Prerequisites for completing the quality chain in the safety management

Byongho Choe
Lead Researcher
Korea Transportation Safety Authority
ANSAN

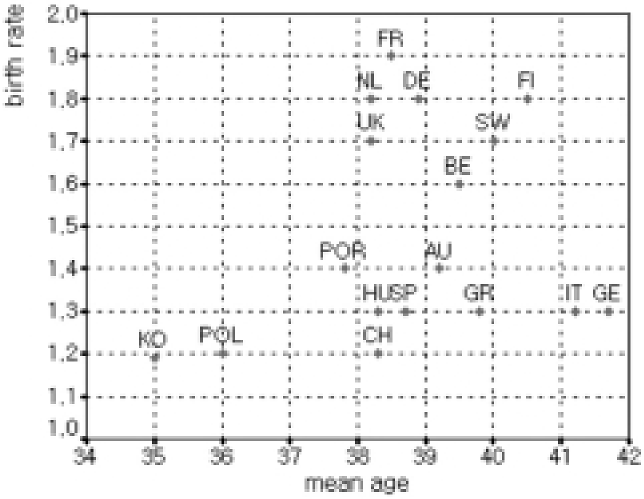
Summary

Korea has more killed at the order of magnitude of 10 times compared to advanced countries, thereby faring the highest pedestrian fatalities among OECD members. Looking back on the past, local authorities have been scurrying to roll out measures without accident data, which exacerbates the chronic problem of inefficient safety practices. Thanks to revised Traffic Safety Law, local authorities have begun to realize their liability for accident prevention, which is now legally binding. Bracing for fight against high level of fatality, local accident investigation was implemented to deal with the most likely situations with structural similarity. It is to be discussed that sharing of accident data allows safety problems to be correctly diagnosed and addressed. The objective of this study is to suggest the procedure of local accident investigation for local authorities with a view to efficiently and effectively managing traffic accidents.

1. General State of the Art

Since 1997 up to the present time, Korea has been drastically being made better in scales measuring the level of traffic safety in OECD. Now that the changes add positive value to absolute level of safety, however, there is n un-surmountable cleft in becoming a middle-level nation. While looking into the report from International Road and Traffic Accident Database (IRTAD, 2004), Sweden proves to be the safest of all. It is regrettable to note that both Korea and USA be the worst nations in traffic safety matters. As WHO has estimated the external costs caused by road and traffic accidents as about 2% of gross national product(WHO, 2004), Korea has reached 14.2 trillion won including PGS-costs(short for Pain-Grief-Sufferings), which account for 1,8% of GDP(see Shim & Yu, KOTI, 2007). Considering that it is a matter of seeking or assuring an optimal value for which the order of magnitude of traffic accident - being a number of collisions or its severity - is to be social-culturally acceptable, which can be determined by that where to find the relative position of traffic safety in contradiction to other diverse social-cultural needs scales in the Korean society that is still lagging in safety awareness.

Figure 1: Mean ages and birth rate in 2003 (Korea based on data 2005)



Recently National Statistical Office gave forecasts on socioeconomic parameters such as birth rate, aging, population by 2050. Birth rate will drastically cut in half(1,19 as of 2005), while the size of population staying as it is, however the proportion of elderly people is expected to come to fourfold increase compared to 2005.

	2005 1.000(%)		2030 1.000(%)		2050 1.000(%)	change (%)
0 ~ 4 years	9.241(19,2)	➡	5.525(11,4)	➡	3.763(8,9)	-10,3%
Injury collision	34.530(71,7)	➡	31.299(64,4)	➡	22.424(53)	-18,7%
Fatal collision	4.367(9,1)	➡	11.811(24,3)	➡	16.156(38,2)	+29,1%

Moreover, school-aged children and labor forces from 2005 are expected to decrease by more than 10% that has to come in 2050(Fig. 1). It is signaling to focus upon traffic safety of elderly people, which indicates that the paradigm of national transport policy changes from fluidity-oriented to safety-prior.

Figure 2: Traffic safety strategies (Choe et al., 2005)

By definition, traffic safety is a "eliminated state of risk factors" (see Durth & Bald 1987; DIN31004, 1982). Traffic safety strategies are grouped into accident prevention, damage prevention, rescue/rehabilitation, and traffic behavior (Fig. 2). Especially local accident investigation alongside road safety audits is deemed to be core safety strategies for local authorities. The act of collecting road and traffic accident data by police has its main interests in discriminating who be a culprit and a victim, whether traffic regulations are violated or not, level of punishments etc. all of which can be 99% accused of human errors, which puts local authorities in a bafflement looking into causal relations with other factors of road environment. As such, with no accident information local authorities could not be 'managing safety jobs', say tracing traffic accidents to its origins and its solutions, instead placing a bundle of money to the maintenance of road and traffic facilities.

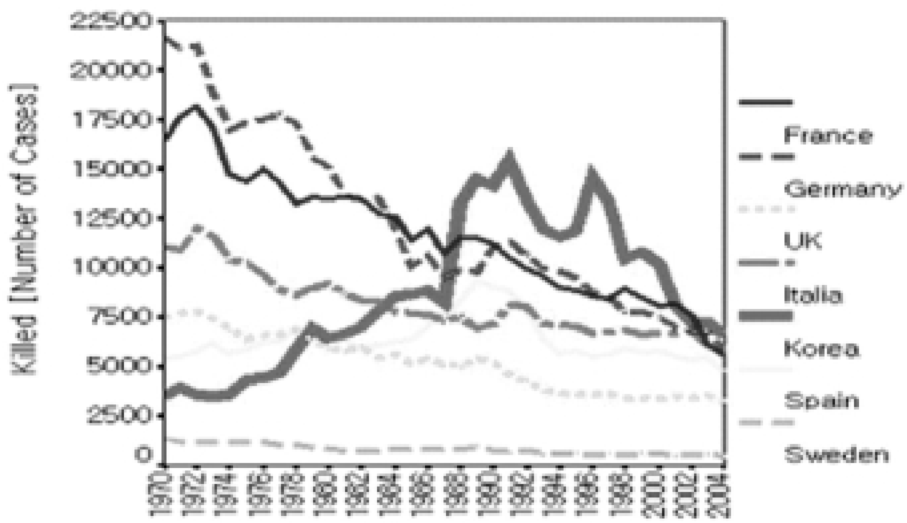
On the other side, due to the monotony of data collection system, it leads to a difficulty tracing the causes linked to road characteristics, drivers, traffic facilities, pedestrians, cyclists, vehicles in depth. Henceforth, sharing the accident data by local authorities and other safety related organs makes it possible to cross-check, to clarify accident types, to devise exactly suited counter-measures for each factor respectively, and it is indispensable to practicing diverse accident investigations by safety related organs.

Introducing some practical speculations, the prerequisites for such activities as to identifying the optimum needs of vulnerable road users with 'ordinary facilities' and to assure the behavioral traits against the excessive demanding characters of road and traffic facilities are to share accident data with which to make a better understanding about why more causalities are occurring on specific sites. Evolving preemptive measures taken against recurrent accidents and evaluating its outcomes are subject to assuring the quality of accident data which to share. Accident information should be collected on a theoretical basis (i.e. accident type, taxonomy of causes etc.), as it provides a clear-cut understanding about the structure and development underlying the incidence. Thanks to the newly revised Traffic Safety Law, local authorities have begun to realize their liability for accident prevention, which is now legally binding. Article 50 stipulates Local Traffic Accident Investigation, by placing the liability for road and traffic accidents on local authorities that have to classify types of accident occurring under their jurisdiction, to seek out hot-stretches with priority, to suggest socially acceptable remedial measures fit for local traffic safety plan, all of which activities should be executed to realize the local safety management system. In the enforcement ordinance of the Law (paragraphs 36 and 37), the duty of local authorities is specified as follows: collecting KSI data (short for Killed and Seriously Injured) over last 3 years, classifying the accident types and ranking hot-stretches annually (selection criteria : 3 KSI in 3 years), visiting sites, coordinating, monitoring etc.

2. Actual Circumstances and Safety Problems

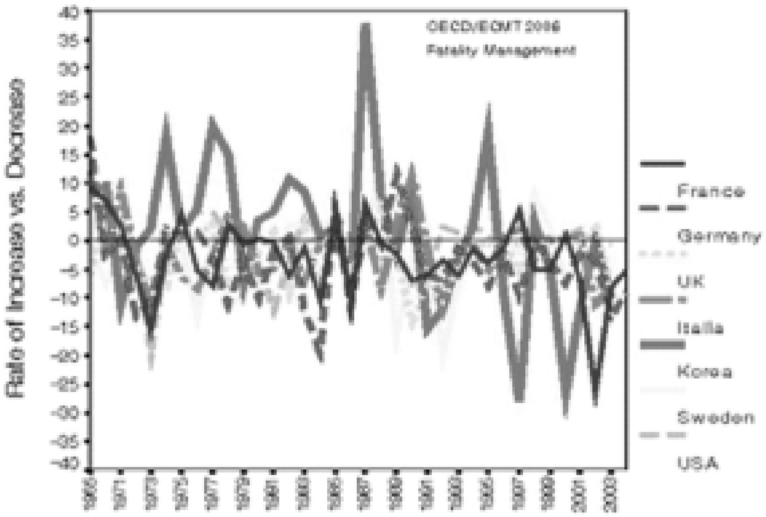
For 2005 Korea had 214.171 casualties on roads, thereby faring 6.376 killed. Looking back on the past 10 years, Korea is decreasing about 4.7% every year (Fig. 3).

Figure 3: Yearly fatality reduction (Choe et al,, 2006)



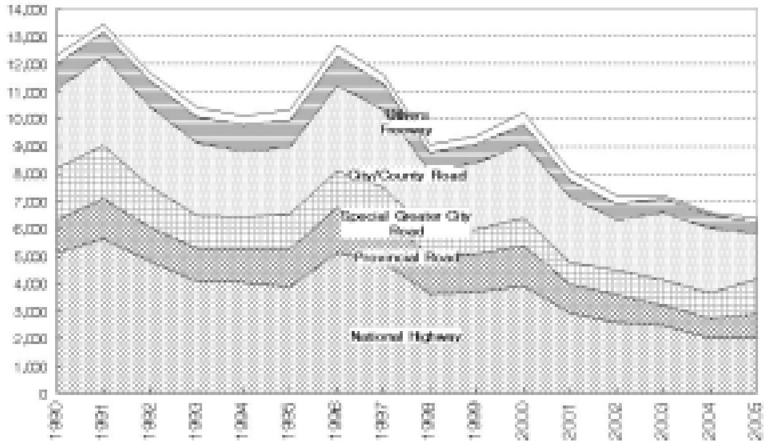
Paying close attention to IRTAD data, however it turns the tables. Taking a look at yearly rate of increase vs. decrease for the time span from 1965 to 2004, Korea is indented in fluctuation depth over 15% within which safer nations are generally moving (Fig 4). The deeper the fluctuation strength the more probable that accidents are as good as left alone or fatality management is in its essence reactive, not in preventive manner.

Figure 4: Yearly fatality rate indicating management competency (Choe et al,, 2006)



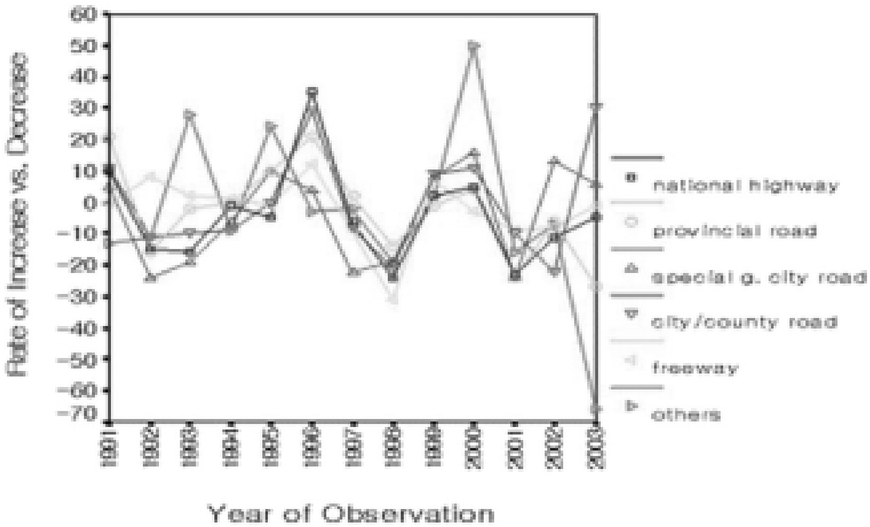
It is generally argued that the number of deaths on roads be decreasing as is shown as follows. Amongst them, national highway shows a drastic fall-off, the other road categories are chronically growing smaller (Fig 5).

Figure 5: Fatality development per road category (modified Choe et al., 2006)



After analyzing its rate of change we find that there tends to decrease yearly with about 3% on all roads but city and county ones. It has, however, to be stressed that the yearly rate of change runs into 30% up to 50% at the highest, suggesting that the injuries be not systematically managed by local authorities (Fig 6).

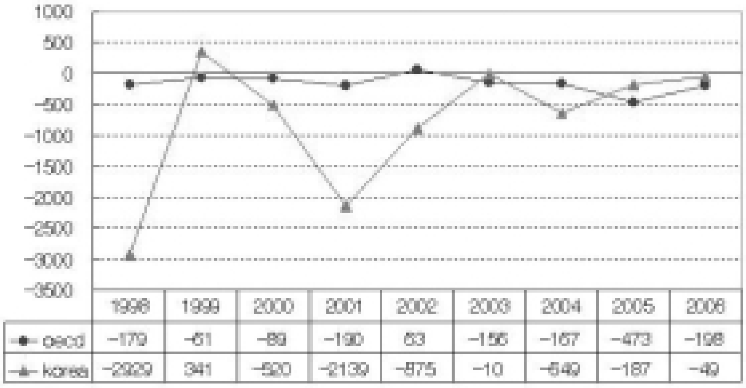
Figure 6: Fatality rate of change per road category (Choe et al., 2006)



For 2006 OECD has decreased yearly 4.1% in fatalities (averaging 5% over last 5 years), Korea is showing yearly 7.6% decrease (averaging 4.7% over last 5 years).

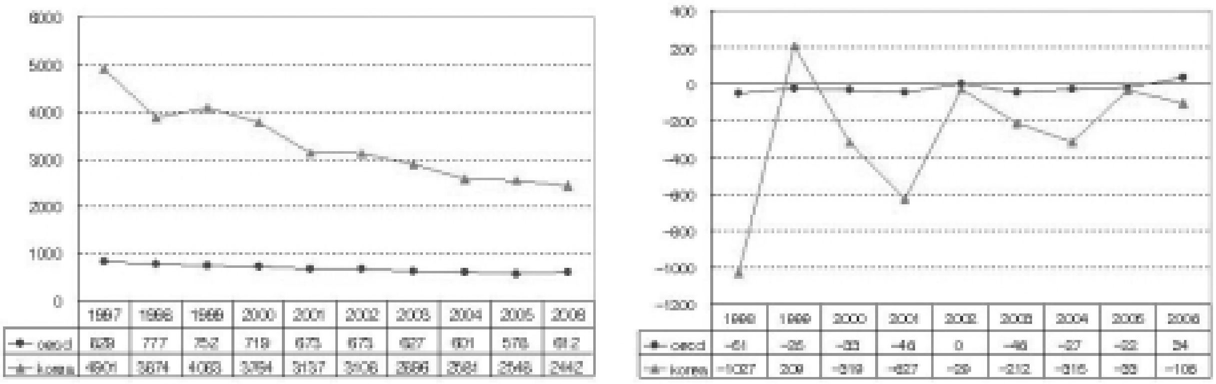
Figure 7: Fatality reductions of OECD and Korea (Choe, 2008)

Modified IRTAD data, April 2008



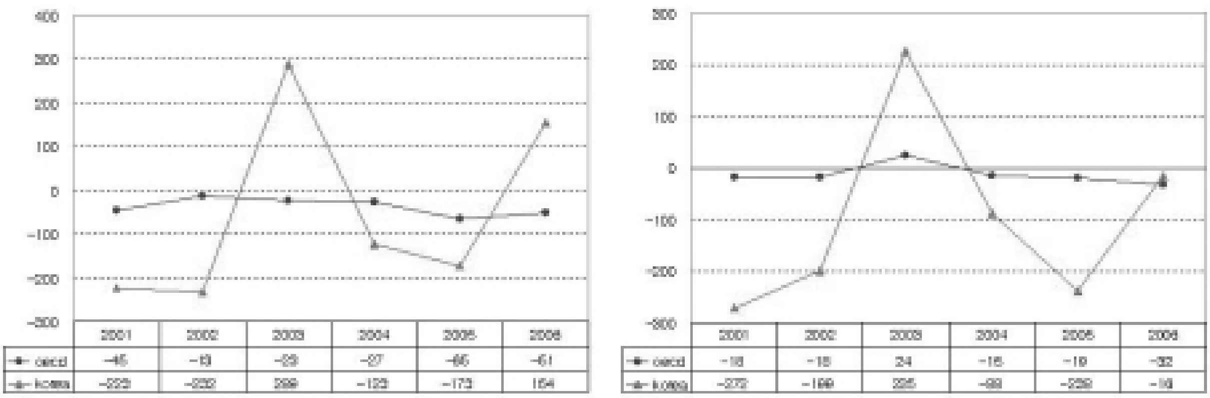
Though on its general decrease, the reduction depth is getting smaller from year to year, over last two years the performance is going less than the average of OECD, which is very suggestive of Korea having no capacity of doing better (Fig. 7). As concerns the pedestrian fatalities, Korea having 38.6% proves to be the worst, followed by Poland (34,4%), Japan (32,5%) etc. Analyzing pedestrian fatalities brings about the similar results with 4,8% falling off compared to OECD average 1,8%, slowdown of which, however, reaches the uppermost limit(Fig. 8).

Figure 8: Pedestrian fatalities in comparison (Choe, 2008)



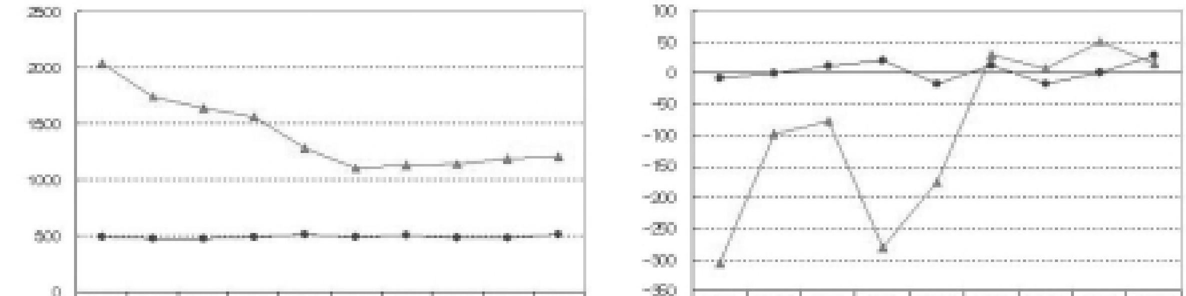
Striking results alluding to a lack of scientific fatality management are to be found in case of analyzing private and commercial vehicles on urban roads (Fig. 9).

Figure 9: Private (left) and commercial (right) vehicle fatalities (Choe, 2008)



When it comes to fatalities involving powered two-wheelers (PWT), there is no progress in OECD, for Korea also being in stalemate. Albeit there was a wide gap between Korea and OECD, it already has approached OECD average, which isn't expected to be improved (Fig. 10).

Figure 10 : Powered two-wheeler fatalities (Choe, 2008)

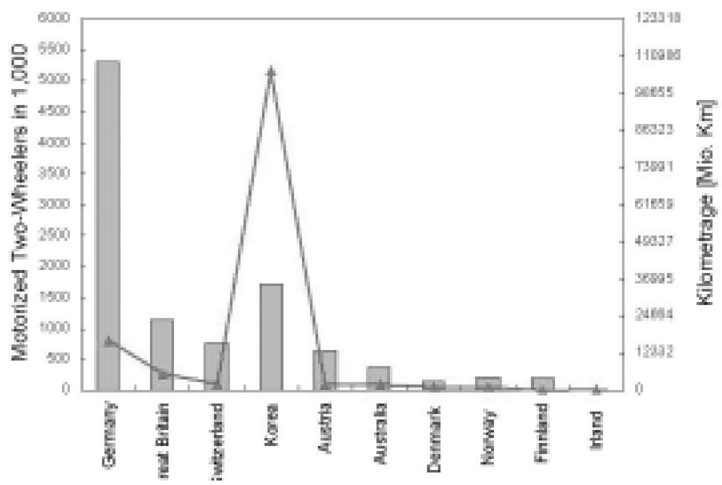


	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
oecd	492	482	481	492	511	494	505	487	486	513
korea	2045	1741	1642	1564	1284	1108	1138	1146	1186	1208

	1998	1999	2000	2001	2002	2003	2004	2005	2006
oecd	-10	-1	11	19	-18	11	-19	0	27
korea	-304	-99	-78	-280	-175	29	7	50	14

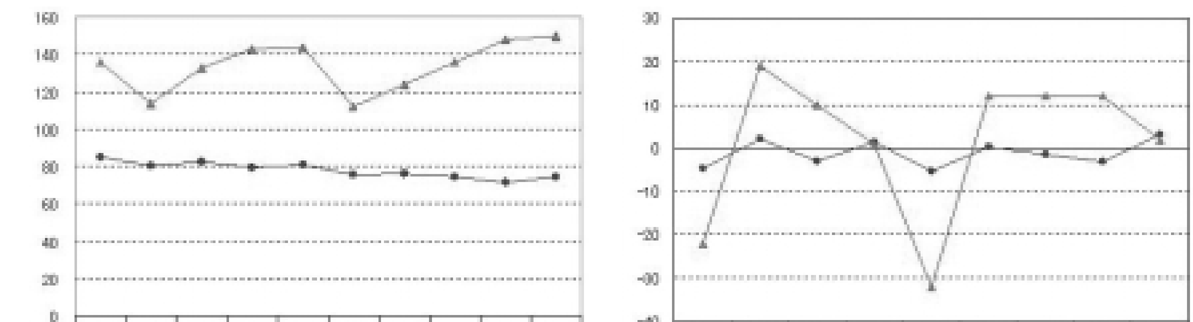
Surely, it is not merely due to a lack of systematic management. There is a close connection between PWT mileages and fatalities. Should one ask which country is so high about PWT mileages, Korea is mostly bustling about (Fig. 11).

Figure 11: Powered two-wheeler mileages (Choe, 2007a) Modified IRTAD, March 2007



As PWT having been used not only for leisure and sports but also for urban distribution services or long-haul transportation, it's necessary to seriously think about disadvantage accruing to society from becoming ever serious safety problems. It is a point for attention that the cyclists fatalities, compared to OECD decreasing as 2.6% averaged, are on the increase, there of 41.7% caused by hitting by car mostly on trunk roads (41.2%), followed by feeder roads (37.7%) and cycle lanes (12.1%). It is due to no right-of-way for cyclist against a car on the carriageway. Focusing upon elderly cyclists (Fig. 12), fatalities show a 1.7% increase over last 9 years alarmingly, compared to OECD (1.6% decrease). There needs to challenge all possibilities.

Figure 12: Elderly-cyclist fatalities (Choe, 2008)

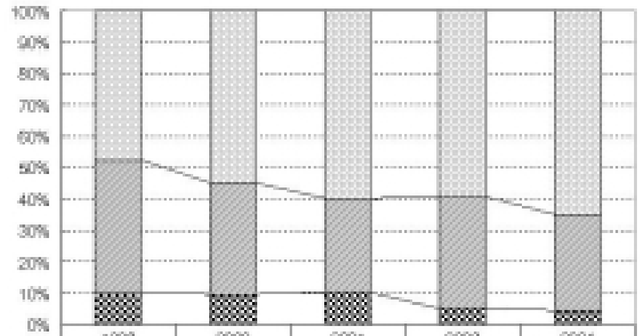


	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
oecd	85	80	83	80	81	76	76	75	71	75
korea	136	114	133	143	144	112	124	136	148	150

	1998	1999	2000	2001	2002	2003	2004	2005	2006
oecd	-5	2	-3	2	-5	0	-1	-3	3
korea	-22	19	10	1	-32	12	12	12	2

The percentage of elderly cyclists killed by colliding with cars is exceedingly high relative to that of other age groups and on the rise as time passes (Fig. 13).

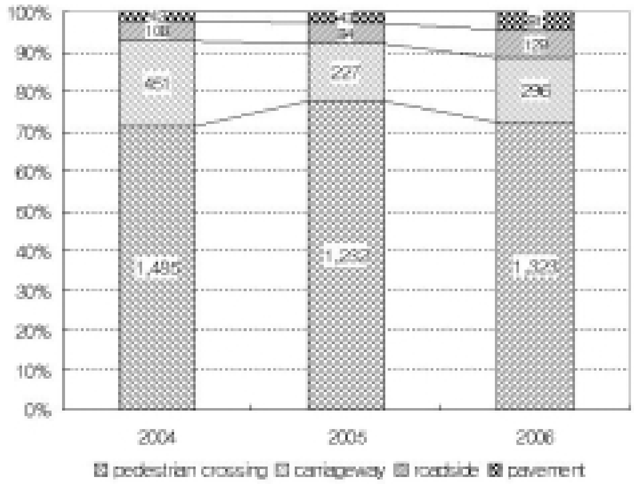
Figure 13: Cyclist fatalities per age group (modified Choe, 2007b)



	1998	2000	2001	2003	2004
over 61 years	47.6	54.9	59.7	59.1	64.9
15~60 years	42.5	35.3	30.0	35.7	30.5
under 14 years	9.9	9.8	10.2	5.2	4.6

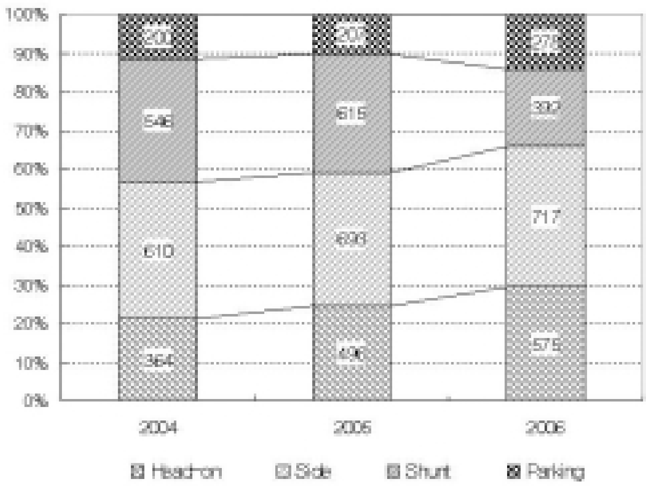
According to a summarized statistics from National Police Agency (2006), the most part of pedestrian fatalities happens while crossing the crosswalk (72.3%), followed by carriageway (16.2%), by roadside (7.1%), and by pavement (4.4%), as shown below.

Figure 14 : Pedestrian fatalities per accident form



Albeit the number of pedestrian fatalities is growing smaller continuously, the truth, however, is that the structure of pedestrian fatalities remains unchanged (Fig. 14). It is subject to very high speed in city, even on feeder roads in built-up area where pedestrians have no right-of-way against cars.

Figure 15 : Vehicle fatalities per accident form



Over three years, the structure of vehicle fatalities has changed in a way that head-on collisions, side swipe, collisions in longitudinal traffic while parking, but only shunts(rear end collisions) have a tendency to increase between 8.5% and 26.1% (Fig. 15) Vehicle fatalities in built-in area are due to inappropriate speed which is more of the problem than high speed.

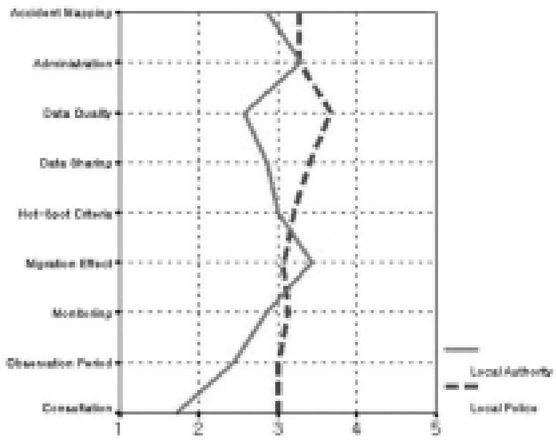
3. Quality Chain in Accident Prevention

Based on the data of Insurance Development Institute and 15 non-life companies, the statistics show that the number of accidents is 807.000, a increase of 8.8 percent, which is more than 3.8 times than that of police (214.171). This leads to doubting about the reliability of the statistical report of National Police Agency (YONHAP news paper, 27 Nov 2006). Road and traffic accident summary published by police accounts for the extremely small segment of total accidents. Limiting only to Killed and Seriously Injured (KSI), however, the gap between information quantities can narrow.

As preliminary investigation of local police(Police Officer Duty Performance Act, Article 2, Clause 1) intends to discriminate between culprits and victims for means of criminal and administrative measures, local accident investigation of local authority(Traffic Safety Law, Article 50) is much interested in understanding accident patterns classified by accident types, finding out adequate engineering measures, monitoring performances etc. with a view to reducing the severity of accident, raising financial efficiency, minimizing lawsuits.

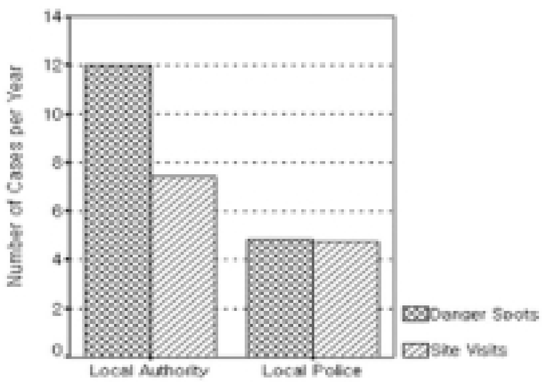
Two years ago before new regulation of local accident investigation being into force, we carried out a questionnaire with local authorities and local policies on the optimum level of hot-spots and -lengths with a view to helping local authorities managing traffic safety systematically and efficiently. In total 70 officials (16 from local authorities, 54 from local polices) responded to the survey as profiled below.

Figure 15: Questionnaire items answered by two groups



Though local authority is taking a skeptical view of quality of accident data collected by police, for the sake of visualizing and monitoring critical hot-spots/-lengths, to mention a few, local authority feels keenly the necessity of sharing and consulting accident data(Fig. 15). Black-spots projects of police (commissioned by local authority) are viewed positive. However local authority considers it worth diversifying approaches. As regards the period of monitoring hot-spot/-length, local authority expresses the necessity of modifying the criteria. In fact, local authority, regardless of black-spots designated by police, selects and investigates more 'danger-spots' than those of police (Fig. 16).

Figure 16: Yearly danger-spots by local authority and police



By analysis of answers to the criteria for hot-spots with killed, local authority considers 1.5 cases to be appropriate, whereas local police sees 3.06 cases as necessary (Fig. 17), which is of statistical meaning($t=-2,559$, $p<0,05$). Upon asking the level of hot-spots with seriously injured, local authority estimates 3,5 cases as optimal, local police takes 5,08 cases into consideration, which proves to be statistical meaningful($t=-3,002$, $p<0,01$).

Figure 17: Rating criteria for hot-spots (modified Choe et al., 2006)

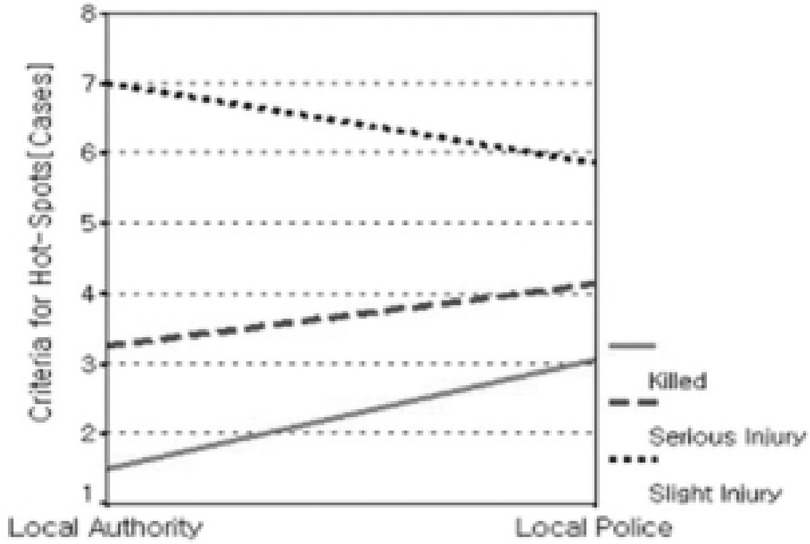
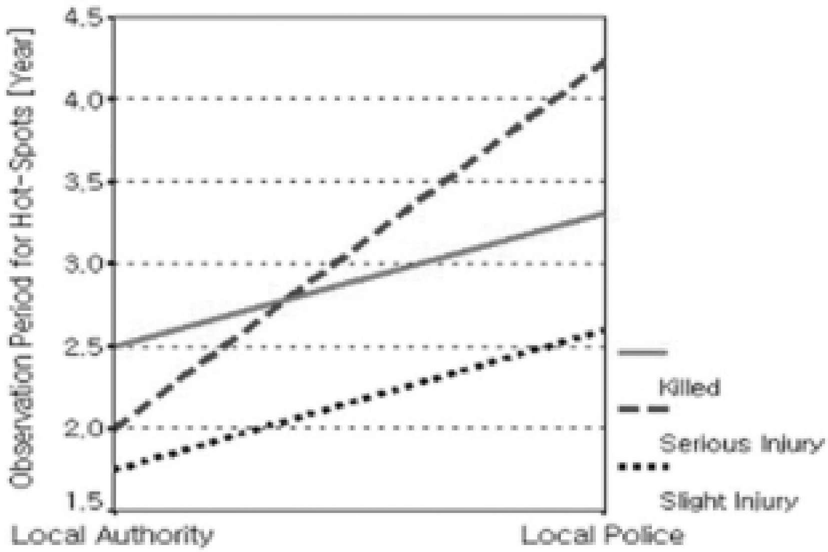


Figure 18: Rating observation period for hot-spots (modified Choe et al., 2006)



When it comes to asking the time window for hot-spots with killed, local authority considers 2.5 years to be necessary, while local police responds with 3.3 years (Fig. 18). The difference in opinion is of statistical meaning ($t=-2.994$, $p<0.05$). It turns out that local authority takes 2.0 years for hot-spots with serious injured into account, whereas local police says the least of 4.2 years($t=-4.979$, $p<0.001$). Backed upon those results, the Ministry of Land, Transport and Maritime Affairs reflected new criteria for hot-spots/-lengths (3 fatalities for 3 years, 3 serious injuries for 3 years) into guidelines for Road Safety Audits and Local Accident Investigation in Traffic Safety Law. As shown above, there needs to exploring diverse ways toward grasping 'true' dangerous places with a view to reducing the severity of accidents(Table 1).

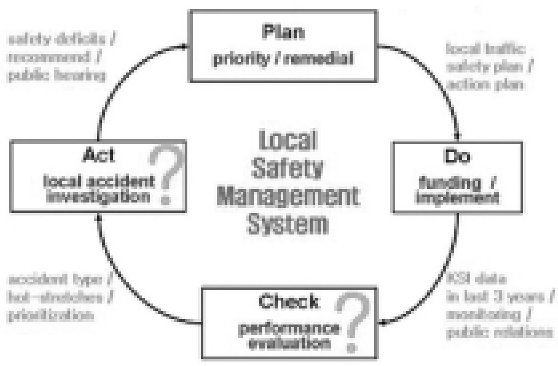
Table 1: Criteria for hot-spots and -lengths (modified Choe et al., 2006)

Country	Hot-Spots	Hot-Lengths	Accident DB, Statistics Announcement
France	- 10 accidents for 5 years - 10 serious injuries for 5 years - Intersection of 850m	- 50 accidents per one mio cars/km (downtown) - 80 accidents per one mio cars/km (suburb) - Section of 10~30km	- Accident DB and statistics by Transportation and Road Safety Department (D.S.C.R) (Police keeps only recording)
Germany	- 3 fatalities for 3 years - 3 serious injuries for 3 years - 5 slight injuries for 1 year - 15 traffic accidents for 1 year - Intersection of 300m	- 3 fatalities for 3 years - 3 serious injuries for 3 years - 15 slight injuries for 1 year - 15 accidents for 1 year - section of 1km	- Accident DB and statistics by Federal Statistical Office - Local Accident Investigation by Federal Ministry of Transport(BMVBS) since 1974 (Police keeps only recording)
UK	- 4 injuries for 1 year - 8 injuries for 3 years - Intersection of 300m	- 10 injuries for 3 years	- Accident DB and statistics by Department of Transport - Local Accident Investigation by Royal Society for Prevention of Accidents(RoSPA) (Police keeps only recording)
Spain	- 3 accidents for 2 years	- 9 accidents per 1km for 2 years (ADT > 80,000) - 5 accidents per 1km for 2 years (ADT > 4~80,000) - 3 accidents per 1km for 2 years (ADT > 40,000) - 3 accidents of the other sections for 2 years	- Accident DB and statistics by Transportation and Environment Office(Moptma) (Police keeps only recording)
Netherlands	- 12 accidents for 3 years - Road Factor(1-1-0)	-	- Accident DB and statistics by Transportation Department (Directie Verkeersveiligheid) (Police keeps only recording)
Greece	- 5 fatalities for 1 year	- 90% Poisson distribution of section average	- Accident DB and statistics by Transportation Department (Ministry of Public Works) (Police keeps only recording)
USA	- Accident rate > statistical accident rate - EPDO-Method	- Accident rate by state government - 0.01mile, 0.03mile, 0.05mile, 1mile, 3mile etc.	- Accident DB and statistics by Department of Transport (Police keeps only recording)
South Korea	- 3 fatalities for 3 years - 3 serious injuries for 3 years - Intersection of 50m	- 3 fatalities for 3 years - 3 serious injuries for 3 years - Built-ups < 300m - Non-built-ups < 500m	- Police keeps not only recording accidents but also managing accident DB, publishing statistics, and doing engineering(black-spots with 5~7 accidents for 1 year) - Local Accident Investigation by Ministry of Land, Transport and Maritime Affairs(MLTM) since 2008

Reference : ETSC, 1996

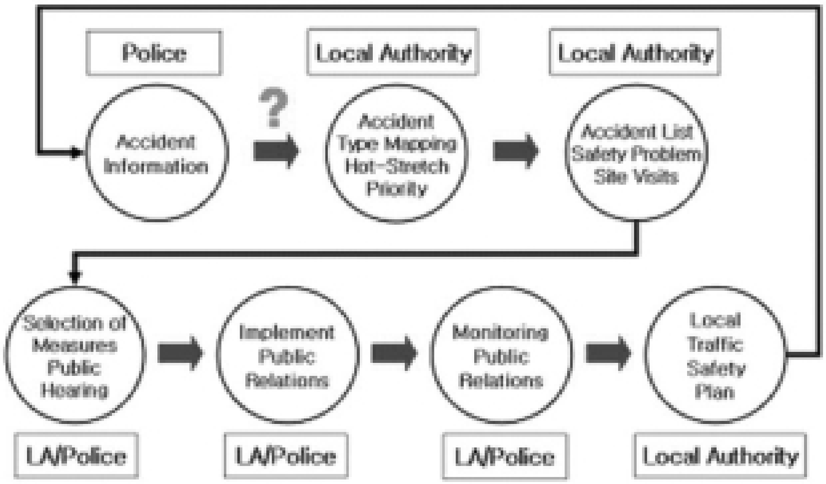
As regards establishing a safety management system on local level, local authorities are lacking in detecting 'true' hot-spots and appraising remedial measures implemented. In filling up a quality management cycle, the basis for local safety management system is the first to analyze accident data including collision sketch, ever never summarized statistics showing only general trends without saying where(location), what(traffic composition), how(accident type) happened.

Figure 19: P-D-C-A cycle for local safety management system (Choe et al., 2006)



Unless local authorities are not borne about where, what, how causing accidents, traffic composition thereof, road and weather conditions, collision characteristics, age of person etc. it is not possible to pinpointing safety defects and adequate safety measures, let alone assessing its performance and securing funds for further safety projects(Fig 19).

Figure 20: Prerequisites for local safety management system (Choe et al., 2006)



Seen as local authority, it is much more important in more or less excluding severe injury unless crash is unavoidable than to focus upon clarifying for whom the accident to be blamed or where the liability to be found. There are no differences in viewing the duties of local authority, e.g. to find out the causes and environments of an accident before it gets to be time to occur rather than its outcomes whatsoever, to advance appropriate, adequate and feasible measures while uncovering some road safety defects, all of which efforts has to keep similar accidents from happening again. The first step to completing the quality chain is to share accident data to be provided by local police(Fig 20).

4. Summary and Outlook

Local accident investigation done by local authorities is seen as a tool for revealing a hot-stretch of road network. In doing so, it is necessary building up a cooperation system between local authorities and local policies to share accident data including collision sketch. Accident data can help local authorities understanding specific safety problems at specific sites, advancing effective remedial measures, ensuring saving potentials, all activities leading to completing a safety chain. As regards how to organize and coordinate local accident investigation which refers to Enforcement Ordinance, Article 39, a concrete procedure isn't as yet indicated. Local authority is obliged to collect data related to fatal and serious injured accidents, to classify and visualize its accidents, to advance strategy to specific problems identified, to monitor and assess its performances etc. Local authority is required to inform regularly the public of hot-spots with whatever safety problems and decided measures, saving effects etc. Assuming that 250 local authorities are satisfying prerequisites for local safety management system, it is expected to save 300 fatalities annually, and that means generating the opportunity costs of about 10billion won (°÷100million euro) at the least. It is apprehended that the execution of local accident investigation is to be restricted by social and political hierarchy of desire pyramid (e.g. traffic park is more attractive than pedestrian islands or sharing accident information). The Ministry of Land, Transport and Maritime Affairs has thus far regard for encouraging local authorities to establish local traffic safety plans guided by national guideline regulated in Traffic Safety Law. Every local authority has to draft out its own traffic safety plan and action program by the end of 2009, while prioritizing hot-spots/-lengths identified. For means of establishing a mutual-assistance system with respect to accident data and raising the efficiency of safety practices, officials have to be trained in collecting safety data, setting priority of hot-spots, monitoring performances, public relations, coordinating and mediating, forward-back to safety plan etc. If all these prerequisites are prepared, a quality chain in local safety management system will be completely executed.

Acknowledgements

Ms Sujin Jung for making proofs of this paper with care

References

Choe, Byongho 2008, "Strategies for Quality Improvement of Traffic Safety Management" Joint Symposium on Reducing Injuries in Halves (hosted by the Office of Premier), May 2008, Seoul, Korea (written in Korean language)

Choe, Byongho (2007a), "Study on Mobility and Mileage of Powered Two-Wheelers", Korean Journal of Transport Technology and Policy Vol. 4/1 41-59, March 2007 (written in Korean language)

Choe, Byongho (2007b), "A study on the reduction of greenhouse gas in EU and challenges facing Korea - Coping strategy for cutting CO2 emissions from transport sectors", Korea Transportation Safety Authority (written in Korean language)

Choe, Byongho et al. (2006), "Development of techniques for evaluating and managing cumulative accidents on urban roads within the jurisdiction of the local authorities", Korea Transportation Safety Authority (written in Korean language)

Choe, Byongho et al. (2005), "Study on the guidelines for in-depth accident investigation of self-governing bodies - including a concept of data analysis system", Korea Transportation Safety Authority (written in Korean language)

Shim, Jaeick; Yu, Jeongbok (2007), "Estimation of 2006 Traffic Accident Costs in Korea", Korea Transport Institute (written in Korean language)