IMPROVING HIGHWAY SAFETY IN BANGLADESH: ROAD IMPROVEMENT AND THE POTENTIAL APPLICATION OF iRAP

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Abstract

Road infrastructure safety design and engineering have now emerged as the core function of contemporary road transport safety policies. Developing countries like Bangladesh however have been slower in devising and adopting such an approach and many roads still remain substandard. In Bangladesh, nearly 70% of road accident fatalities occurred in rural areas including rural sections of national highways. Accidents and fatalities on national highways are characterized as clustering on selected sections, identified as Hazardous Road Locations (HRLs). Nearly 40% of road accidents are concentrated on around 2% of the highway network.

On-scene in-depth study of accident locations revealed that factors relating to road environment are significant in road accidents in Bangladesh and the road design features are indeed associated with particular accident types and hazards. It is time to ensure that the road and its environment are put into safety through both reactive (treatment of hazardous locations) and proactive approaches (road safety audit, inspection and assessment).

This paper presents an overview of road safety in Bangladesh in terms of its factors and striking characteristics including aspects of road infrastructure safety improvements. The paper in particular highlights the potential of introducing iRAP tool of road safety inspection and assessment for systematic analysis of road infrastructure deficiencies towards providing targeted countermeasures to improve road safety across the entire road network in Bangladesh.

INTRODUCTION

The essential goal of the safe system approach is to provide a road system in which road safety engineering and design principles are geared to recognize that humans make mistakes and are highly susceptible to serious injury in impact. Therefore, safety design and engineering have now emerged as the core function of contemporary road transport safety policies in leading developed countries. Efforts on road infrastructure safety are stimulating and gaining acceptance for sustained improvement of safety and speed management on the network (Turner et al. 2009; ETSC 2008).

The specific measures that are gaining increasing importance are road safety impact assessment, road safety audit, network management and safety inspections. Developing countries like Bangladesh however have been slower in devising and adopting such an approach and many roads still remain substandard. There is widespread disregard of explicit safety considerations in the road planning, design and rehabilitation program. Black spots are still being created where many of the accidents and casualties could have been prevented by implementing simple road engineering and environmental measures based on proper safety
checks or audits as well as road safety inspections encompassing systematic analysis of road infrastructure deficiencies.

This paper presents an overview of road safety in Bangladesh and argues that road factors are particularly significant in accidents and casualties. It then outlines some promising yet most urgent actions of road safety engineering improvements under the safe system approach. The paper in particular highlights the potential of introducing the iRAP tool of road safety inspection and assessment for systematic analysis of road infrastructure deficiencies towards providing targeted countermeasures to improve road safety across the entire road network in Bangladesh.

ROAD SAFETY OVERVIEW IN BANGLADESH

Characteristics of Accidents

Road traffic injuries are one of the major causes of mortality, morbidity and disability in Bangladesh. About one-fifth of injury related hospital admissions are due to road traffic accidents. Children are highly vulnerable in the traffic situation compared with many other countries of the world. Road traffic crashes are the leading cause of death for children aged between 10-14 years.

There were at least 3765 reported fatalities in Bangladesh in 2008 (BRTA, 2009a). It is estimated that the actual fatalities could well be 20,038 each year, which equates to a death rate of 12.7 deaths per 100,000 population (WHO, 2009). In economic terms, road accidents in Bangladesh cost the community in the order of US $ 1000 million, nearly 2% of GDP. The reported number of fatalities has been increasing from 1009 in 1982 to almost 3765 in 2008, nearly 4 times in 26 years period showing an increasing trend in recent years. In terms of vehicle ownership, the statistics revealed that Bangladesh has one of the highest fatality rates internationally in road accidents, over 100 deaths per 10,000 motor vehicles (Hoque and Mahmud, 2009a).

About 70% of road accident fatalities occurred in rural areas including rural sections of national highways. Almost 80% of fatalities are vulnerable road users e.g. pedestrians, bicyclists and motorcyclists. Pedestrian-vehicle conflicts are clearly the greatest problem with significant involvement of trucks and buses. It has been observed from the studies that up to 62% of urban road accident deaths are pedestrians alone and in Dhaka city, they represented nearly 70%. Some further more frequently occurring features of accidents are (Hoque and Mahmud, 2009a):

- Of the total reported accidents nearly 50% occurred on national and regional highways.
- The severity of accident outcomes on highways is often devastating with a result of involving many fatalities and injuries, up to 60 deaths and 150 injuries on the spot in a single accident at one location.
- Accidents and fatalities on national highways are characterized as clustering on selected sections, identified as Hazardous Road Locations (HRLs), nearly 40% of accidents concentrated on around 2% of the highway network, demonstrating that accidents are amenable to site specific treatments.
- Accident type analysis showed ‘hit pedestrian’ as the dominant accident type both in urban and rural areas, 45% involvement in fatal accidents. Other common accident types are: rear end collision (16.5%), head on collision (13.2%) and overturning (9.3%).
- Heavy vehicles such as trucks and buses including minibuses are major contributors to road accidents (bus/minibus 33%, trucks 27%) and in fatal accidents their shares are 35% and 29% respectively.
- About 2.5% of reported accidents occurred on bridges and culverts.
Trends and Factors in Accidents and Fatalities

As indicated earlier, the current national statistics reveal that road traffic accidents in Bangladesh have been on the rise in the recent years and are forecasted to aggravate further unless urgent action is taken (see Table 1). The trend for the annual number of fatalities (reported and estimated) for the last four decades are shown in Figure 1 (Ahsan, 2009).

Significant under reporting of deaths is of particular note which needs to be addressed for determining the actual societal and humanitarian impacts of road traffic accidents. For example, after comparing the number of deaths and serious injuries recorded by police with the results of a survey of 83,199 households, Aeron-Thomas et al (2004) concluded that actual number of deaths is four times the number officially reported by police (and the actual number of serious injuries 75 times greater).

In Bangladesh, motorized traffic is growing very rapidly, with around 400 new motorized vehicles are coming on to roads every day (see Figure 2). Over the next decade motorized traffic is expected to be double and this will exacerbate this challenging situation further unless the problem is duly and urgently addressed (Howard and Breen, 2008). It is noted that the growth of motorized two wheelers is significant, and this is emerging as a serious safety threat as well.

<table>
<thead>
<tr>
<th>Year</th>
<th>Accidents</th>
<th>Fatalities</th>
<th>Injuries</th>
<th>Casualties</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>3917</td>
<td>2968</td>
<td>2752</td>
<td>5720</td>
</tr>
<tr>
<td>2005</td>
<td>4949</td>
<td>3187</td>
<td>2754</td>
<td>5941</td>
</tr>
<tr>
<td>2006</td>
<td>3794</td>
<td>3193</td>
<td>2409</td>
<td>5602</td>
</tr>
<tr>
<td>2007</td>
<td>4869</td>
<td>3749</td>
<td>3273</td>
<td>7022</td>
</tr>
<tr>
<td>2008</td>
<td>4427</td>
<td>3765</td>
<td>3284</td>
<td>7049</td>
</tr>
</tbody>
</table>

Table 1: Road traffic accidents in Bangladesh in recent years (BRTA, 2009a)

Figure 1: Trends for annual road fatalities (reported and estimated) for the last four decades (Ahsan, 2009)
The principal contributing factors to accidents are adverse roadway and roadside environment, poor detailed design of junctions and road sections, excessive speeding, overloading, dangerous overtaking, reckless driving, carelessness of road users, failure to obey mandatory traffic regulations, variety of vehicle characteristics and defects in vehicles and conflicting use of roads. The road environmental factors are particularly prevalent (typical road safety hazards are shown in Figure 3).

Other issues of concern are: defective and road unworthy motor vehicles; driver incompetency; inadequacy in police inspection and law enforcement; poor road user behaviour and safety education; and institutional weakness.

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**Accident Hazards on Highways**

Detailed analysis and findings of accident investigation on national highways have been reported by Hoque and Mahmud (2009b). The distribution of total accidents according to road types is:

- national highways 38%
- regional roads 12%
- feeder roads 15%
- others (including city streets) 35%.
Of the accidents and fatalities of known locations, the share of national highways is much higher, 56% and 61% respectively. It is clear that addressing accidents on the national highways are of primary importance to improving the road safety situation in Bangladesh.

More detailed analysis of accident distribution revealed that accidents are highly clustered on relatively few sections of the national highways demonstrating that accidents are amenable to site specific treatments. This aspect has been examined in some greater detail to identify locations with high concentration of accidents and fatalities. The intensity of accidents (accidents per km) on national highway network was examined to identify the links of high concentration of accidents (Figure 4). It can be seen that the national highway links in the central part connecting northern regions are having high incidence of accidents. It is noted that these figures do not take account of under reporting of accidents discussed earlier.

![Figure 4: Accident density on major national highways in Bangladesh (accidents per km)](image)

More frequent accident types on the national highways were also identified with particular consideration of N2 and N3 highways which have been inspected under the current iRAP pilot study (see Table 2).

Of the total reported accidents, hit pedestrian emerges as the most common type of accident, amounting to 42% of total accidents and 40% of all fatalities. This is followed by head on (19%), rear end (9%) and overturning (13%), rear end (9%) and side swipe (6%) types of accidents. These five accident type groups accounted for 89% of all accidents and 90% of all fatalities. The greater incidence of head-on types collision on national highways as compared with its share in total accidents, highly justifies the necessity of separating opposing traffic stream. The head-on accidents are particularly prevalent on N2 and N3 highways.
Table 2: Reported accident types on national highways in Bangladesh (1998 to 2008)

<table>
<thead>
<tr>
<th>Collision Type</th>
<th>N2 Highway</th>
<th></th>
<th>N3 Highway</th>
<th></th>
<th>Remaining Highways</th>
<th></th>
<th>Total Accident</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>%</td>
<td>Number</td>
<td>%</td>
<td>Number</td>
<td>%</td>
<td>Number</td>
<td>%</td>
</tr>
<tr>
<td>Hit Ped’n</td>
<td>764</td>
<td>47</td>
<td>382</td>
<td>48</td>
<td>5919</td>
<td>42</td>
<td>7065</td>
<td>42</td>
</tr>
<tr>
<td>Head On</td>
<td>282</td>
<td>17</td>
<td>127</td>
<td>16</td>
<td>2701</td>
<td>19</td>
<td>3110</td>
<td>19</td>
</tr>
<tr>
<td>Over Turn</td>
<td>165</td>
<td>10</td>
<td>79</td>
<td>10</td>
<td>1896</td>
<td>13</td>
<td>2140</td>
<td>13</td>
</tr>
<tr>
<td>Rear End</td>
<td>162</td>
<td>10</td>
<td>108</td>
<td>14</td>
<td>1312</td>
<td>9</td>
<td>1582</td>
<td>9</td>
</tr>
<tr>
<td>Side Swipe</td>
<td>92</td>
<td>6</td>
<td>30</td>
<td>4</td>
<td>914</td>
<td>6</td>
<td>1036</td>
<td>6</td>
</tr>
<tr>
<td>Sub-total</td>
<td>1465</td>
<td>89</td>
<td>726</td>
<td>91</td>
<td>12742</td>
<td>89</td>
<td>14933</td>
<td>89</td>
</tr>
<tr>
<td>Others</td>
<td>176</td>
<td>11</td>
<td>71</td>
<td>9</td>
<td>1518</td>
<td>11</td>
<td>1765</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>1641</td>
<td>100</td>
<td>797</td>
<td>100</td>
<td>14260</td>
<td>100</td>
<td>16698</td>
<td>100</td>
</tr>
</tbody>
</table>

The incidence of aggressive speeding was also evident on national highways. An examination of the distribution of accidents on a national highway corridor (Dhaka-Aricha Highway section) was made according to specified speed zones. It showed that higher incidence of accidents occurred on the designated highway segments of high-speed limit zones (see Figure 5).

![Figure 5. Distribution of fatal accidents on the Dhaka-Aricha Highway with varying speed limits](source: Newaz et al, 2006)

IMPROVING HIGHWAY SAFETY IN BANGLADESH

Priorities

Based on the understanding of the local problem characteristics some emerging road safety priorities and issues which should be addressed with due urgency were identified. These priority issues are (see for example, Hoque and Mahmud 2009a):

- Reducing and control of vehicular speeds.
• Promote pedestrian and non-motorists safety as a priority issue.
• Treatment of known Hazardous Road Locations (Blackspots and Blacksites).
• Introduction of the road safety audit process.
• Addressing the issue of over involvement of buses, minibuses and trucks.
• Catering non-motorized and slow moving vehicles on roadways and streets.
• Setting up and running road safety demonstration/plot projects.
• Prevention and reduction of dominant accident types and their severities.
• Strengthen data collection system and conduct of research.
• Intensified and effective traffic law enforcement and safety conscious behaviour of road users.
• Ensure vehicle standards and fitness requirements for roadworthiness.

Safety Challenges

Successfully dealing with these priority areas is most likely to have the greatest potential to reduce road trauma and is likely to bring about substantial improvements in safety in Bangladesh. They are indeed major traffic safety challenges in Bangladesh where there is very little safety expertise available to deal with road safety issues holistically. There are encouraging signs and has been some progress with road safety organizations, establishment of accident research institute and preparation of strategic road safety action plan. However, with the current state of efforts and initiatives, it appears most unlikely to bring about any noticeable safety improvements. Road traffic accidents and fatalities cannot be expected to decrease rapidly and substantially unless focused and continuous efforts with a scientific basis are put in place with a sense of urgency. In particular there is an urgent need to accelerate implementation of problem specific countermeasures, policies and conduct of good practice based on efforts of enhanced understanding, scientific analysis, monitoring and research. One fundamental step to be taken by the government is to create an organization dedicated to initiating and coordinating road safety activities as well as by activating lead agencies with a mandate of implementing very specific and explicit actions and strategies. In particular efforts should be strengthen on the following aspects:

• making road safety a policy priority, setting up of goals and objectives
• designating a single central agency with the authority to address road safety
• activating lead agencies in relevant sectors with appropriate authority, co-ordination and resource availability and to monitor and evaluate improvements.

There is an urgent and obvious need for developing priority safety programs giving special attention to hazards on roads, highways and streets with high-accident experience. It is now abundantly clear and should be noted that engineering, road safety engineering in particular, can and should play a leading role in road safety. The underlying contention is that safety engineering practice, particularly low cost engineering improvements, can indeed contribute the lion's share to the reduction of accidents and casualties on the roadway system (Snyder, 1972; Anderson, 1976; Lay, 1988; Ogden, 1996; and iRAP, 2008). In leading developed countries where great progress has already been made on driver behaviour and vehicle safety, national safety strategies show investment in safer infrastructure is expected to deliver twice the casually saving provided by investment in either behaviour or vehicles (iRAP, 2008). This observation is especially cogent to the situation in Bangladesh where there is specific need and much scope
for road environmental improvements aimed at correcting the most common deficiencies through wider application of traffic engineering approaches emphasizing on low cost engineering based improvement schemes.

Indeed, many of the observed characteristics of accidents and fatalities are indicative of problems and deficiencies associated with road infrastructure and environment. It is therefore time for countries like Bangladesh to quickly tighten this area of road safety engineering practice through sustained understanding, innovation and commitment with due regard to the learning of the complex phenomena of accidents involving road, human, vehicle, psychological and technological factors and with particular consideration of the prevailing conditions, social acceptability and requirements of the vulnerable road users. Understanding and implementation of the recently developed safe system principles are particularly important for addressing road safety more holistically.

It should however be understood that road safety involves shared and co-operative responsibilities of broader alliance of many sectors, professions and disciplines (engineering, technology, education, law, enforcement, psychology, community and health and emergency care and others). Engineering is one and perhaps the leading one to address such enormous road safety challenges. In fact it is the moral responsibility of road engineering professionals to protect the safety of the road users (Anderson 1976). This responsibility and obligation needs to be understood and deliver by road engineers putting safety into its proper perspectives which would require significant specialized training and awareness programs in Bangladesh. The following section of the paper aims to discuss the role and the promising areas of road infrastructure safety improvements for reduction and prevention of accidents and fatalities.

The Safe System Approach and Road Infrastructure Safety Improvements

Road traffic accidents result from failures in the interaction of humans, vehicles and the road environment- the elements that produce the road traffic system. The combination of these various elements to produce road accidents means that road safety itself has to be tackled in a multi-functional manner in order to break the chains of events that lead to accidents and the eventual injuries of road users. An integrated, multi-disciplinary approach is required to reduce road accidents and consequent injuries and economic losses.

Clearly, road deaths and injuries are the result of a complex interaction between the way people behave on the roads, the types of vehicles in use and the speed they are travelling, and the design of the roads themselves. Despite this complexity, the process of creating a road system that is genuinely safe is now well understood. Experience in implementing the well-established ‘safe system’ approach, which recognises the mutual importance of safe road users, safe vehicles and safe roads, shows how death and serious injury can be prevented on a large scale. The following principles broadly underline the safe system approach.

- mistakes, errors of judgment and poor driving decisions are intrinsic to humans. The road safety system needs to be designed and operated to account for this
- humans are fragile, physically vulnerable, and have limited tolerance for surviving crashes (see for example, OECD, 2008)
- unprotected, we cannot survive impacts that occur at even moderate speeds
- people who behave with criminal disregard for the safety of themselves and others should expect tough policing and tough penalties
- safety can be built into the road system in a comprehensive and systematic fashion, not just having the apparent problem areas patched up
the 'engineered' elements of the system - vehicles and roads - can be designed to be compatible with the human element, perhaps taking lessons from motor racing that while crashes will occur, the total system is designed to minimise harm.

Importantly, the road component remains a major consideration in the overall road safety management strategies. Indeed, as Fisher and Camou (1977) remarked, the road component is a most important determinant of traffic accident frequency.

Promising Actions of Road Infrastructure Safety Improvement

In Bangladesh, extensive studies of police reported accident data as well as on-scene in-depth investigation of selected major fatal accidents have been conducted for improve understanding of the problem characteristics and identifying effective safety improvement options with particular regard to engineering road infrastructure improvements. As discussed in the preceding sections and under the prevailing conditions, the authors consider that the following promising actions of road infrastructure safety are of prime importance for road safety improvements in Bangladesh. The treatments and approaches would help road infrastructure required to deliver safe system outcomes.

Accident black spot treatments

Spot safety programs - those that seek to identify, prioritize and treat accident locations that are statistically aberrant have been very successful (Polanis 1995). There is specific need and scope for road environmental improvements aimed at correcting the most common deficiencies in hazardous road locations and accident blackspot in Bangladesh. Accident black spot treatments have demonstrated high economic benefits and therefore demand priority consideration in Bangladesh. Desirably, emphasis should be placed initially on introducing low cost improvement schemes which proved to be highly effective. Typical safety measures are incorporation and treatments of road shoulders, pedestrian facilities (segreded footways, crossings), junction improvements, treatment of hazards, speed control devices, median barriers, access control, channelisation, traffic islands, skid resistance treatment, improved delineation devices, safety zones etc. including provision of divided roads.

Observational and on-scene in-depth studies of selected hazardous locations clearly demonstrate the urgency of strengthening accident remedial works through systematic and widespread application of low-cost road and traffic engineering measures with due regard to the related issues of accident migration effects.

Road safety audits

Alongside accident reduction work, accident and injury prevention work must also be pursued through road safety audit as an important process in road safety engineering. An effective road safety audit process has great potential for improving road safety. Road safety audit being a systematic examination of roadway elements for safety would focus on explicit safety implications and recommend desirable changes or modifications in highway design and operational aspects appropriate to the local safety needs. Road safety auditing or checking is a very essential and systematic step that needs to be introduced to document such widespread safety deficiencies for appropriate corrections. Proactive identification and treatment of accident black spots through road safety audit is considered to be highly beneficial to Bangladesh context. Regular audit of existing roads allow road safety hazards to be identified before they results in accidents.

Road inspections and assessment

This approach has now emerged as a new tool for systematic analysis of road infrastructure deficiencies and provides targeted countermeasures programs to improve road safety across an entire road network. The iRAP tools particularly address the safety of vulnerable road users and asses each stretch of roads for its safety for pedestrians, bicyclists, motor cyclists and car occupants separately. The iRAP methodology offers 'vaccines for roads' and therefore demands
priority consideration for application in Bangladesh with support from the international road safety community. It is important to note and learn that effective safety management of existing road network require infrastructure improvements at targeted locations throughout the road network apart from focusing on just a few black spots that might have high short term accident experience (iRAP 2008). The ongoing efforts of the International Road Assessment Programme (iRAP) for low and middle income countries could well be extended to Bangladesh and is seen particularly beneficial to develop local road safety capability. The iRAP targets high-risk roads where large numbers are killed and seriously injured and inspects them to identify where affordable programs of safety engineering can reduce large number of deaths and serious injuries on the basis of strong partnership for key local stakeholders. The details of the applicability of iRAP in Bangladesh are discussed in the following section.

Some related aspects

Importantly, the long term solution to road accident problems particularly in rural areas is to provide a higher quality road system with increased length of divided highways, which have a better safety record than undivided highways. The safety of the vulnerable road users must also be sufficiently catered for in the road safety strategies and principles. Potential approach to protect these users is by giving special consideration in designing vehicles and roads to ensure that they are not unnecessarily exposed to high speed traffic.

It should be noted that road traffic safety professionals can only prevent accidents if they understand what causes them. Traditionally, this understanding is achieved through systematic accident investigation and scientific research on road traffic accidents. Importantly, therefore, the pursuit of the above road infrastructure safety improvements however would require clear understanding of the known relationships between accidents experience and various roadway and traffic engineering design features. As such it is of paramount importance to creating a competent cadre of professionals specifically trained in road safety issues and developments of new perspectives on road safety management (safe system approach), supported by developing programs for training and research (Tiwari et al. 2005; Breen, 2008)

In passing it should be noted that an emerging aspect of identification of potential countermeasures and treatment options is that the essential goal should be a reduction in total harm of accidents based on exposure, risk and consequences (Mohan et al. 2009)

It is important that engineering road infrastructure safety practice takes note of this approach as well. It is also important that road engineers understand and must be aware of the part that human factors play and realized that traffic engineering applications and countermeasures work through their influence of human behaviour (Ogden, 1996; Sabey, 1995)

THE POTENTIAL AND APPLICABILITY OF IRAP IN BANGLADESH

Introduction to iRAP and its Applications in Asian Countries

The International Road Assessment Programme (iRAP) is a not-for-profit organisation dedicated to saving lives through safer roads. The role of iRAP is to focus specifically on the ‘safe roads’ element of the safety equation, in the context of safer road users, safer vehicles and safe roads. iRAP builds on the experience of developed countries that have a proven track record in infrastructure safety and, with the support of local engineers and researchers, applies knowledge and technical processes that are applicable for low and middle-income countries.

iRAP works in partnership with government and non-government organisations to:

- inspect high-risk roads and develop Star Ratings and Safer Roads Investment Plans
- provide training, technology and support that will build and sustain national, regional and local capability
track road safety performance so that funding agencies can assess the benefits of their investments.

In 2006, iRAP won the generous support of the FIA Foundation for an ambitious investment programme to develop tools to help low and middle income countries find the high social and economic returns possible through the provision of safer roads. The major Road Assessment Programmes in developed countries (AusRAP, EuroRAP and usRAP) worked in partnership with global road safety research organisations and local experts to develop and test these tools.

iRAP was invited to work in four pilot countries: South Africa, Malaysia, Chile and Costa Rica. These countries offered exposure to a variety of road safety scenarios from a high proportion of motorcyclists in Malaysia to single carriageway roads with high speed limits in South Africa. The iRAP Safer Roads Investment Plans for those countries identified opportunities to prevent 73,000 road crash deaths and injuries and save US$7 billion over 20 years.

Following the success of the pilot inspection programmes, iRAP secured support from the FIA Foundation, World Bank Global Road Safety Facility and the Inter American Development Bank to develop programmes worldwide. To date, RAPs are active in some 60 countries.

In Asia, iRAP is active in: Australia; Bangladesh; China; India; Malaysia; New Zealand; Philippines; South Korea; Thailand; and Vietnam. Programmes are also in development in numerous other countries. The results of the recent iRAP Vietnam project are typical of projects that have been completed to date. In that project, an iRAP Safer Road Investment Plan showed that an investment of US$1.95 million would result in the prevention of 78,000 deaths and serious injuries. For each $1 invested in the plan, $6 in crash costs would be saved. The results of the iRAP Vietnam project are now being incorporated into the national road safety strategy and development bank road projects (see for example, Smith et al, 2010).

The Potential of iRAP in Bangladesh

In March 2010, with the financial support of the FIA Foundation, the iRAP Bangladesh Pilot Project began. The aims of the project are to:

- support the Government of Bangladesh and the Roads and Highways Division (RHD) in their efforts to make roads safe during the Decade of Action for Road Safety (2011-2020)
- support the Bangladesh Road Safety Coalition Project, which is led by Bangladesh Rural Advancement Committee (BRAC), the Centre for Injury Prevention Research Bangladesh (CIPRB), Chevron and the Accident Research Institute at the Bangladesh University of Engineering and Technology (ARI)
- provide a practical demonstration of the iRAP approach to safety.

This paper provides an overview of the parts of the project that had been completed at the time of writing. It is expected that full results from the project will be available for presentation at the 2010 ARRB Conference.

iRAP Field Demonstration

The pilot project focuses on two key roads:

- the Dhaka to Sylhet Highway (N2), which is approximately 94km in length
- the Joydebpur to Mymensingh Highway (N3), which is approximately 274km in length.

Inspections of the road were carried out by Indian Road Survey Management (IRSM), who are now developing their skills in iRAP surveys and who also benefited by the technical and administrative support from ARRB Group. The inspection used ARRB Hawkeye 2000 survey
equipment, and involved recording panoramic, calibrated digital images of the roads at 10 metre intervals. Each image is also linked to geometry data and geo-reference data (such as GPS coordinates).

Numerous participants from key stakeholder organisations took part in the inspections, to both provide expert local guidance on the roads and learn about the iRAP inspection process.

The on-road inspections enabled many observations about the safety situation on the roads to be made. Perhaps the most prominent feature is the sheer volume of people using the road. School children, factory workers, farmers and people visiting markets all vie for limited road space with high-speed trucks, buses and cars, as shown below in Figure 6.

![Figure 6: A screenshot from the inspection data, showing a typical section of the Dhaka to Sylhet Highway (N2)](image)

The roads are largely single-lane undivided, have at-grade intersections and very little formal provision for the vast mix of motorized vehicles, pedestrians and bicyclists. Combined with relatively high travel speeds of many vehicles – especially buses - the result is what appears to be a high risk environment for all road users. This is confirmed by recent media reports that show deaths on the road are common. In fact, during the two-day inspection of the N2 highway, the team passed the scene of a recent serious head-on collision between two trucks, which was a vivid reminder of the level of risk on the road (see Figure 7).
Risk Assessment and Star Ratings

Using the digital images and data collected during inspections, desktop rating of 50 road attributes at 100 metre intervals is currently underway. The elements that are to be rated include provision for vulnerable road users (such as footpaths), lane widths, roadside conditions and intersection layouts.

This will then enable the generation of iRAP Star Ratings and Safer Roads Investment Plans (iRAP, 2009a and iRAP, 2009b). iRAP Star Ratings are based on the and the degree to the rated road attributes impact the likelihood of crashes occurring and the severity of the crashes that do occur. The focus is on the features which influence the most common and severe types of crash on roads for motor vehicles, motorcyclists, pedestrians and bicyclists. They provide a simple and objective measure of the relative level of risk associated with road infrastructure for an individual road user. 5-star (green) roads are the safest while 1-star (black) roads are the least safe. Star Ratings are not assigned to roads where there is very low use by that type of road user.

iRAP then considers more than 70 proven road improvement options to generate affordable and economically sound Safer Road Investment Plans that will save lives. Road improvement options range from low-cost road markings and pedestrian refuges to higher-cost intersection upgrades and full highway duplication. Safer Roads Investment Plans are developed in three key steps:

1. Drawing on the Star Ratings and traffic volume data, estimated numbers of deaths and serious injuries are distributed throughout the road network.

2. For each 100 metre section of road, countermeasure options are tested for their potential to reduce deaths and injuries. For example, a section of road that has a poor pedestrian Star Rating and high pedestrian activity might be a candidate for a pedestrian refuge, pedestrian crossing or signalised pedestrian crossing.

3. Each countermeasure option is assessed against affordability and economic effectiveness criteria. The economic benefit of a countermeasure (measured in terms of the economic benefit of the deaths and serious injuries prevented) must, at a minimum, exceed the cost of its construction and maintenance (that is, it must have a benefit cost ratio (BCR) greater than one). In many circumstances, the ‘threshold’ BCR for a plan is lifted above one, which has the effect of reducing the overall cost of the plan. This
ensures that a plan that is affordable for a country and represents a positive investment return and responsible use of public money can be generated.

It is expected that results for Star Ratings and Safer Roads Investment Plans will be available at time of presenting at the 2010 ARRB Conference.

The Future: iRAP Establishment in Bangladesh

In many ways, Bangladesh embodies the spirit of the United Nations Decade of Action for Road Safety. It is a nation where substantial road safety challenges exist, but where there is strong support for safety. The Bangladesh Government has been a keen supporter of calls for the declaration of a Decade of Action on Road Safety and is putting in place strategies to save lives. During a meeting to discuss the iRAP project, the Honorable Minister for Communications encouraged his departmental officials to ensure that plans for new upgrades are safe. The Roads and Highways Division has been quick to act on this direction.

There is also a very strong will outside of government, in the form of the Chevron, BRAC, Centre for Injury Prevention and Research Bangladesh (CIPRB) and Accident Research Institute (ARI) at the Bangladesh University of Engineering and Technology (BUET).

This provides a strong basis for iRAP activities in Bangladesh for the future. The results generated by the Pilot Project will guide improvements to the N2 and N3 Highways that will potentially prevent thousands of deaths and serious injuries. However, iRAP also provides a strong basis to support the development, implementation and monitoring of road safety strategy in Bangladesh throughout the Decade of Action.

CONCLUSIONS

This paper has presented a brief overview of road safety in Bangladesh in terms of its factors, characteristics and priority safety improvement options. Road infrastructure and environmental deficiencies are particularly prevalent in accidents and casualties and engineering safety on the road has clearly emerged as a priority issue in Bangladesh. Aspects of road infrastructure safety improvement in the context of safe system approach are therefore outlined in this paper. In particular, the paper discusses blackspot treatments, road safety audits and road inspection and assessment. At the time of writing this paper, an iRAP pilot project was underway on the bust N2 and N3 highways in Bangladesh, each of which experience high levels of road trauma. It is expected that the iRAP pilot will not only produce Star Ratings for these roads, but also plans for large-scale, affordable road safety improvements.

As the Decade of Action for Road Safety (2011-2020) draws near, it becomes increasingly important for countries such as Bangladesh to set in place comprehensive plans for road safety. Bangladesh is a nation where substantial road safety challenges exist, but where the will to act in the interest of those using the roads is strong.
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