

THE USE OF ROAD SAFETY TARGET SETTING IN FATALITY AND INJURY REDUCTION

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ABSTRACT

The World Health Organisation has predicted that over the next twenty years the total annual global road fatalities will increase rapidly with the greatest proportion occurring in low-income countries. An evaluation of the models used for setting road safety targets in sixteen countries revealed the use of different performance indices. The effectiveness of target setting in high income countries has historically been characterised by a short period of major fatality reduction, followed by longer periods of smaller incremental gains. The intent of the study reported here was to provide an articulated phase approach for improving the road safety of countries with a different historical and economic background to those high income countries studied. It was concluded that while some developed countries are moving towards the phase of smaller incremental gains road fatalities, most of the Asian developing countries are now at the early stages of road safety initiatives. In this phase sustained commitment from governments for implementation of initiatives, data collection and record keeping, and the capacity development of key professionals is vital and has greater potential to reduce major injuries and fatalities.

INTRODUCTION

The World Health Organisation (2009) reported that each year nearly 1.3 million people die as a result of road traffic collisions and more than half of these people are not occupants of vehicles involved in these collisions. It was forecasted in 2009 that by 2020, two thirds of the world's road fatalities will occur in Asia. Although China's number of fatalities has been decreasing since 2004, together China and India accounted for more than half of the reported number of fatalities in Economic and Social Commission for Asia and the Pacific (ESCAP) region in 2007. Such casualties typically cost between one and three per cent of a country's annual Gross National Income (ESCAP 2009), an additional burden for the nation.

Historically greater attention has been paid by the relevant agencies to rectifying situations and conditions contributing to road traffic collisions in higher income countries than poorer countries. The use of target setting has helped those higher income countries to greatly improve safety. As a pioneer in OECD countries, Finland introduced its road safety targets (target setting) in 1973 (Wong *et al* 2009). Over the last two and a half decades, most of the developed countries have followed suite and introduced their own road safety targets and the effectiveness of such target setting has been proven in countries such as Australia, Canada, Sweden and Finland (OECD 2009; ETSC 2010). In order to be successful, when a road safety target is developed in a country, there must be a commitment by all parties to focus on fatality and injury reduction as a priority, raise public awareness, generate activities to deliver road safety improvement strategies, improve data collection, and to start monitoring performance or outcomes. It is also recognised that planned safety strategies should be realistic and achievable in a local context.

Currently, the road safety gap between developing and developed countries is widening as a function of ability to spend and the availability of other resources. Although some of the developing countries have initiated similar steps, the successes hoped though the planned safety strategies have not been achieved due to many factors including culture, politics, budget allocation and capacity of the relevant professionals (Wong *et al* 2009; ESCAP 2009; Loo *et al* 2005; WHO 2009). In order to address this background problem, a framework should be developed that facilitates systematic approaches to identify individual potential problem within a country's economic, social, and cultural differences. This paper aims to evaluate the sue of road safety target setting practices to establish such a framework. Results from this study will provide useful information to systematically formulate road safety initiatives and targets, especially in developing Asian countries.

OVERVIEW OF CURRENT FATALITY STATUS

The relationship between road traffic fatalities and economic conditions helps to determine the level of importance that is given to road safety in any country. For example, when a country is poor, any actions to simulate economic activities will increase the number of motor vehicles on the road network, and consequently the number of traffic incidents. Thus a country's economic condition and stage of development becomes a good indicator of the perceived importance of road safety. However road safety levels are not exclusively dependent on income – they also depends on other factors such as historical development, political background and other specific situations which are difficult to predict. Therefore, road safety levels are likely to differ within a group of countries that fall within the same income group, irrespective of whether it is a poor or rich group.

In this section, an overview of current fatality status in the form of fatalities per 100 000 people (F/P) and fatalities per 10 000 registered vehicles (F/V) as a function of economic condition is analysed. The fatality and economic data used in this study have been taken from country profiles data published by WHO's Global status report on road safety (WHO 2009). The income and fatality data for 2007 for all the countries are separated and an overview of these fatality rates is shown in Figure 1 and Figure 2, respectively. Results highlight that there are differences in road safety levels within the countries that categorized as similar economic condition. The following countries within their economic group performed relatively poorer in fatalities per 100 000 population: Libya, Oman, Saudi Arabia, Kuwait, and USA.

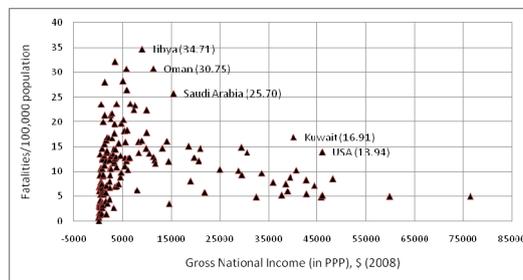


Figure 1: Fatalities per 100 000 people in 2007

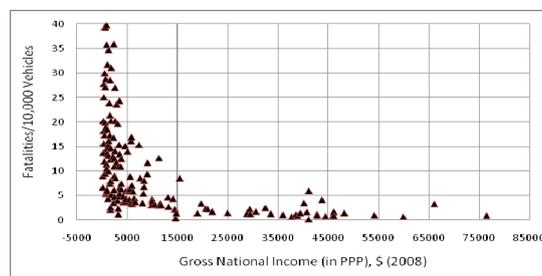


Figure 2: Fatalities per 10 000 vehicle in 2007

The study also produced a fairly simple relationship between fatalities per 10,000 registered vehicles (F/V) and Gross national income as can be seen in Figure 2. The ten countries with the highest F/V are: Sao Tome and Principe (164.07), Ethiopia (103.05), Cambodia (100.07), Togo (97.86), Uganda (78.04), Niger (69.42), Chad (67.69), Malawi (64.54), Mozambique (58.06) and Zambia (56.98). On the other hand, the fatalities per 100 000 population (F/P) for all of these countries fell below 12.70. In these countries, road crashes have not become a national priority, perhaps because relatively few people were killed on the road compared to other causes such as disease. There is also evidence that inadequate or limited accident information is collected in these countries, and thus crash statistics alone are insufficient to evaluate the true road safety level in many of these countries.

The data in Figure 2 suggests when the fatalities per 10000 registered vehicles reach a peak and then decline rapidly, with the rate of decline being slower for higher income countries. Kopits (2005) reported that this sharp decline in F/V with increases in income reflects the fact that, as income rises, a higher percentage of vulnerable travellers who previously contribute the

bulk of fatalities and injuries became vehicles passengers. It also may reflect the move to safer vehicles (such as from motorcycle or three-wheeler to car or old vehicle to new), occupant protection and vehicle maintenance have also made a significant contribution to crash reduction as income grew in these countries and newer vehicles can be afforded. Kopits (2005) further reported that when a country reaches a per capita income of \$8 600 (1985 \$ International prices), traffic fatality risks for people begin to decline, supporting the inverted U-shaped pattern. The same study also highlighted that if the present policies were continued into the future, road death rates in India, for example, would not begin to decline until 2042; similarly Brazil would not peak until around 2032.

Recent studies (OECD 2009; Wong *et al* 2009; Loo *et al* 2005; ESCAP 2006 and ETSC 2003) highlighted that among the group of high-income countries, those who already have their own targets for improving road safety demonstrate significant improvement compared to other countries within in the same group. So road safety level is not only influenced by income increase but can also be improved significantly by the introduction of target setting practices and related initiatives.

EVALUATION OF TARGETS PRACTICES

In 1973, Finland was the first European country to set a national target to reduce road fatalities by 50% (Wong *et al* 2009). It met this very challenging target by the end of the 1970s (ETSC 2003) and this was the first significant reduction achieved in Europe during the 1970s. Since then, the role of road safety targets has been recognised by many wealthy countries as a tool for reducing death and injury resulting from road traffic crashes.

Numerous views on road safety initiatives and management of road safety targets have been widely published (Wong *et al* 2009; Elvik 2008; and Loo *et al* 2005). One approach to develop and evaluate successful road safety targets was summarized by Elvik (2008) in nine components: (1) Vision; (2) Objectives; (3) Targets; (4) Action plan; (5) Evaluation and monitoring; (6) Research and development; (7) Quantitative modelling; (8) Institutional framework; and (9) Funding. The first four components are essential for the formulation of a road safety strategy, and the remaining are key to its successful implementation.

Evidence exists that countries with road safety targets have reduced their road fatality rate in a much more effective manner than the counties without such targets (OECD 2009; Wong *et al* 2009; Loo *et al* 2005; ESCAP 2006 and ETSC 2003). There is also however, evidence that some developing countries that have set their road safety targets in the recent past, and have struggled to achieve the expected goals. Reasons for these failures have been discussed by several authors highlighting the social, political and economical changes over a period of time in a country as key factors (Elvik 2008; Wong & Sze 2006; and OECD 2009).

Targets are often expressed in the form of estimated percentages of reduction in fatalities or casualties during a period of time. Currently, road safety targets are planned at local or regional levels in a country or even expanded to a specific region or Global level. The following section discusses the use of planning performance indices, target period and their geographical coverage.

Performance Indices

An important part of an effective road safety target is to decide on one or more quantitative targets that could be realised at the end of the target period. In this process of evaluation of safety levels of a country, generally the annual number of fatalities and annual fatality rates such as the number of fatalities per people, fatalities per a registered vehicle, fatalities per a unit of distance travelled and fatalities per unit of road length, are typically used to evaluate and define performance.

Different quantitative performance indices used in sixteen countries are given in Table 1. The data indicates that the number of fatalities is used in most countries in one form or another. Many countries use more than one indicator to frame their desired outcomes including total injuries, seriously injured, and lives to be saved,

The reasons for the use of multiple performance indices have been widely discussed in the literature (ESCAP 2006; Loo *et al* 2005). For example, fatality trends in India from 1996 to 2005

are given in Figure 3. As can be seen from this figure, while the number of fatalities increased, the number of fatalities per 10,000 registered vehicles reduced from 1996 due to rapid increases in vehicle ownership. Therefore if F/V is set for benchmarking road safety performance in India, it could mislead the output and subsequent safety initiatives. In general, when a country is very poor, a reduction in the number of fatalities or casualties provides a meaningful assessment, and similar approaches are practiced in Bangladesh, Myanmar, Vietnam, Indonesia, and Thailand.

Table 1. Road safety targets in selected countries

Country ^{2,3&4}	GNI in 2008 ¹ (\$)	Target Initiated	Latest target	Overall Targets
Bangladesh	520		2008-2010	F by -(10~12) %
Myanmar	-		2005-2010	940 P & 32,900 SI
Viet Nam	890		2005-2010	7,000 P & 16,100 SI
Indonesia	2,010		2005-2010	20,411 P & Reduce F growth by 2.4%
Thailand	2,840		2005-2010	13,000 P & 1,508,000 I
Malaysia	6,970		2001-2010	F/V < 2, F/P < 10 & F/L* < 1
South Korea	21,530		2008-2012	F by -50%
New Zealand	27,940	1990	2001-2010	F < 300, F/L < 6.1, F/P < 7.3 & F/V < 1.1
Japan	38,210		2006-2010	F < 5,500
Australia	40,350	1993	2001-2010	F/P by - 40 % (F/P < 5.6)
Canada	41,730	1996	1996-2010	KSI by 30 % of average in 1996-2001
France	42,250	1997	2007-2012	F < 3,000
Germany ^{EU}	42,440		2010-2020	F by -40 %
Great Britain	45,390	1981	1998-2010	KSI by - 40 % of Average in 1994~98
USA	47,580	1996	1996-2008	F/L < 1.0
Switzerland	65,330		2000-2010	KSI by -50 %

F- Number of Fatalities, SI- number of serious injuries planned to prevent, I – number of injuries planned to prevent, KSI – Killed or seriously injured planned to prevent, P – Lives planned to be saved

^{EU} – EU set an ambitious target for 2020 of reducing road accident deaths by 40 percents from 2010

* - Malaysia's target of reducing fatalities per 100 million vehicle kilometres (F/L) travelled (**-USA's F/L in miles)

Source: ¹World Development Report 2010, ²ESCAP 2006, ³OECD-2009 & ⁴ESCAP-2009

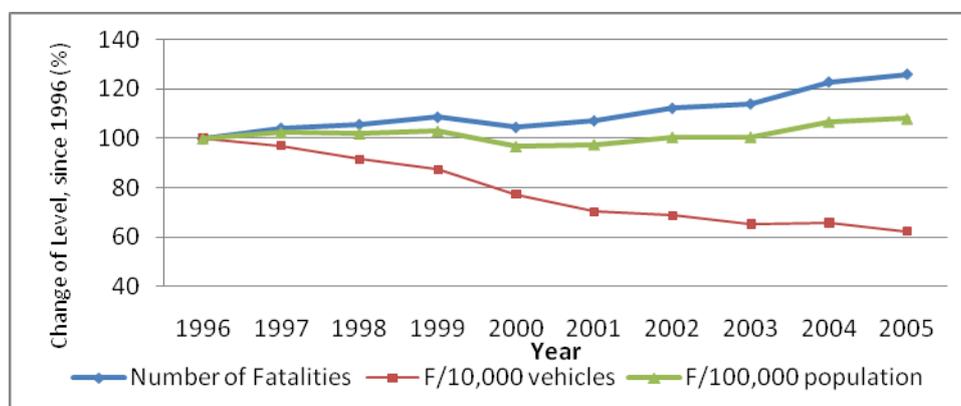


Figure 3. Road fatality trend in India between 1996 and 2005

The actual achievement of any road safety actions, initiatives or strategies is obtained from comparing performance indicators between the base and target years, while noting the strengths and weaknesses of the various indicators. In addition, cross monitoring of performance indicators take place throughout the target period in order to adapt to the changing circumstances and experience. This exercise of cross monitoring of performance indicators also highlights the difficulties in maintaining a consistent pathway during a target period.

Target periods

The target period is defined as the number of years between the base year(s) and the target year(s). Although many countries set target periods of ten years for road safety, it varies between 5 and 15 years. As stated in the previous paragraph, most of the countries also examine and evaluate their short-term achievements within their target period.

Geographical coverage

The issue of setting road safety targets has achieved international recognition. The recent ministerial conference on road safety in Moscow considered a ten-year target period to declare '2010-2020' as the 'Decade of Action for Road Safety', with the objective of a forecast reduction in road deaths of 50 per cent (CGRS 2009). The European Commission presented its 4th Road Safety Action Programme with the objective to reduce road deaths and, for the first time, serious injuries by 40% between 2010 and 2020 (ETSC 2010). ESCAP's declaration includes the overall goal to save 600,000 lives and to prevent a proportionate number of serious injuries over the period 2007 to 2015. These initiatives at global and regional level show the importance of target setting to improve the road safety, even in a wider geographical area.

In addition to the overall road safety program of a country, a national goal is may also be partly transferred to individual states or regions or even down to local level programs. For example, Australia, USA, and UK are some of the countries who implemented their state level road safety programmes with the full support of their state governments. In Australia, starting from 1980, a series of State and Territory road safety initiatives were initiated in all eight States or Territories (Queensland, New South Wales, Victoria, Southern Australia, Western Australia, Tasmania, Australian Capital Territory and Northern Territory). This kind of target setting generally matches the appropriate efforts to the resources at regional and local level such as road infrastructure development, capacity and law and order.

THE CONCEPT OF PHASES OF TARGET SETTING PRACTICES

The desired outcome for any road safety target is to continue decreasing road based fatalities and serious injuries. Evidence shows that overall countries with road safety targets have consistently performed better than others without a target (Wong *et al* 2009; ETSC 2003, Loo *et al* 2005).

When it comes to road safety, each country assigns unique importance to certain aspects, based on its own historical background and political circumstances. As a result, the nature of road safety initiatives undertaken differs between countries. ESCAP (2002) splits the status of road safety initiatives into three phases. However, it does not provide any useful framework to facilitate a systematic relationship of road safety strategies that can help to highlight good practices across different nations with diverse economic, social, and cultural differences (Loo *et al* 2005). Similar weakness is also observed in ESCAP (2009) where it analyses the status of road safety in the region; discusses the proposed set of road safety goals, targets and indicators; and highlights the importance of road safety data for monitoring achievement at the national and regional level. A simple philosophical framework shown in Figures 4 and 5 has been developed by the first author and the model illustrates that when economic status and political background of a country improves, road safety initiatives change from Phase 1 to sequentially higher levels.

The earliest stage of road safety initiatives is Phase 1, which has the prime purpose of raising awareness amongst key role players in the specific country. Generally Phase 1 consists of developing road safety policy by specialists, and some limited initiatives for road safety improvements. During this phase, a comprehensive investigation is carried out by the specialists; and seminars, workshops and key forums used to discuss and plan the next move.

This phase is generally funded by external agencies and/or nongovernmental organisations in Asian developing countries. At this stage, a working group is usually identified to work closely with the government sectors, as support of the key professionals in government is vital to ensure progress. During this phase, some actions may become visible to the public in the form of traffic signals, sign boards, suitable street lighting accompanied by reasonable media coverage.

The main purpose of Phase 2 is to build on Phase 1 and develop an overall strategy, action plans, remedial measures and activities. During this phase, many countries also establish road safety organisations to enhance the efforts to achieve long term goals. The typical activities of such organisations are to develop frameworks for an effective data system, and to identify pipeline projects on road safety. The major proportion of funds for this phase is usually from external development banks and other nongovernmental organizations.

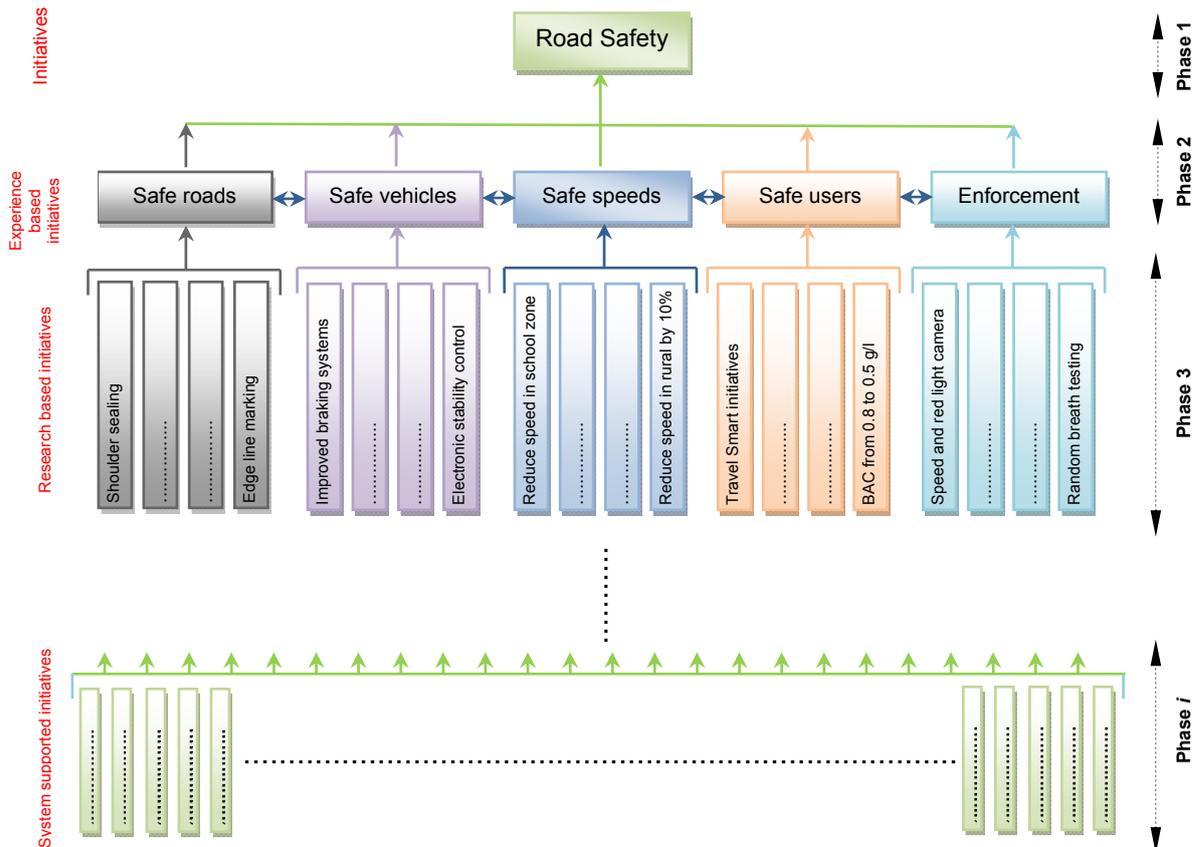


Figure 4: Development of road safety target setting practices

During Phase 2, the remedial measures for road safety problems still typically have a strong link with design, construction, modification and maintenance of road infrastructure facilities rather than behavioural issues. The role of engineers and police to increase road safety through better infrastructure management and enforcement contribute more during early phases of implementing road safety initiatives than other efforts as shown in Figure 5. At this Phase 2, the road safety remedial measures are also based on experience-based initiatives or findings from other successful countries. The remedial measures include black spot treatments, hazardous location improvements, compulsory seat belts, defined school zones, road safety campaigns, reduced speed and limitations on heavy and old vehicle usage. Many countries have stagnated at Phase 2 for a long period of time and often without further progress.

In Phase 3, road safety research and development activities are linked to more specific actions, however, most of them evolve from Phase 2 activities as shown in Figure 4. Fatality modelling and trend analysis help key players to design appropriate safety programs and remedial measures. At this stage, setting of national road safety targets is generally accepted as a tool to enable the monitoring the safety performance. The actions in Phase 3 consist of research based

initiatives for road safety improvements and choosing the most effective strategies as a key concept. Some of these actions include the reduction of Switzerland's maximum legal blood alcohol content (BAC) from 0.8 g/l to 0.5 g/l; New Zealand's initiative to deploy speed cameras on an 'anywhere, anytime' basis; Great Britain's increased implementation of lower speed limits (32kmph) at school zones; Sweden's key strategy to manage injuries so that they do not cause death; and the Australian federal government's funding for learner drivers program, known as "keys2drive" (DTMR 2009; ATC 2000; ETSC 2010). All of these strategies utilise research-based estimates by specialists to predict what may be achieved by adopting the proposed measures.

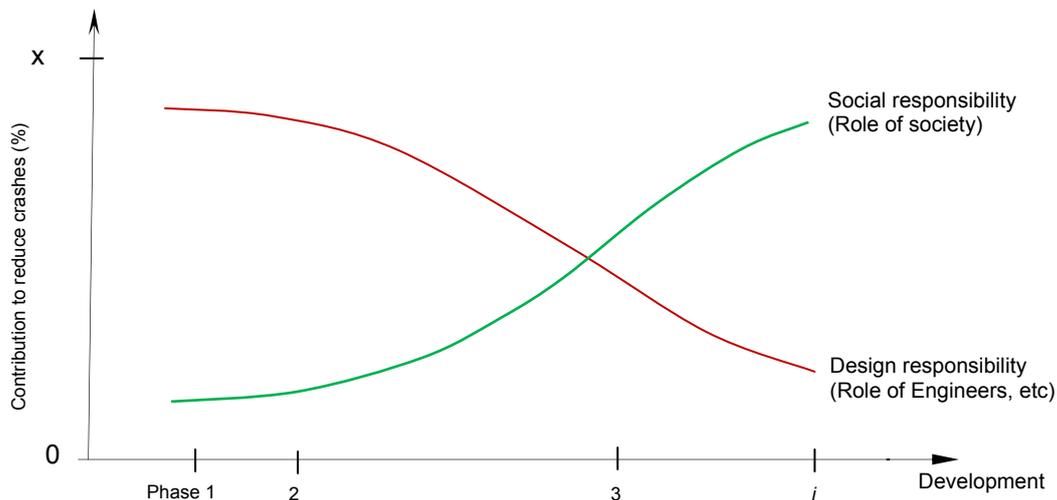


Figure 5: Responsibility towards road safety ($x < 100$)

Phase 3 is that which specialists would normally agree that transferring successful road safety strategies from one country to another will not necessarily succeed. At this stage social responsibility, inclusive of government support, becomes the key to success. Naturally it is in governments' interest to reduce the economic loss that is incurred through loss of life, injury and property damage from poor road safety practices.

In future, there may be a need for expanding the sequence of the Phases as detailed in Figure 4. For example, one strategy may need to split into a few, or a phase may disappear. So a Phase i is suggested for future safety planners to microscopically look at the remedial actions to support the set target. For example, application of high-tech measures will be vital in future. For instance, at the moment eCall (an emergency call box) is currently a high priority area within the European countries. Therefore eCall will also be as a standard option in every new vehicle in Europe (SafetyNet 2009). When a motor vehicle equipped with eCall is involved in a crash, a built-in emergency call system can be activated manually or automatically to organize emergency assistance. This shows that there will be an ongoing need to continue to research and adapt evidence-based innovative approaches to save lives.

At this phase, specified capacity for key players and social responsibility are very vital to further improve the safety. Richard Allsop commented that "*the challenging but achievable targets for reducing road deaths and serious injuries are to be based on expert analyses of past trends in numbers of deaths as well as estimated capacity for further improvement*" (ETSC 2010).

PROGRESS IN DEVELOPED COUNTRIES: AUSTRALIA

The annual fatalities per 100,000 people in Australia from 1945 to 2008 are shown in Figure 6. There was a steady increase of fatalities between 1945 and 1970. This increased trend has actually been observed since 1925 (AustGovt 2009). The annual fatalities peaked at 3,798 in 1970 up from 1,111 in 1945. During this period from 1945 to 1970, the number of vehicles also increased by about 350%.

In the early 1970s, there were initiatives to improve road safety including compulsory wearing of seat belts throughout Australia (1973) and random breath testing in Victoria (1976). These initiatives helped to improve road safety, but only at a slow rate.

The more constructive steps taken can be attributed largely to the development of more systematic approaches to tackle road safety issues. These included a series of State and Territory Road Safety Strategies (especially from the 1980s onwards) such as the motor vehicles standards act (1989); compulsory wearing of bicycle helmets throughout Australia (1992); the national ten point plan (1990); the introduction of automated traffic law enforcement measures such as speed and red light cameras (1990); and other initiatives reported by Langford and Newstead (2008).

Since 1980, evidence collected in Australia indicates that when appropriate road safety counter measures were implemented, progress in road safety can be characterised by short periods of major casualty reductions (seen as large downward steps in the 1980s and the early 1990s in Figure 6) followed by longer periods of consolidation of these benefits with smaller incremental gains in the late 1990s and in the 2000s (ATC 2009).

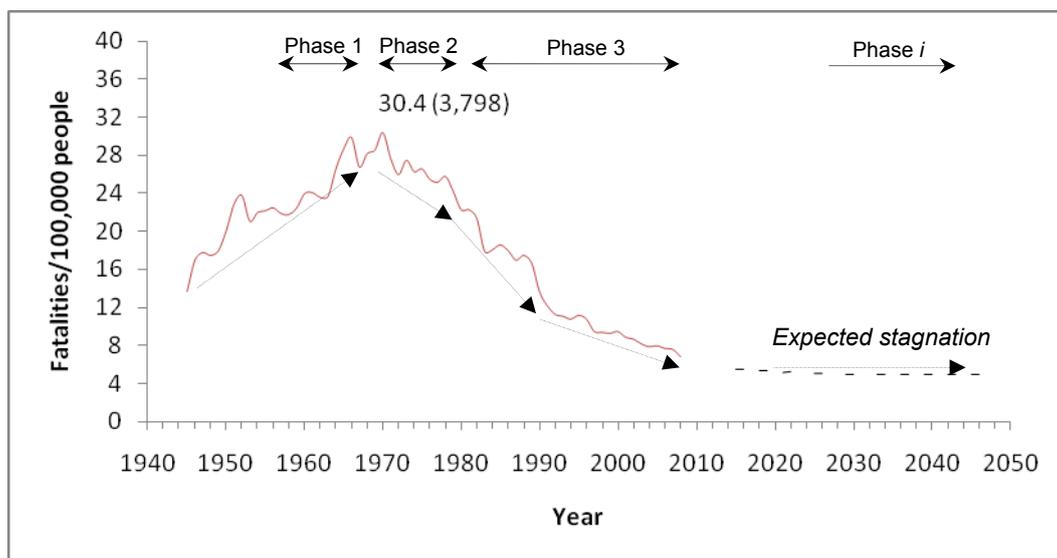


Figure 6: Fatalities per peoples in Australia

In order to accelerate the safety gain, an action plan for the period from 2001 to 2010 was developed jointly by all Australian jurisdictions with input from the individual states. It had the specific numeric target of decreasing the annual number of road deaths per 100,000 people by 40 percent over this decade, to no more than 5.6 by December 2010 (AustGovt 2000).

Currently, a mix of remedial measures is adopted in individual states, and the details of specific measures are developed to reflect local circumstances and priorities (ATC 2009). All of them intend to use the best practice safe system approach to achieve the goal of safe road users travelling at safe speed in safe vehicles on safe roads and road sides to achieve the set target at local and national levels. However, recent trends in fatality data have made it apparent that future reductions will be more challenging and will require a multiple system approach (including current safer system approach) to improve safety. In two to three decades, it may be increasingly difficult to achieve additional gains and a state of stagnation may be reached.

CURRENT STATUS IN ASIAN DEVELOPING COUNTRIES

Currently most of the Asian developing countries are primarily focused on seat belts, helmets, controlling the use of heavy and old vehicles, speeding, drinking and driving, introduction to road safety elements into the school education and, for some, trauma management. These are some of the initial (Phase 1) or interim (Phase 2) actions which have already taken place in

successful countries with well established safety strategies. There is evidence that the developing countries in Asia could be operating in Phases 1 or 2.

Many Asian countries have also taken some other forms of road safety initiatives based on target setting (Malaysia, Bangladesh, Myanmar, Vietnam, Thailand, and Indonesia), as detailed in Table 1. Although a safety target is planned, reducing the road fatality level is a difficult task in some of these countries, especially due to lack of commitment in financial and human resources. Experience shows that countries seem to succeed with their set target only when there is a genuine commitment towards achievement of the goal. To be successful the following areas need to be considered in Asian countries: determination, data collection, capacity of the key players and collaboration.

Determination to start

Some important social and political issues may militate against the achievement of the goals in developing countries. These issues include unregulated or malpractices in driving licence procedures; the operational outcomes from a complex money driven environment propelled by the alcohol industry; lack of transparency in the government sector including in police, and inadequate trauma management (Davis et al 2003). Tackling these problems will require strong commitment and determination by the relevant authorities and support from the populace. In order to improve the road safety situation in a developing country, a sufficiently influential person (such as a strong and honest political leader) or group of people, or a sufficiently powerful coalition of stakeholders, needs to develop and promote a practical vision for safer road use. This is sometimes a challenging task in developing countries due to the political climates.

However attempts to improve road safety cannot be postponed until all social and political problems are resolved. The key players and professionals in road safety, including educators, road and traffic engineers, lawyers, doctors, and policy-makers, need to have a clear understanding about the critical issues discussed in the previous paragraph while planning or initiating road safety interventions. As a first step, due to the limited support network initial targets may need to be set that are simple and realistic. A simple target can have far-reaching and long term effects, and can lead to further work to investigate, identify and implement remedial actions.

Data Collection and monitoring

The problem of under reporting of crashes in Asian developing countries is considered to be as high as 25-50% (Jacobs et al., 2000). Accurate data is vital in order to make meaningful forecasts, and will give also give a sound knowledge of what efforts have succeeded or failed in the recent past. Most of the developing countries have fatality data but only possess limited or even misleading data about injuries. Jacobs et al (2000) reported that fatalities represent the 'tip of the road casualty iceberg' and higher priority needs to be given to the collection of road injury data. Jacobs also stated that crash statistics alone are insufficient to assess the road safety situation and other performance indicators are needed. Collection of the following data seems to be vital for future initiatives: number of pedestrian crossings installed, number of hazardous locations improved and number of safety audits conducted.

Analyses of data and forecasting are very important for target setting and monitoring impact. Specifically, a forecast represents the continuation of trends that may be expected if no efforts are taken. Thus a forecast is the starting point for monitoring a target what may realistically be achieved in the future.

Capacity of development

The majority of the proposed road safety interventions in Asian developing countries are based on the traditional and successful methods or experiences from other countries. Identification of appropriate actions is one of the difficult tasks faced by the key players in road safety. Those who now teach, plan, design, construct, operate and manage the transport system and infrastructure have had virtually no training in road safety and rely on judgment rather than training and skills (Hauer 2005). It would be beneficial to build the technical and practical capacity of road safety agencies to use the available data more effectively, and to facilitate

generation of further relevant data about the magnitude, underlying causes and impact of road traffic injuries (Hauer 2005, Elvik 2008).

In this regard, nongovernmental organizations such as the United Nations agencies, development banks, donor countries and similar agencies have an important role to play in increasing support for improved road safety at global level. Global Road Safety Initiative (GRSI) is currently helping Myanmar, Malaysia, Vietnam, Thailand, Cambodia, Philippine, Laos, Indonesia, to build the capacity in these countries to reduce traffic fatalities. This includes building and expanding the capacity of the Global Road Safety Partnership to deliver road safety improvements in line with the recommendations of the World Report on road traffic injury prevention. It is also the responsibility of the individual governments to develop the capacity of their own professionals, and to conduct long-term road safety research with the assurance of stable and progressive future for well qualified personnel.

FUTURE OF THE TARGET AND PERFORMANCE INDICES

An overall fatality reduction is the desired outcome from setting road safety targets. The effectiveness of a road safety target is commonly evaluated by three common approaches such as general comparison of developed performance indices, statistics analysis and trend analysis.

Many developed countries now use experimentally proven and statistically verified strategies to set road safety targets based on their past experiences. In this approach, targets are based on empirical evidence relating to the previous effectiveness of the selected interventions combined with best estimates of future effectiveness. This method of setting targets is continuously modified by specialists. Currently target setting is aimed at developing several micro-level performance indices such as annual reduction of fatalities and casualties from the crashes related to: speed (such as reduction in speed related fatalities), intersections, young drivers, motor cycles, heavy vehicles, riders, pedestrian, alcohol-related, run-off-road and head-on-crash (DTMR 2009). In order to incorporate these micro-level analyses into road safety, a new framework also needs to be established for data collection, monitoring and reporting of road safety (Elvik 2008; Loo *et al* 2005; Wegman 2010; and OECD 2009).

The question remains as to what extent these new indicators and data collection framework can be used in future or what shape new indicators will take to facilitate the future evaluation processes? When a country has achieved its ultimate road safety target, for example; Sweden's 'Vision Zero', then the future of the road safety will reach a point of stagnation, as similar condition is tentatively projected for Australia as indicated in Figure 6. As discussed previously, at this stage, road safety will need to receive strongest support from both road users (a strong social commitment) and road infrastructure facilitators (a well designed protective road traffic system). An iterative process will however need to exist to ensure that the protective road traffic system is well informed by its own performance. At this phase, new shapes for performance indicators need to accommodate a total system approach. This is however a focus for future studies.

CONCLUSION

Road safety targets are considered as a tool for improving the level of fatalities and casualties. In addition, its performance management capabilities help to monitor the road safety progress over time. It has been revealed that countries that set their own individual road safety targets tend to be better performers than others. Lessons from developed countries indicated that when appropriate remedial measures were implemented, a major casualty reduction was possible at least with a reasonable gain over a short period followed by longer periods of smaller incremental gains.

A review of outcomes from road safety practices in developing countries indicates that safety improvements were related not only to the target setting but also to the amount of resources allocated to road safety improvement programmes. Improvement also appear to have occurred due to other positive commitments during the target period by government and professional bodies. Results have shown that road safety levels in most of the developing countries in Asia are still at the early stage (Phase 1). It appears that to be successful the strong commitment, data collection, and capacity of the key players are also essential.

The Phase 1 to Phase 3 framework concept outlined in the paper indicates that when a country is poor, actions towards improving road infrastructure facilities significantly contribute to improved road safety. Conversely when a country is rich, strong support from the society is vital for road safety improvements. In other words, improvements in road safety of the rich countries will be heavily dependent on a total protective system approach. The constant assessment process may help to identify problems within any existing countermeasures as well as to define new specific actions.

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