BEST PRACTICES FOR ROAD SAFETY IN JORDAN:  
A SYSTEMATIC APPROACH

K. Jadaan¹, E. Braisat², and S. Zeater²

¹ Professor, Civil Engineering Department, University of Jordan
² Researcher, Civil Engineering Department, University of Jordan

ABSTRACT

Jordan suffers from a serious road safety problem that must get more attention from the decision makers. The magnitude of the problem requires the researchers and decision makers to provide approaches to reduce the overall number and severity of accidents. However, the implementation of road safety measures bears a lot on the various stakeholders with multitude of interests leading to the development of what is termed “Best Practice” strategy for road safety.

This paper explains the concept of best practice, presents a number of road safety measures and assesses them in order to identify the most promising sets of investments under Jordanian roadway and traffic conditions. The assessment process was facilitated through using some developed selection and ranking measures.

The final output of this study provides all parties involved in traffic safety with a best practice guide and a comprehensive road safety strategy to assist them in their initial strategic choice of cost-effective investments that aim to improve road safety.

1. Introduction

Road Traffic Accidents (RTA) cause serious threat to human life worldwide. According to the World Health Organization (WHO), about 1.3 million people die globally each year in motor vehicle accidents and more than 50 millions are injured. Furthermore, if no action is taken to address the road traffic carnage, it is estimated that 1.9 million people and 2.4 million people will die through road traffic crashes by 2020 and 2030 respectively.
The majority of traffic accidents occur in the low and middle-income developing countries. The level of traffic safety in Jordan falls well behind many countries. The speed of economic development and population growth are expected to produce further increase in traffic volume and consequently an increase in traffic accidents. During the last 20 year, traffic accidents in Jordan have increased from 17838 accidents in 1990 to 112817 accidents in 2012. The economic cost to our country of more than 700 fatalities per year combined with the high number of injury crashes is at least JD 330 million per year and does not even include the extreme levels of human suffering by those affected by this carnage.

The magnitude of the problem, its rates of growth and the associated economical and social impacts are alarming, this calls the need for a comprehensive strategy to improve the road safety in Jordan. Recent work (1) paved the roar towards the development of more comprehensive strategy for Jordan which this paper is aiming at. However, researchers (2) indicate that the implementation of road safety measures bears a lot on the various stakeholders with multitude of interests leading to the development of what is termed “Best Practice” strategy for road safety, the focus of the work presented in this paper.

2. Road Safety Management

Road traffic can be considered as a system that consists of three basic components that interact with each other, namely, the road user, the vehicle and the road environment. A crash occurs when one or a combination of these components fails. Road safety practitioners are unanimous in recognizing the importance of understanding the interaction between these components in developing countermeasures for improving safety.

The Haddon matrix is a two dimensional matrix that maps the vehicle, road environment and road user to a timeline before during and after a crash occurred, each of the nine available cells in the matrix may contain a strategy particularly focused on achieving an improvement of road safety. The Haddon Matrix is therefore an invaluable tool in assessing the extent to which road safety strategies succeed in providing an all-encompassing approach towards improving road safety.

Five pillars were identified as the focus of action to improve road safety. These pillars are:

1. Road safety management;
2. Safer Infrastructure;
3. Safer vehicles;
4. Safer road user behaviour and
5. Improved post-crash care.

A safe road environment should satisfy the following requirements (2)

The road should

1. Warn road users of any possible hazards;
2. Inform road users of the type of unexpected conditions that are likely to be encountered;
3. Guide road users through sections of a route with sometimes unexpected conditions;
4. Control road users through conflict points or areas of conflict;
5. Forgive errant vehicles and behaviour of road users involved.

3. Definition of "Best Practice" and “Best Practice Guidelines”

There is no commonly agreed definition of “Best Practice” but it obviously refers to a road safety policy that has proven to be successful meaning brings about a sustainable reduction in the number of road accidents and in particular the number of resulting casualities(1).

The term “Best Practice Guidelines” for road safety engineering refers to guidelines intended to help highway agencies implement effective safety management of the road system for which they are responsible(6). The literature(2,4) covered aspects of this complex topic dealing with low cost road and traffic engineering measures and with road safety audits and safety impact assessment. This work is mainly based on the previous research in the area, but adds some new material.

4. Selection Criteria For Best Practice Measures

The best practice candidates are identified and described based on the following criteria(1):

1. Focus of the measure: a clear definition of the road safety problem to be solved and precise idea of how the measure will affect this problem.
2. Magnitude of the road safety problem
3. Expected effects on safety which addresses the process of implementation.
4. Evaluation of effects on road safety based on accident statistics
5. Costs and benefits analysis
6. Acceptance by public and policy makers
7. Sustainability over time
8. Transferability: using the measure successfully on a larger scale (regional/national level).

5. Best Practice Example

This section presents a best practice example based on the Qatar National Road Safety Strategy 2013-2022 – “safe road users, safe vehicle, safe roads, safe speeds” (3)

Between 2000 and 2006, Qatar experienced a steadily increasing number of road crash fatalities as its population rapidly expanded. With the introduction of an initial series of road traffic reforms in 2007, the number of fatalities and serious injuries declined. However, even with this reduction, road fatality rates in Qatar remain excessive when compared to other HICs. For example, in 2010 there were 13 deaths per 100,000 population in Qatar, compared with around 3 per 100,000 population in countries like the Netherlands, the UK and Sweden.

In response to this burden of RTIs, the Qatar National Road Safety Strategy has been developed. This ten-year strategy (2013-2022) sets out to reduce road crash fatalities from about 13 to 6 per 100,000 people, and serious injuries from 33 to 15 per 100,000 people. This will be accomplished by pursuing a variety of tactics, including increased police enforcement measures, mass media campaigns, concentrating on “high-risk drivers and riders” such as males aged 18-30, improved street and infrastructure design, police-backed data-collection efforts, and enhanced vehicle safety standards.

This multi-pronged strategy conforms to the five pillars designated by the Global
Road Safety “Decade of Action”, and illustrates the need for national road safety strategies to be comprehensive and ambitious in design. Qatar’s experience will provide valuable lessons for the global community in the field of road safety

6. Road Safety Best Practice Guidelines

The essential elements of a systematic approach to road safety engineering are outlined in the following steps(6):

**Step 1:** Define suitable elements of the road system such as road sections of a given length, junctions, horizontal curves, bridges, and tunnels.

**Step 2:** Analyse distribution of accidents for each type of element with respect to the mean number of accidents and the variance.

**Step 3:** Identify the safety performance function in each set of elements

A safety performance function is an equation that describes the sources of systematic variation in accidents, fitted by means of appropriate multivariate analysis.

**Step 4:** Estimate safety for each element using the empirical Bayes method which combines information from two clues to safety, and can be used to estimate the expected number of accidents for each element.

**Step 5:** Define the abnormally high accident locations and identify them statistically

As a first step it is necessary to define the elements of the road system that are suitable for safety analysis. These elements may include road sections of various types of roads, junctions, curves, bridges or tunnels. It is important that the elements of the road system are identically defined and can be counted.

Once a typology of elements of the road system has been developed, the distribution of accidents has to be analysed for a suitable period of time for each set of elements.

The objective of studying the distribution of accidents is to determine if it contains systematic
variation in the number of accidents. If present, the next task is to identify sources of that variation. This is best done by fitting a so-called safety performance function (SPF), which is a multivariate equation describing the effects of sources of systematic variation in the number of accidents.

A SPF will typically not include the effects of all sources of systematic variation in the number of accidents. The effects of these factors can be modeled by means of the empirical Bayes method. Any difference between the normal number of accidents expected and its recorded number of accidents is decomposed into the contribution of two factors: (A) pure randomness, and (B) effects of factors not included in the safety performance function. The effects of pure randomness, often referred to as regression-to-the-mean, are eliminated producing an estimate of safety that captures the joint contribution of factors included in the safety performance function and factors not included in that function.

The logical next step is to define the locations that have a high expected number of accidents, in particular locations where there is reason to believe that a high expected number of accidents is attributable to factors whose effects are not included in the SPF. It is essential to define high accidents locations in terms of the expected number of accidents, not the recorded number of accidents. By doing so, the problems of regression-to-the-mean are eliminated.

At many high accident road locations, low cost measures will solve the problem, though a few may need more expensive solutions. The term low cost measure refers to any measure that can be carried out within the existing roadway area; that is without having to acquire new land or draft new land use plans. Moreover, low cost measures would typically not cost more than – at most – a few hundred thousand Euro.

7. Identifying Best Practices For Jordan

A) Methodology

The aim of this study is to develop best practice for road safety in Jordan by considering different topics, various approaches and a huge variety of implementation scenarios for being included in one comprehensive strategy. The process to develop the best practice is by reviewing different strategies and approaches that were developed in a various countries.

The first phase of the study involved selection of a number of best practice measures that are considered relevant to improve future traffic safety in Jordan. As a starting point, a set of instruments was prepared (5):

- A list of road safety measures in order to select the best practice measures;
A decision upon the selection criteria for the best practices which was the acceptance of drivers population to these practices.

a questionnaire for data collection in order to provide an insight into these issues with the aim of evaluating how effective road users thought the best practice measures would be in reducing the number of accidents (effectiveness index on a 0-5 scale), and also how much they would be in favor of the measure if actually being introduced (favourability index on a 0-5 scale).

For the purpose of this study, given the range of road safety fields to cover, the set of categories chosen included

- Education and campaigns
- Driver training, testing and licensing
- Vehicles
- Infrastructure
- Enforcement
- Institutional organization of road safety

In order to be labelled as Best Practice, a measure should comply with most of the selection criteria. In particular its effectiveness in terms of expected reduction of road crashes, deaths and serious injuries should have been demonstrated in previous scientific work.

The questionnaire was distributed to collect information on what representative sample of road users with different income and educational level thought about a variety of possible best practice measures.

In total, 39 Best Practice nominations were chosen, taking the above six selection criteria into account. The measures were considered to reduce road traffic accidents and were devised to gauge how well the public might accept and favor them as countermeasures (CMs), and how effective these measures were as perceived by road users.

**B) Results**

The questionnaire was analyzed and the effectiveness and favorability indices were computed. Table 1 and 2 list the measures with the highest and lowest effectiveness and favorability indices.

**TABLE I. Highest and lowest measures on “effectiveness index”**

<table>
<thead>
<tr>
<th>Remedial measure</th>
<th>Effectiveness Index</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest</td>
<td></td>
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</table>
Control intensification on over speed violations in rural roads & 4.00 & 1 \\
Increasing of stoppers in residential areas & 3.99 & 2 \\
Decreasing the maximum speed limits over urban roads & 3.93 & 3 \\
Increasing control of speed limit in urban areas & 3.91 & 4 \\
Increase pavement thickness in residential areas & 3.90 & 5 \\

**Lowest:** 
Increasing max. speed limits along highways & 3.07 & 1 \\
Retesting drivers every five years & 3.38 & 2 \\
More concentration of the driving test on written part & 3.41 & 3 \\
Retesting drivers who are over 65 year every five years & 3.44 & 4 \\
Improving lights on streets in the night & 3.44 & 5 \\

**TABLE II.** Highest and lowest measures on “favorability index”

<table>
<thead>
<tr>
<th>Remedial measure</th>
<th>Favorability Index</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increasing control of speed limit in urban areas</td>
<td>4.21</td>
<td>1</td>
</tr>
<tr>
<td>Improving lights on streets in the night</td>
<td>4.21</td>
<td>2</td>
</tr>
<tr>
<td>Control intensification on over speed violations in rural roads</td>
<td>4.17</td>
<td>3</td>
</tr>
</tbody>
</table>
Considering both the effectiveness and favorability indices, five best practice measures were identified as being the most appropriate for implementation. These are:

1. Control intensification on over speed violations in rural roads.
2. Using automatic jail penalty against drunk drivers causing accidents
3. Decreasing the maximum speed limits over urban roads
4. Impose the use of reflecting triangle
5. Improving lights on streets in the night

8. Road Safety Strategy For Jordan

Core to the Road Safety Strategy is a framework of best practices. The framework consists of a multi-cell matrix of key target groups and contributing factors, along with a variety of road safety initiatives that jurisdictions may adopt to address their specific priorities(5).
Jurisdictions will have the flexibility to adopt specific strategies depending on their suitability, feasibility (i.e.: resources) and acceptability (i.e.: operating environment). The framework of best practices is intended to be fluid, meaning that new target groups, contributing factors and suggested initiatives and strategies can be added to the Road Safety Strategy over time. Details of the strategy, outlined earlier, are as follows:

**A. The Vision**

A clear vision is to have the “safest roads in the world” so that no person should be killed or seriously injured on Jordan's roads. In order to achieve this ultimate vision the Jordanian Government must set reduction factors that suit Jordan, support this vision and focus its road safety efforts on contributing towards achieving this vision.

To place the vision of having the safest roads in context, the vision would result in Jordan achieving a rate of 6.4 fatalities per 100,000 population. In 2012, there were 816 fatalities, which translate to a comparable fatality rate of 12.8 per 100,000 populations. For Jordan to achieve a target of 408 fatalities or less per 100,000 populations would have required a further reduction of 408 fatalities in 2012.

**B. Key Guiding Principles**

The development of the Strategy is based on four key guiding principles, including:

1. downward trends in fatalities and serious injuries over the years,
2. safer systems concepts,
3. a five-year timeframe,
4. a framework of best practices.

**1. Downward Trends**

The successes in achieving a directional downward trends in the rate-based number of fatalities and serious injuries will be the principle against which the strategy will be measured at the national level on a yearly basis, rather than the actual fatalities and serious injuries.

Two rate-based indicators are commonly used internationally: fatalities (or serious injuries) per million populations; and fatalities (or serious injuries) per billion kilometers travelled. However, in view of the fact that no data are available on the second measure, then only the first measure (fatalities/million population) will be used.

**2. Safer Systems Concept**

This “safer systems concept” is an effective mean to bring all stakeholders together by recognizing the interdependencies that exist between these elements. It incorporates “safer systems concepts” rather than a “safe systems approach”, which traditionally involves very significant long-term investments.
3. **Five-Year Timeframe**
The term for the Road Safety Strategy is five years rather than ten years and could be renewed or extended. A shorter timeframe will help build and maintain momentum for jurisdictional initiatives throughout the life of the Road Safety Strategy.

Jurisdictions will continue to report fatalities and serious injuries to Traffic Department on an annual basis and these data will be used to produce a report on national progress in reducing fatalities and serious injuries using rate-based indicators.

4. **The Framework of Best Practices**
A Framework of best practices is core to the Road Safety Strategy. The framework consists of a multi-cell matrix of key target groups and contributing factors, along with a variety of road safety initiatives that jurisdictions may adopt to address their specific priorities.

The framework is intended to enable new target groups, contributing factors and suggested initiatives and strategies to be added to the Strategy over time as need arises.

C. **Key Target Groups**
The key groups of driver being targeted are defined as follows:

- **Young drivers**: Drivers under the age of 21 years.
- **Vulnerable road users**: Pedestrians, motorcyclists and cyclists and persons in personal mobilized devices such as scooters.
- **Commercial carriers**: A person or entity who is responsible for the operation of a commercial vehicle.
- **High-risk drivers**: Repeat offenders with patterned illegal driving behaviors such as recurring incidences of traffic violations. The medically-at-risk-drivers may also be targeted within this category. Those are the drivers whose existing medical condition (e.g.: epilepsy, ischemic heart disease etc.) may affect their safe vehicle operation, the safety of their occupants and the safety of other road users. This includes aging-related driver performance considered beyond normal driving.
- **General population**: Road users who benefit from making roads, vehicles and road users safer through introducing the interventions.

D. **Key Target Contributing Factors**
The key causes of collisions being targeted are defined as follows:

- **Aggressive Driving**: Includes driving too fast for road conditions, driving at speeds beyond posted legal limits on all road types, and driver behaviors that put other road users at risk of crashes and injuries.
• Impaired Driving: Includes all forms of impairment, such as impairment resulting from fatigue, distracted behaviors or the ingestion of a substance such as alcohol.

• Occupant Protection: Includes issues pertaining to proper restraint use among all road users, vehicle technology enhancements (crashworthiness and crash avoidance) and safer roads (e.g.: dangerous roadside obstacles, lighting, etc.).

• Environmental Factors: Includes all factors that may increase the risk of crash occurrence such as roadway construction, road surface condition, and weather conditions.

For each target group and contributing factor there may be more than one intervention or strategy. A range of strategies is recommended to address road safety issues which may include education and training, communication and awareness, enforcement, Information/data/research, Policy, legislation and regulation, technologies aimed at helping drivers to avoid collisions, road infrastructure improvements and establishment of linkages between jurisdictional, national or international governmental and non-governmental organizations with a vested interest in road safety.

9. Conclusions

This research on best practices related to road safety illustrated the concept of best practice worldwide, which is essential as it may assist to better understand the way that road safety improvements have been achieved.

A number of road safety measures were presented and assessed in order to identify the most promising sets of investments under Jordanian roadway and traffic conditions. The assessment process was facilitated through using some developed selection and ranking measures .A predesigned questionnaire was used for data collection in order to provide an insight into various road safety issues with the aim of evaluating how effective road users thought the best practice measures would be in reducing the number of accidents (effectiveness index on a 0-5 scale), and also how much they would be in favor of the measure if actually being introduced (favourability index on a 0-5 scale).

Considering both the effectiveness and favorability indices for 39 nominated measures, five best practice measures were identified as being the most appropriate for implementation. These are:
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The final output of this study provides all parties involved in traffic safety with a best practice guide and a comprehensive road safety strategy to assist them in their initial strategic choice of cost-effective investments that aim to improve road safety.
10. Recommendations For Further Work

A comprehensive analysis and selection process is recommended where measures covering more road safety fields such as post accident care, statistics and in-depth analysis are considered then identified into more refined categories as, for example, Best Practice, Good Practice and Promising Practice.

A best practice candidate could qualify as Good Practice if it’s evaluation to the level of accident and casualty reduction was difficult to carry out and the measure was based on a sound theory and at least impact on risk determining factors was evident. A Promising Practice is mainly a new measure that has not yet been fully evaluated but a high potential of improving road safety.

Road safety measures are a fast-moving field and opinions about them may change over time due to new scientific results or simply by being solved in another way. The Anti lock Brakes System (ABS) is a good example which received much attention two decades ago, meanwhile every car is fitted with the system without any law requiring it. Therefore, it is recommended to create a Best Practice database which provides an up-to-date collection of best practices and be accessible to any interested stakeholder. Furthermore, new road safety measures could be artificially design by merging Best Practice elements or successful implementation processes from various countries producing what may be termed as “meta-Best-Practice” (3).

References


