Traffic Safety in Developed and Developing Countries: A Comparative Analysis

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Abstract-It is now well recognized that road safety is a worldwide public health problem and there is a high public awareness about road traffic injuries, their grave consequences and enormous costs to society. Road safety developments are correlated with socioeconomic factors such as level of motorization and economic growth which differs significantly between developed and developing countries. This paper discusses and compares the magnitude, trends and causes of traffic accidents, accident costs and cost estimation methods, strategies and countermeasures in both developing and developed countries. Traffic safety data for the period 2003-2013 from selected developing countries are analyzed and compared with European countries (EU). The fatality rates per population for the developing countries were found to be substantially higher than those in EU countries. EU strive to make their fatality rates dropping towards their zero vision while those for developing countries may continue to be high unless effective measures are implemented to reduce the magnitude and severity of their accidents. Accident costs were found to be a real economic burden in developing countries estimated at more than 2% of their Gross Domestic Product (GDP) much higher compared to developed countries. The results suggest that road safety is more appreciated in developed countries. Although developed countries have a good experience in applying road safety programs, it is more difficult to apply the same safety programs in developing countries. This research also highlights the countries' experiences in road safety improvements.

Index Terms—Road fatalities, accidents cost, safety programs, developing countries

I. INTRODUCTION

Road Traffic Accidents (RTA) cause serious threat to human life. Worldwide, approximately 1.2 million people are killed each year in motor vehicle accidents and the global cost of road traffic injuries is estimated at US\$ 518 billion each year [1]. Some countries are achieving improvements in road safety and have been more successful in reducing their road fatalities than many others.

This paper presents, discusses and compares the various issues of road safety in both developing and developed countries in an attempt to understand the reasons behind the good performance of developed countries and learn lessons which are transferable to developing countries.

II. THE INTERNATIONAL SCENE

According to the World Health Organization (WHO), 90% of road traffic deaths occurred in the developing countries (low-income and middle-income), where 5098 million people or 82% of the world's population live and own about 54% of the world's vehicles as shown in Fig. 1 and Fig. 2. In higher-income countries road traffic accidents are among the top ten leading causes of disease burden whereas in less developed countries, they are the most significant cause of injuries. However, lower fatality and injury rates can be found in the developed world. On the other hand, WHO statistics show that Ethiopia has the highest fatality rate followed by Uganda. Pedestrians were found to be the most vulnerable group of road users in Ghana and South Africa [2].



Figure 1. Population, road traffic deaths, and registered motorized vehicles by income group. Source: Ref 2



Figure 2. Road traffic fatality rates per 100 000 population by WHO region. Source: Ref 2

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Motorization rates are increasing rapidly in developing countries. This, together with rapid development and population growth, contribute to higher number of accidents and resulting causalities. However, accident statistics from developing countries should be treated with caution due to the problem of under-reporting that results from the low priority given by the governments to road safety, but data management is improving through the more widely use of computerized systems, Moreover, there is a growing awareness of the various problems associated with traffic accidents. In the last two decades, many developing countries have commissioned or considered conducting studies, which are designed to develop a future road safety strategy, and provide a framework for facilitating action [3].



Figure 3. Developing countries safety situation summary

The main reason for discrepancies in traffic safety level between developed and developing countries is whether the traffic safety is made a political priority or not. The situation for developed and developing countries are shown in Fig. 3 and Fig. 4 respectively.



Figure 4. Developed countries safety situation summary

Other important issues are the differences in mobility habits of the population, the role and quality of the public transport systems and its characteristics. [5]

III. AN OVERVIEW OF TRAFFIC SAFETY

A. Traffic Safety in Developing Countries

Fatalities, injuries and road accidents are shown in decreasing trend in the past few decades and it is expected to continue to drop in the future as shown in Fig. 5 and Fig. 6.



Figure 5. Trends in road traffic fatality rates in selected developed countries. Source: Ref 2



Figure 6. Trends number of Injures in EU. Source: Road safety evolution in EU [5]

B. Traffic Safety in Developing Countries

Fatalities, injures and road accidents are increasing dramatically in developing countries.

The road network in developing countries is used by several different categories of motorized and nonmotorized vehicles, which can vary in length, width and speeds. These differences influence the behavior of road users in the traffic streams causing traffic safety level to decrease dramatically. [5]

Fig. 7 and Fig. 8 show fatality rate trends in a number of selected developing countries.



Figure 7. Fatality rates trends in developing



Figure 8. Fatality rates trends in GCC. Source: Fatal crashes in GCC countries [6]

IV. ACCIDENTS COSTS

A. Developed Countries

- The 2008 study Crashes vs. Congestion What's the Cost to Society? Commissioned by the American Automobile Association compared crash and congestion costs in major U.S. cities using Federal Highway Administration crash costs and the Texas Transportation Institute's Urban Mobility Study congestion costs. It found that crash costs average more than twice congestion costs. Per capita crash costs decrease with increased city size, which is the inverse of congestion costs. Urban crash costs are estimated to average 25 ¢-41 ¢ per vehicle mile. Note that this study examines the compressive cost of crashes and therefore reports higher values than sources which only cover selected or external costs
- A study for Capital Region Intersection Safety Partnership (CRISP) committee developed a collision cost model that includes estimates of

direct costs, human capital costs and willingnessto-pay to reduce damages from various types of crashes. The results indicate that direct plus human capital costs average \$1,819,800 for a fatality, \$361,700 for a major injury, \$47,200 for a minor injury and \$11,400 for a property damage only crash. Willingness-to-pay costs average \$ \$5,416,200 for a fatality, \$1,385,600 for a major injury, \$30,600 for a minor injury and \$11,400 for a property damage only crash [6]

B. Developing Countries

- Examples on developing countries include the work of Ismail and Abdelmageed who estimated the cost of road traffic accidents in Egypt for 2008 to be around 10 billion Egyptian Pounds(\$1.5 billion) with an average cost per accident of 500 thousand Egyptian Pounds (7)
- Xuan (8) studied the cost of accidents for the year 2004 in Vietnam and found it to constitute about 1.21% of the Gross Domestic Product (GDP)
- A recent detailed study of accident costs in Jordan for the year 2009, estimated their magnitude to be equal to JD 336 million (\$516.2 million) which constitute over 2% of the GDP of the country [9]. A band of min-max total external marginal accident cost was found to be JD366-604 million(\$550 million)

C. Global & International Comparisons

Estimates of road accident costs measured as a percentage of gross domestic product (GDP) for a number of countries excluding non-market impacts (pain and suffering), showed an average 1.3%, with a range of 0.3-2.8%. Fig. 9 shows the results of traffic accident costs as a portion of GDP for various countries



Figure 9. Crash costs as portion of GDP. Source: (Elvik 2002)

The magnitude of the problem, its rates of growth and the associated economic and social impacts are alarming, this calls the need for a detailed analysis of the present and future evolution of the problem, its causes, costs and possible effective countermeasures in an attempt to improve road safety.

V. POTENTIAL COUNTERMEASURES IN DEVELOPED AND DEVELOPING COUNTRIES

Traffic safety in developing countries faces many obstacles that prevent its improvement. Low resources

allocation for safety projects forms the main obstacle followed by the absence of safety national goals, performance measures and policies. Thus it is recommended by WHO that successful policies from developed countries should be imported and adapted to developing nations.

Due either to a lack of awareness of traffic regulations or to a general "attitude" towards road safety, generally low standard of road-user behavior exists in developing countries such as high speed driving, which increase crash probability, thus death risk. So it is important that adequate traffic law enforcement is provided by the police. An example is the national speed limits in different streets types that are used to balance mobility and road safety. There is however likely to be considerable potential in the developing countries, for in many of them the traffic police are not so well trained or equipped as they are in developed countries. Further, in many developing countries the police are obliged to spend much of their time controlling traffic, with little time available for traffic law enforcement.

Perhaps the two important measures that can be adapted to protect the road user during the course of an accident are the use of seat belts for vehicle occupants and crash helmets for motorcyclists. There has been growing evidence from the developed world that the compulsory wearing of seat belts results in a significant reduction in injuries.

Mandatory seat-belt-use laws have significantly reduced traffic injuries in developed countries [10], such laws must be tailored to the local situation, in developing countries.

In the developed world, an awareness of the importance of good infrastructure began in the 1950s, mainly in programs treating hazardous locations or "black spots" as they were then known. Programs on rural roads were developed to straighten bends, stagger junctions and change the camber. Developing countries can also benefit from this experience.

Cooperation between developed and developing countries, especially in the field of experience sharing and data transmitting could improve safety in developing countries. [11]

VI. STRATEGIES AND ACTION PLANS FOR ROAD SAFETY IMPROVEMENT

Europe and other high income countries plan to decrease traffic deaths by 27 percent over the period 2000-2020. The European Commission (EC) identifies the following primary causes of road accidents in the member states [2]:

- Excessive and improper speed resulted in one third of death and serious injuries.
- High risk accident site (black spots).
- Failure to wear a seatbelt or helmet, which can affect severity of accidents.
- Non-compliance with driving by professional drivers.

There is a diversity of views on formulating and implementing road safety strategies. To some researchers,

the road safety strategy should be as comprehensive as possible. A well-planned and well-timed 'war' should be launched against the enemy or the epidemic that takes the lives of people and inflicts heavy economic losses [12].

Good planning and a clear national framework, and support at all levels, are emphasized for the successful implementation of an effective road safety program. A different perspective is to study road safety measures from the economic point of view, such as cost-benefit analysis. However, it is extremely difficult to quantify the full cost of road traffic fatalities accurately [13].

Probably the first systematic approach concerning accident and injury prevention strategies was the socalled Haddon matrix which caused a shift from an almost exclusive focus on trying to improve driver behavior to a more comprehensive approach. This approach has led to many successful safety improvements within all elements of the matrix. Recognized limitations of this model are that neither the concept of exposure nor the importance of interactions between the elements of the matrix are addressed [14].

New approaches like the "Vision Zero" and the "Safe System" approach view the traffic system more holistically. Sweden is among those countries which has developed a "Vision Zero" approach based on a refusal to accept human deaths or lifelong suffering as a result of road traffic accidents. The Sweden's Vision Zero road safety policy is an example of an innovative road safety policy. It envisions zero deaths as the ultimate road safety goal [15].

Full Safe System approach to road trauma requires that the crash energy in an accident is low enough to prevent (serious) injuries, recognizes that humans will always make mistakes in traffic, and requires system designers to provide a transport system that supports the highest level of safety possible [16].

Other important elements are formulating road safety strategies, educating society to recognize road traffic safety, setting targets, and monitoring performance [17]. A summary of national strategies worldwide showed that several countries, mostly developed, are currently using the safe system approach in developing and implementing their road safety programs [18]. Netherlands [19] has developed a closely related "Sustainable Safety" approach which aims to prevent (serious) crashes from occurring and if this cannot be done, to prevent severe injury. Sustainable Safety aims to prevent these errors and offences as much as possible or to mitigate their consequences by designing the traffic system according to the 'human measure'.

Recent efforts were made to develop road safety strategies for developing countries such as those for Jordan, Saudi Arabia, Qatar and Bahrain [20]-[22]. However, some of these attempts were not very comprehensive and many were not fully implemented. The purpose of the Jordanian plan, for example, was to establish coordinated approaches which will assist in devising the most appropriate solutions for the road safety problem, implementing these solutions and evaluating them to improve future program design. Furthermore, some rich developing countries such as Bahrain and Qatar have developed comprehensive National Road Safety Strategies (NRSS) which were reflected on varying level of fatality reductions according to the level of implementation.

VII. CONCLUSION

The majority of the world's road traffic deaths (about 90%) occurred in the developing countries where only 54% of the world's vehicles exist. Yet, road safety is more appreciated in developed countries and their accident rates are generally improving. In comparison, the problem may appear of little concern in developing countries and their accident and casualty rates are much higher than developed countries.

Accidents costs are also much higher in developing countries compared to developed countries.

It is recommended by WHO that successful policies and effective countermeasures from developed countries should be imported and adapted to developing nations.

Many strategies and approaches were applied in developed countries and lead to decrease in traffic deaths while many developing countries still do not have any proper form of national strategy. Even those countries who established their national strategies could not achieve a satisfactory level of successful implementation mainly because of the lack of political will and support of decision-makers.

A comprehensive national road safety strategy must, therefore, be developed, adopted and implemented, and a multi-directional approach should be considered in developing countries. In addition, a safety management system need to be established.

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