Traffic and Road Safety Management

Prof. Saman Bandara

Department of Civil Engineering
University of Moratuwa

Abstract

Improving road safety is getting more attention all over the world due to increase in number of road accidents and associated loss of lives and resources. Safety management concept is being promoted to achieve acceptable safety standards. Traffic management is considered one of the tools that can effectively be used to achieve improved safety standards.

Introduction

A road accident is defined as a collision of one or more vehicles resulted due to unexpected sequence of activities. When a road user perceives a possible hazard situation, he or she usually undertakes an evasive action. Those who fail to complete the evasive action(s) prior to reaching a point of no escape ended up with a collision. In a road environment, a collision is a result of deficiency between road user performance and system demand.

It is important to consider what is meant by "safety". The concept of safety is dependent on individual perspective. Though the traditional practice is the consideration of the number of accidents that occur as a measure of safety, it is not a reasonable measure as we cannot allow a defined number of accidents to happen before mitigating hazardous situations. Another measure that can be used is risk of meeting with an accident. There are two aspects to this concept. One is the risk for an individual of meeting with an accident and other is the risk that passing road user will generate an accident. As complete elimination of accident risks is an impossible task, it is necessary to decide on an acceptable level for inherent risks. The number of accidents is a deterministic quantity and easy to measure. The risk of an accident is a probabilistic quantity and is difficult to be evaluated. Few tools are available to evaluate the level of risk of accidents at a given location. Another extreme measure that could be used is road user stress level. Road user stress level is a qualitative measure which is very subjective, but it can be considered as the correct representation of the acceptable level of safety for individuals.

Today, safety is considered as "management of risk" and is defined as the state in which the risk of harm to person or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and risk management.

The need for interventions

Ignoring safety hazards may lead to increase in the number of serious accidents. There is a need to manage accident risks on roads due to increasing trends in road accidents and enormous cost of road accidents that is estimated over 10 Billion Rupees per year that include vehicle and road furniture damages, medical costs and police and other administrative costs. Further, having no positive measures may lead to loss of confidence of road users.

The main objective of the safety management is to minimise unexpected situations encountered by road users that may result in a conflicting situation. As shown in Figure1, user concentration level (performance) can change with time due to a number of reasons such as engaging in other activities such as tuning the radio on, looking at a road side advertisements or falling asleep. However, when a driver perceives a risk in the road environment, he/she would pay more attention and the performance curve can go up. At the meantime, the road environment has its own behaviour. When the road traffic is less or when there are no road-side obstructions or no road - side friction, environment

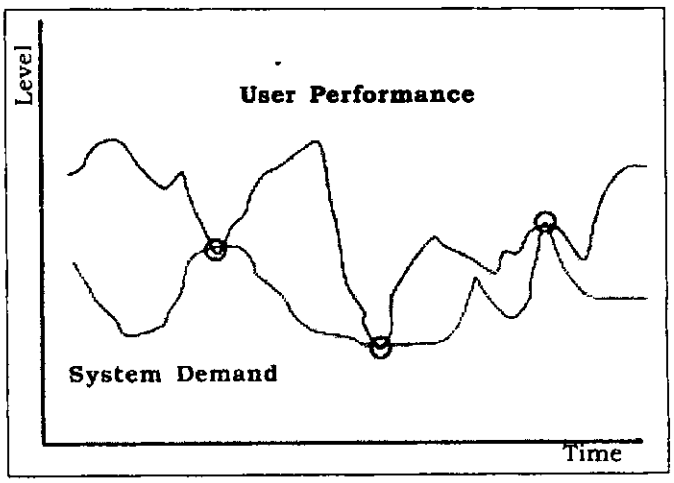

Figure 1 **Cause of an accident**

does not demand a higher user performance, and thus, the system demand curve will be low. Some situations such as damaged road surface, sudden pedestrian movement across the road or an unexpected manoeuvre of a nearby vehicle will increase the system demand. Whenever the user performance level falls below what the system demand from the road user, there can be an accident.

Based on the above explanations, there are two strategies to reduce traffic accidents; one to increase the driver performance level and other to reduce the system demand. Driver education, user knowledge about road rules, hierarchical levels of driver behaviour, law enforcement, physical and mental fitness and other fiscal policies such as insurance, fines, etc. have been identified as the factors influencing the user performance levels. Steps that are required to increase the user willingness to improve their performance levels and policy changes necessary as incentives for the road users to change their attitudes need to be identified. System demand can be reduced by proper vehicle design, correct intersection and highway design and maintenance practices.

The main elements involved in road accidents are the road user, the vehicle and the road environment. A somewhat loose parallel can be drawn between these and the host, agent and vector concept used in epidemiological studies. Therefore, the preventive mechanisms used in medical field can be applied to a road accident during prc-crash, crash and post-crash situations.

Traffic and safety management

Traffic management can be defined as the effective utilisation of available road space to improve traffic flow and safety. The main objectives of traffic management are to; minimise delays, increase capacity, improve safety and security, give priority to selected traffic and minimise emissions. Safety management tools could be incorporated in the road development work and transport operations to improve the safety standards. This will result in minimising loss of human life, injuries, property damage and financial, environmental and societal losses. The need for managing transport demand arises mostly due to the rapidly increasing vehicle fleet in the world where the increase of motor vehicles often outstrips the provision of road space in many countries.

Safety management is a systematic process which increases the chances of reaching safety goals by ensuring that all opportunities to improve road safety are identified, considered, implemented as appropriate, and evaluated in all phases of highway planning, design, construction, maintenance, and operations. The level of attention to the safety measures should be decided based on the three risk elements; the probability of accidents, the level of exposure and the magnitude of the consequences. Maintaining an acceptable level of risk can be achieved through safety performance indicators and safety performance targets.

Safety management could be implemented through safety programmes and safety management system. A safety program is an integrated set of regulations and activities aimed at improving safety. A safety program has a broad scope and includes many activities aimed at achieving the program objectives. A safety management system is an organised approach to managing safety. It usually includes necessary organisational structures, accountabilities, policies and procedures.

Approaches to traffic management

Traffic can be managed through engineering design, through enforcement and through education.

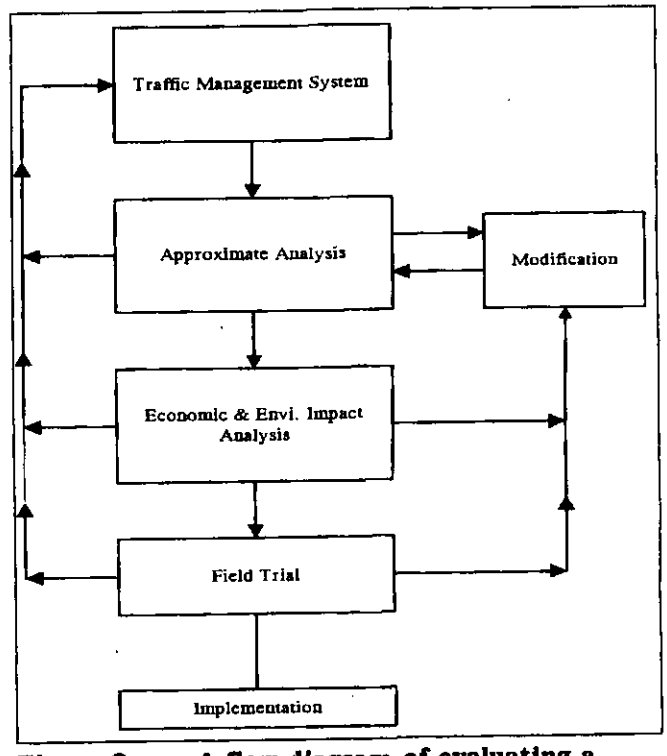

Figure 2 A flow diagram of evaluating a traffic management plan

Design includes; intersection designs, medians, islands, cycle paths, pedestrian paths/ malls, bus bays/ parking bays, street lighting, road geometry, road surface and drains.

Enforcement can be either manual or physical. Manual controlling consists of parking control, land use control, speed control and turn prohibition. Physical controlling includes road signs, lane markings, barriers, pedestrian crossings, one-way roads and road closure. Education includes, driver training, training schoolchildren, advanced training of professional drivers, public awareness and public participation.

Any traffic management system should be properly evaluated before implementation. The following methodology (Figure 2) could be used to ensure the effectiveness of any traffic management system. A sound knowledge in traffic engineering theories is required for the approximate analysis.

Evaluating mitigation options

All risk mitigation measures may not have the same potential for reducing risk. Therefore, it is necessary to evaluate options available prior to implementation. These options could be evaluated with respect to effectiveness, cost/benefit, practicality, challenges and acceptability, enforceability, durability, residual risk and possible new problems. Preference should be given to the measures that could contribute most towards eliminating risk.

Road design

Proper road design is vital for the success of effective traffic management. Road Safety Audit is one of the tools that could be used to improve the safety standards of a road design. Road safety audit is a formal and independent review of a proposed design by an expert safety team to assess the multi-modal safety performance of the design.

The main objectives of carrying out a road safety audit are to reduce the whole of life costs of the project, minimise post-construction remedial work, consider the safety of all road users, minimise preventable collision-producing elements, provide injury-reducing elements at suitable locations, include suitable collision-reducing elements and ensure the project does not impact safety on adjacent roads.

A report identifying any safety concerns with the design, quantifying the safety implications of the relevant design decisions, and suggesting safer alternatives for consideration will be an outcome of a road safety audit. The responsibility of the safety team is making documented recommendations. Then the design team gets an opportunity to outlining how the safety recommendations are being addressed.

When using design standards, steps should be taken to evaluate the desirable vs. minimum standards. Further, the combination of standards may contribute towards conflicting situations with respect to safety. Age of the standards is another factor that should be considered in road designs.

Safety during the operation stage

During the operation stage "traffic conflict study" technique could be used to evaluate the safety condition at a given location within a short period of time. Here, it is assumed that the serious conflicts are proportional to the type of traffic accidents, and the identification of conflicts can be used to understand the potential safety issues without waiting for accidents to happen.

Based on the results of conflicts studies, one can identify the appropriate traffic management options for a given location. However, it is important to monitor and evaluate any traffic management option to be implemented as residual problems could arise due to unexpected and random behaviour of road users.

Conclusion

Road safety management system is a useful tool to improve the road safety standards. Success of a safety management system will depend on the attitude of the management towards safety, safety cultures developed within organisations, reporting, analysing, training and monitoring mechanisms used in handling safety. Understanding traffic flow behaviour and knowledge on traffic management measures are required for the successful implementation of road safety management system.

Contact details

Saman Bandara

Professor in Civil Engineering
University of Moratuwa
E-mail: bandara@uom.lk
Telephone: +94 11 2650567
(ext. 2129)