 30 days. Injury crashes are defined as

crashes resulting in at least one injured or killed person. A person seriously injured is defined as a person requiring medical treatment for more than 3 weeks. However, police is only one authority for accident investigations for reported accident in Korea. No other body can't access or on-scene investigation without police permission. Like other countries, their primary role for accident investigation is found out who is 1st responsible for the accident or violates the traffic law. Nevertheless, the written macroscopic level of accident statistical data is available for pubic annually, it is not suitable for addressing traffic safety enhancement to analyze the real road vehicle safety problems.

VEHICEL SAFETY ENHANCEMENTS

Historically governments and research organizations have used the traditional statistical approach to assess benefits of safety program such as NCAP or safety device using in-depth crash data which normally allows a more detailed level of analysis. In Korea, public available accident data is only published police report, not allowed direct accessing the detailed raw database. Current Korean in-depth accident database as research purpose has a limited number of cases and is still in the early stages. In this study, as an alternative, the improvement of vehicle safety in terms of KNCAP rating was compared the tested vehicles in chronological order.

For frontal crash tests, the average combined serious injury risk probability (AIS 4 +) for the first 3 years tested vehicle (1999-2001) was 21.6%. Safety performances have been significantly improved, in the last three years (2011-2013), the average P_{comb} value was decreased to 15.1%. Results from side crash test analysis, the probability of serious injury (AIS 3 +) was 11.3% in 2003. In 2013, the value was dramatically dropped to 2.0% as shown in Figure 2. Side pole impact case, potential serious injuries (AIS 3 +) is 95.6% in 2009 and also dropped to 8.9% in 2013 (see Figure 3). Side pole crash test was added in KNCAP protocol as an optional test which manufacture's choice to get maximum additional 2 points from this extra test. Within four years, even though side pole test was initiated as an optional test, but recently most of vehicles are equipped with side curtain airbag as standard option. In addition, it was clearly proven that side curtain airbag is most effective safety device to protect occupants from the side pole collision type accidents [1, 2, 3].

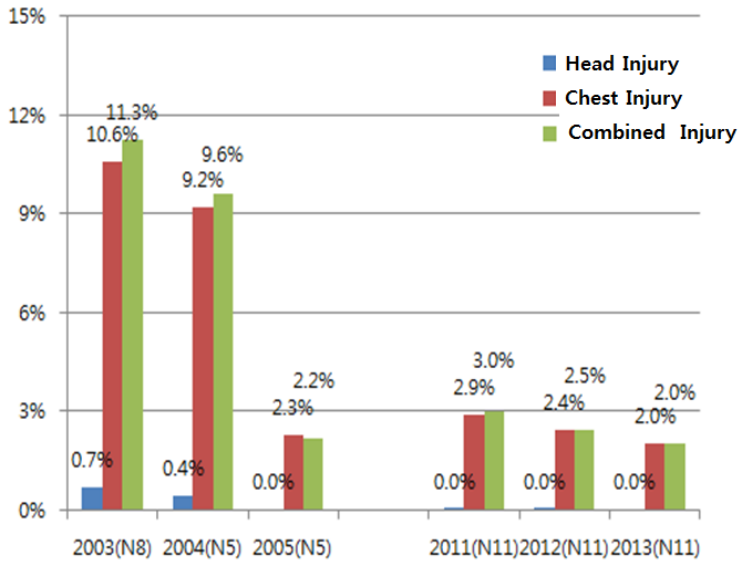

Figure 2. Improvement of side crash safety

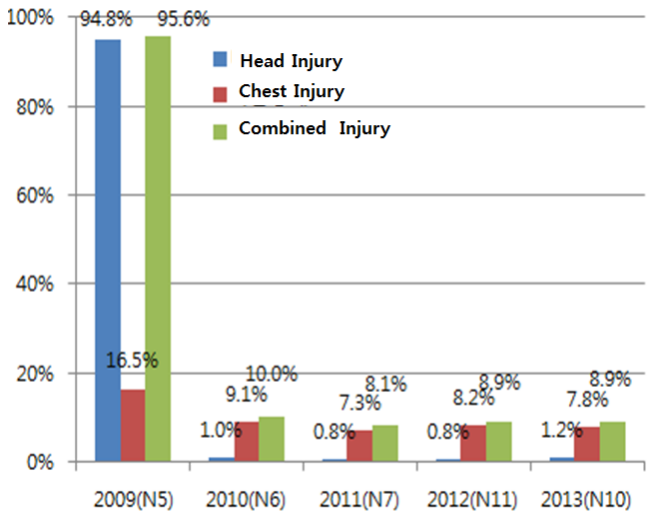

Figure 3. Improvement of side pole crash safety

Pedestrian safety in 2013 compared to 2008 was improved nearly twice times (see Figure 4). But still pedestrian accidents and higher fatality is big issues which given the plenty of room for improvements in KNCAP.

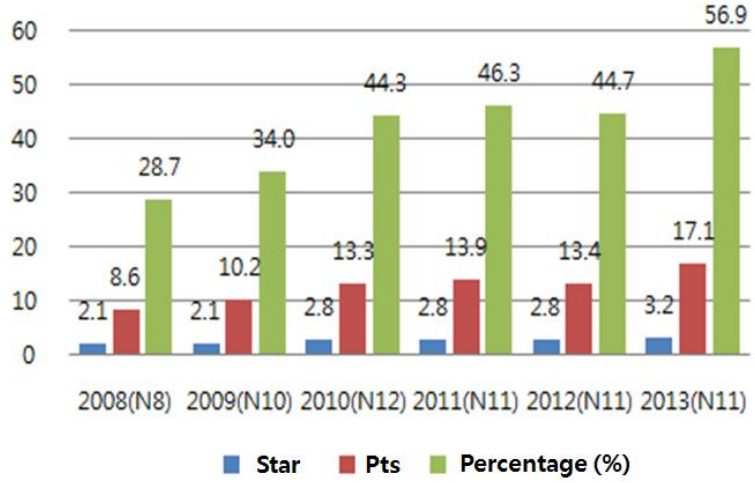

Figure 4. Improvement of pedestrian safety

MACROSCOPIC STATISTICS OF TRAFFIC ACCIDENTS

From police report which counted only injury involved road traffic accident in 2012, the total number of accident was 223,656 cases, 5,392 deaths (within 30 days), and 344,565 injured persons were reported. As shown in Figure 5, fatalities involved the accident patterns can be classified by 1,997 deaths from car-to-pedestrian accidents (37.0%), 2,156 deaths from car-to-car accidents (40.0%) and 1,256 deaths from single vehicle involved accidents (23.3%), and rail crossing type accidents involved 3 deaths in 2012 [4]

According to classification by types of road user, fatality can be categorized with 2,027 (37.6%) deaths from pedestrians, 2,090 (38.8%) deaths from vehicle occupants, 908 (16.8%) deaths from motorcyclists, 286 (5.3%) from bicyclists, and 81 (1.5%) deaths from other types of road users as shown in Figure 6. The passenger vehicle involved 49.7% of all fatal accidents while trucks were share of 22.8% and 12.1% from the motorcycles.

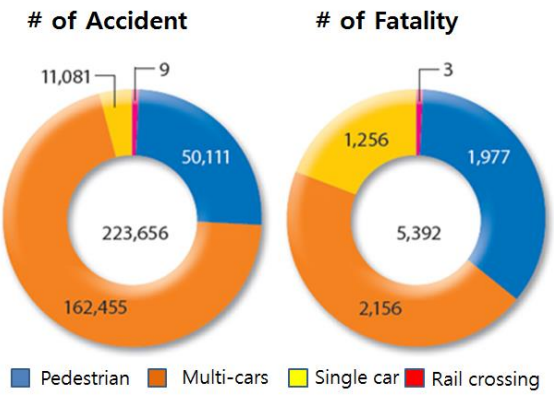

Figure 5. 2012 Fatalities by accident types

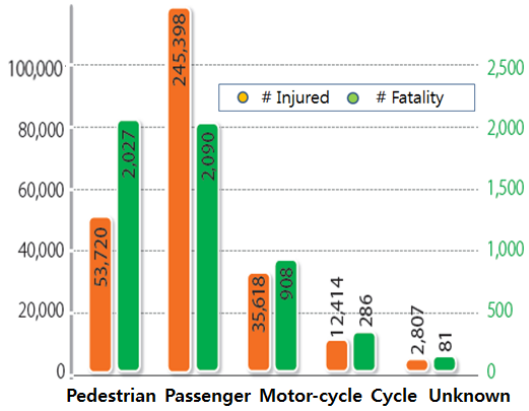

Figure 6. 2012 Casualties by road users

According to the police statistical data, the head-on collision was shown the most fatal severity. The fatality rate was 4.6 deaths out of 100 accident cases while side collision showed 1.1 deaths ratio, rear collision while driving was 1.3 deaths ratio, rear collision while parking was 1.1 deaths ratio as shown in Figure 7. It was also noticed that ration of female driver involved accident and fatality of female driver was continuously increased. In 2012, 16.6% of traffic accidents were caused by female driver. The female driver's fatality rate has been reached up to 9.3% which meant 9.3 deaths of female driver out of 100 cases of accidents.

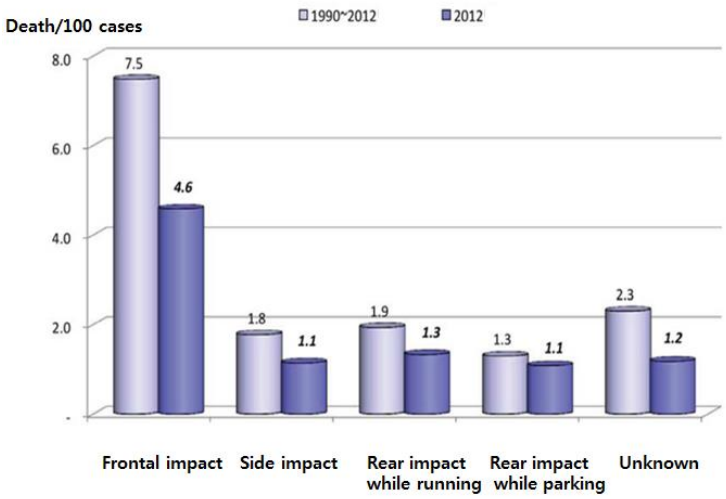

Figure 7. Fatal severity ration in car-to-car accident in 2012

INITIATION OF KIDAS BASED ON iGLAD

The issues of current traffic accident investigation and data collection from polices in Korea were very limited access for an individual accident event. Also, the lacks of automotive related information which police is not much concerned, are very difficult to analyze the accident involved vehicle's safety problems. The total 97 variables [5] are normally collected according to the specification of police report format, but, only 27 variables are accident related items. The detailed accident types, collision types, vehicle specifications, injury severity of occupants, detailed restraints system and seated positions were missed from the report.

As part of Korea Advanced Safety Vehicle (KASV: 2009-2017) project, the pilot study of KIDAS(Korean In-Depth Accident Study) has been initiated in 2012. The research organizations are

consisted KATRI, KoreaTech and 3 Medical schools to collect accident data as well as establishment of KIDAS structures. These three medical schools are located within 150 km boundaries of Seoul metro area as shown Figure 8.

Figure 8. Locations of 3 hospitals for accident data collection

Unlike other DBs, on-site investigation is not allowed, all collected accident data were related to in-patient of 3 medical school's hospitals. Once injury involved accidents occurs, the occupants may in-hospitalized these emergency centers. After medical treatments, the research team can search for police station for more information but, unfortunately not always successful achieving accident data from police due to the privacy protection restrictions. After collecting police's accident report or verbal information related the accident with inspection of crashed vehicle, even though the total amount of collected data is limited, can be constructed the each individual accident database.

In globally, there are numerous numbers of in-depth accident database are exist. For instance, GIDAS is one of most sophisticated in-depth databases in the world with 30 different categories which required about 2,500 input variables [6, 7]. Also, recently, "iGLAD" (the Initiative for the Global Harmonization of Accident Data) has been initiated by FIA's Mobility Group and ACEA in Europe [8]. As objectives, iGLAD considers all corresponding regional standardisation efforts and strives to ensure continuous exchange of information to avoid individual, non-harmonised approaches, redundant activities and duplication of work. Therefore, as the first step, the research team decides to adopt iGLAD format as KIDAS structure as a Korea standards in-depth accident study. It will be continuously modified to accommodate regional traffic environment effects, but keeps the fundamental structures of iGLAD.

ESTIMATION OF ENERGY EQUIVALENT SPEED

In short term, the most driving force of establishment of KIDAS in this ASV project, is required cost-benefit analysis for each individual active safety device. To estimate real benefit of road safety in terms of reducing numbers of accident as well as injury levels, in-depth accident database is essential to set up the specific accident scenarios of advanced vehicles.

One of the most frequent missing data is impact speed or delta V of the accident. Since on-site investigation was not allowed, the trace of accident can't be collected as it was. As an alternative method, photo-modeling technique was adopted to overcome limit access or deformation measurement of crashed vehicles with photographic scale measurements as shown in Figure 9. EES can be determined in both deformation and stiffness of vehicle structures. In the event of vehicle crash, the absorbed impact energy is depended on the stiffness of vehicle as the following equations [9, 10, 11].

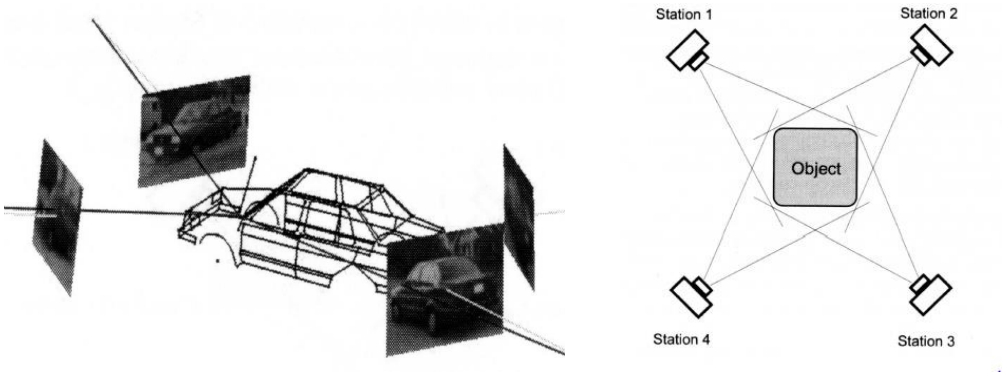

Figure 9. Application of photographic technique (from PhotoModeler Manual)

$$EES_{of\ the\ vehicle} = \sqrt{\frac{2E}{m}} \quad (1)$$

$$E = L(AC + \frac{BC^2}{2} + G)(1 + \tan^2\theta) \quad (2)$$

Where E= the amount of absorbed energy by a car
L= width of crush
C= represents the crush depth
A,B = Coefficients
θ= force angle from perpendicular

In this study, PhotoModeler S/W was used to measure the crashed vehicle deformation as shown in n Figure 10.

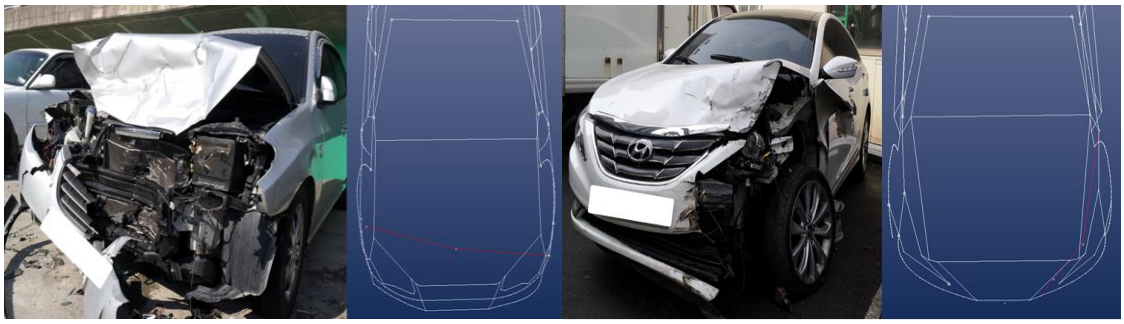

Figure 9. Vehicle deformations calculation using PhotoModeler

DISCUSSION AND FUTURE WORKS

The main purpose of establishing KIDAS is needed a detailed accident data for national level future planning strategic road traffic safety in terms of vehicle, injury, and road safety. As stated in the previous chapter, from the AVS project in Korea, KIDAS (Korea In-Depth Accident Study) program was initiated as a pilot steps, however, the final goals will be set-up a permanent institution for a detailed accident data. Current situation of establishment of KIDAS in Korea needs overcomes of a lot of obstacles. 1) One of main problems is accessing on-site investigation and sharing police investigation reports which required mutual agreement between MLIT and National Police department. 2) collects accident data without criticizing personal information protection policy 3) needs accident investigation technical experts.

As a role model, GIDAS is one of best database. But, it will be long term goal to adopt GIDAS variable format. In current situation, GIDAS, the most sophisticated in-depth databases in the world with 30 different categories which required about 2,500 input variables can't be achieved in a short

period of time. Therefore, as the first step, the research team decides to adopt iGLAD format as KIDAS structure as a Korea standards in-depth accident study. It will be continuously modified to accommodate regional traffic environment effects, and expanded to GIDAS approaches.

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