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A SYSTEM APPROACH FOR SUSTAINABLE MANAGEMENT OF TRAFFIC SAFETY

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1. INTRODUCTION

Road safety records in developing countries demonstrate that traffic accidents is one of the major causes for casualties. Studies carried out by the Transport and Road Research Laboratory, see Jacobs et al., 1981, World Health Organisation, see WHO, 1989, and the United Nations, have demonstrated that road accidents in the Third World:

- are a major cause of death and injury, for example they account for almost 10 percent of deaths reported in the 5 - 44 year age group.
- are a considerable waste of scarce resources with accidents typically costing at least 1 percent - 2 percent of countries' GNP per annum, in addition to the substantial pain, grief and suffering.
- represent a serious problem in terms of fatality rates with rates at least an order of magnitude higher than those in industrialised countries.

Road safety programmes have gone through several stages starting from identification of accidents blackspots and single sites treatment, through treatment of accidents based on an area wide approach. Currently, traffic safety experts across the world are advocating the development of an integrated approach towards road traffic safety, and especially in developing countries where safety records are relatively poor.

2. APPROACHES TO ROAD TRAFFIC SAFETY

"Transportation systems are multi-dimensional in that they are multi-modal, multi-sectoral, multi-faceted, multi-problematic, multi-purpose, multi-operational, multi-organisational, multi-effect, multi-ownership, multi-network, multi-technological, and multi-disciplinary. In complex, large scale systems, like transport, problems are rooted in the basic structure of the system. Actions taken to deal with one problem may create difficulties else where", Abbas and Bell (1994). Road safety is part of this complex transport system. It possesses a lot of the above stated multi-dimensionality. Road safety programmes have gone through several stages, see figure 1, starting from a piecemeal approach known as the identification of accidents blackspots and single sites treatment, through treatment of accidents based on an area wide approach, and now most of the traffic safety experts across the world are advocating the development of an integrated approach towards road traffic safety.

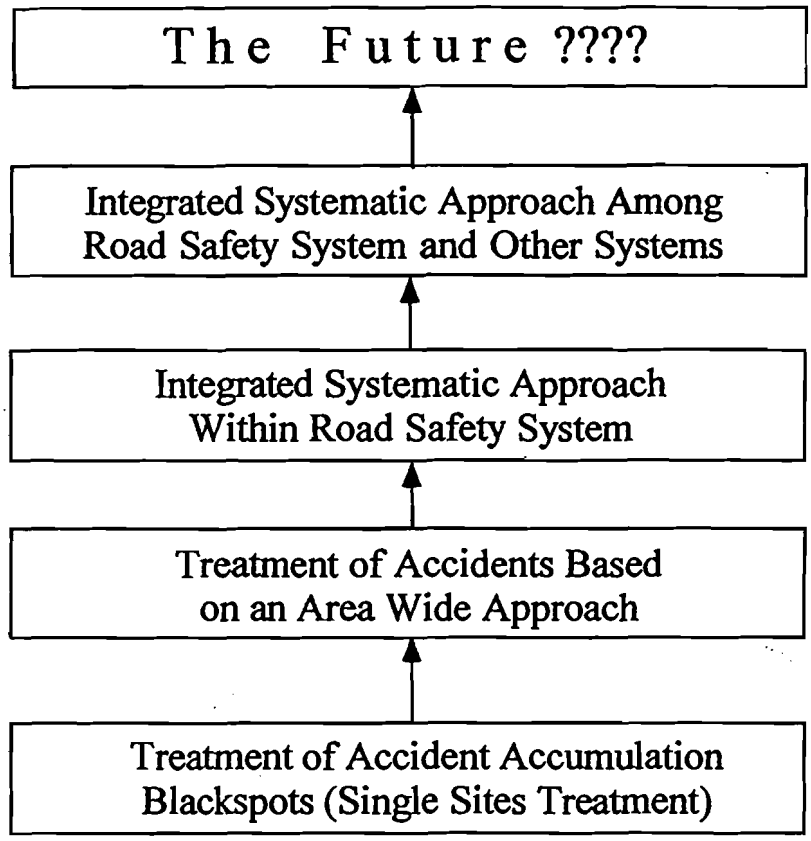

Figure 1: Development in traffic safety approaches seeking prevention/reduction of accidents

Two conceptual frameworks for integrated traffic safety management are displayed in figures 2 and 3. The first developed by an OECD expert group, see OECD, 1990, is composed of six main stages:

1. Review of local policy and decision making mechanism
2. Assessment of traffic safety targets
3. Goal setting
4. Design of an integrated programme
5. Operations and implementation
6. Evaluation

The process is cyclic in nature. It involves a feedback of information, insight and understanding. The second framework developed in a World Bank technical report, see Carlsson and Hedman, 1990, involves five steps:

1. Setting goals and objectives
2. Planning
3. Implementation
4. Monitoring
5. Evaluation

This approach also emphasizes the concept of a continuing safety process with feedback information providing insight, understanding and leading to future improvements.

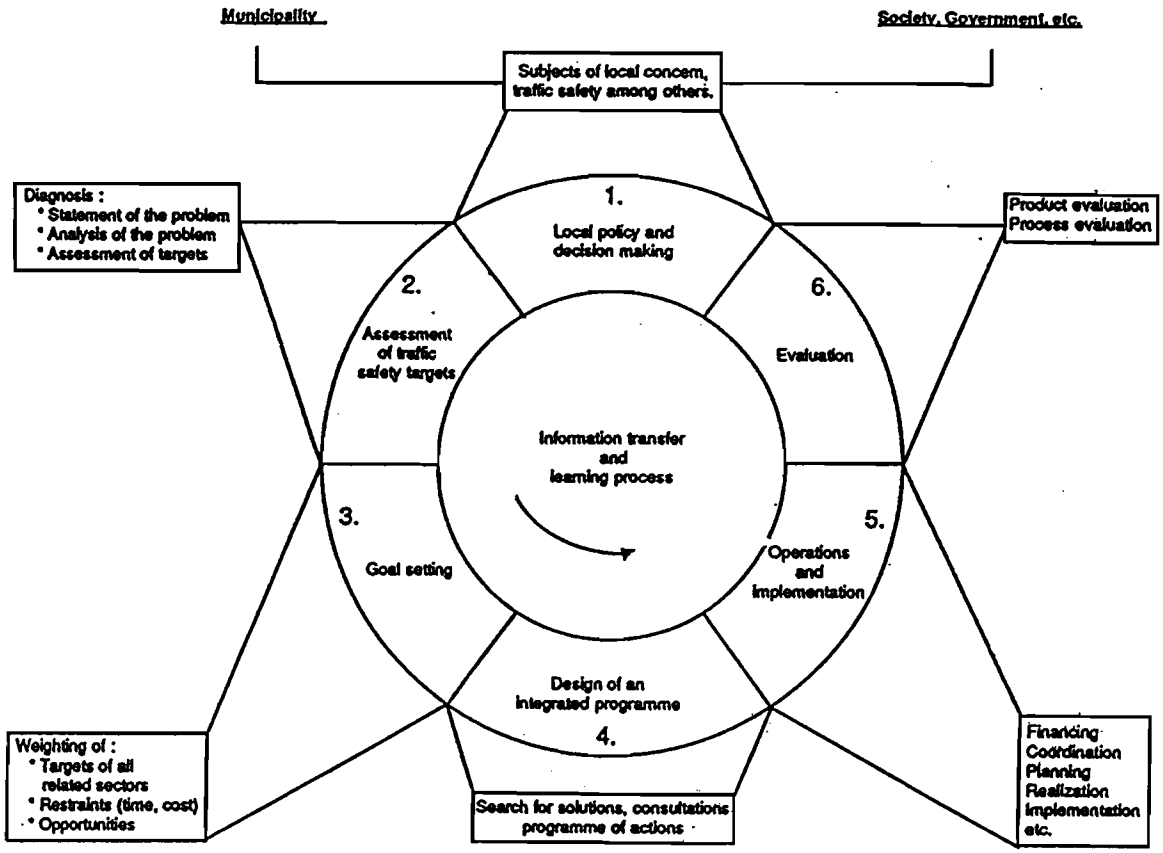

Figure 2: The concept of integration in traffic safety - Source: (OECD, 1990)

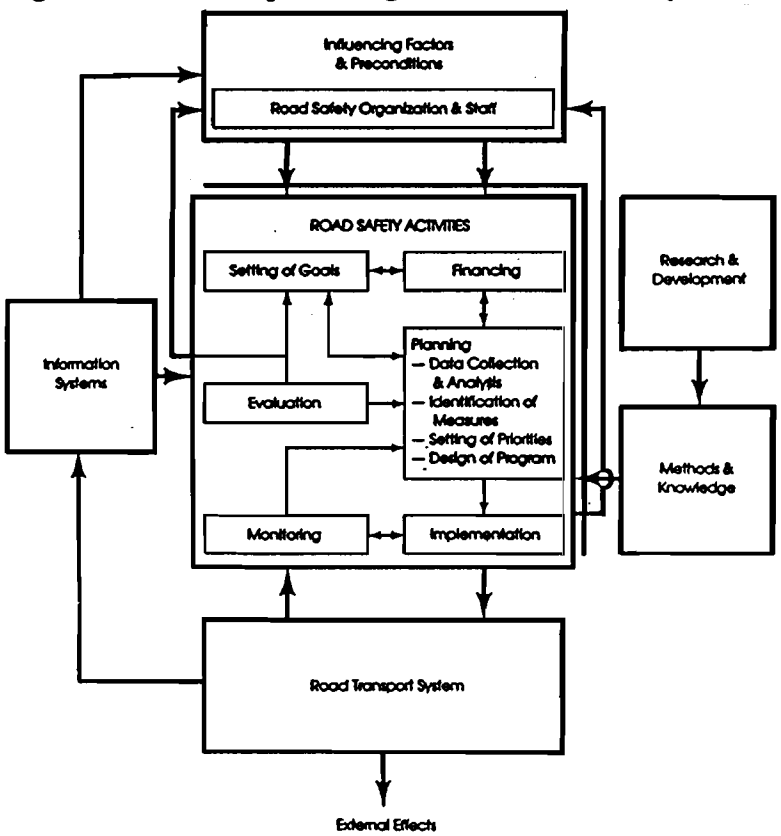

Figure 3: A systematic approach to the road safety process
Source: (Carlsson and Hedman, 1990)

As shown in figure 1, two types of integration can be adopted according to the governing circumstances and priorities. The first can be referred to as the Integrated Approach Within the Road Safety System. It involves the systematic coordination of all necessary functions and activities required to assess the traffic safety situation in its totality. It entails the coordination of the multi-disciplinary design and development of traffic safety packages of countermeasures. Lastly it requires the coordination of the efficient and effective multi-disciplinary implementation of this package through the different organizations and agents at the different levels.

The second type of integration can be referred to as Integrated Approach Among the Road Safety System and Other Systems. It involves the systematic coordination of all necessary functions and activities required to assess the traffic safety problem but as one of other considered problems such as traffic congestion, traffic environmental hazards, public transport provision. In this case, each of the considered problems would be assessed in its individual totality as a separate sub-system as well as in their combined totality as a part of the whole transport system or the urban environment. This would be followed by the multi-disciplinary design and development of integrated packages of countermeasures. Lastly this also entails coordinating the efficient and effective multi-disciplinary implementation of this package through the different organizations and agents at the different levels.

3. A SYSTEM APPROACH FOR SUSTAINABLE MANAGEMENT OF TRAFFIC SAFETY

An integrated approach developed to act as a comprehensive and detailed framework for achieving sustainable traffic safety management is presented. The proposed framework encompasses all the functions and activities that ought to be pursued within a sustainable management process of traffic safety, see figure 4. Activities involved within the integrated management of traffic safety include:

- design of accident reporting system;
- accident analysis and investigation system;
- diagnosis of direct, root and post causes of accidents;
- setting of safety objectives;
- identification of potential safety countermeasures;
- valuation of traffic accidents;
- development of an integrated package of safety countermeasures;
- operation and implementation of a program of an integrated traffic safety package;
- dynamic monitoring and post program evaluation;
- development of an information base on safety countermeasures and packages.

The paper explores each of these functions/activities and shows their sequence and dependencies within the proposed framework. The developed framework is thought to achieve and sustain improved traffic safety situations, leading to a reduction of accident risks. In reading the following sub-sections, refer to figure 4.

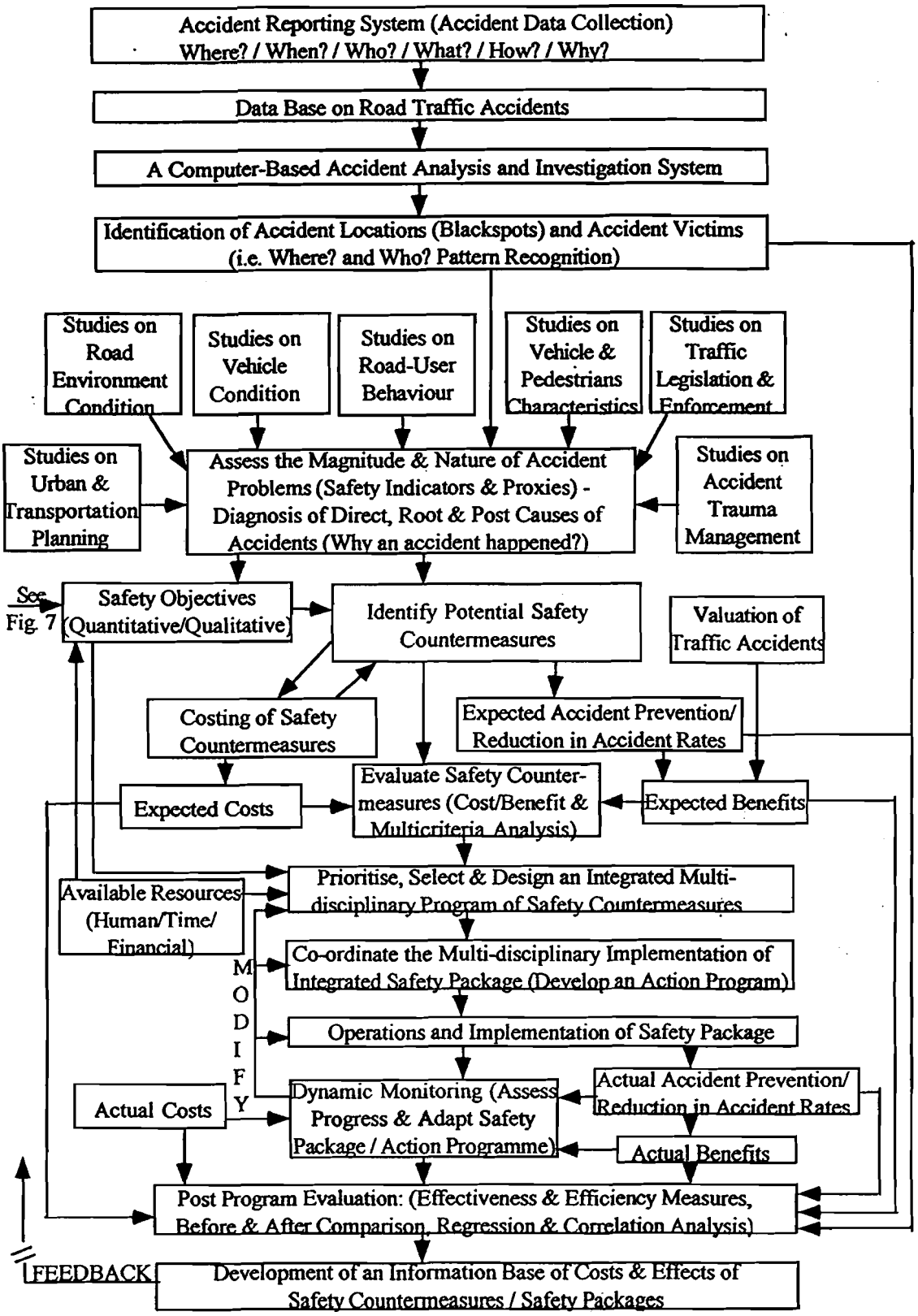

Figure 4: An integrated approach for sustainable management of traffic safety

3.1 Accident Reporting System

This activity is vitally important. It constitutes the root of the whole accident investigation process. It is mainly concerned with the collection of accident data. Accident data collection forms/booklets should be carefully designed so as to capture all the necessary information required to perform an overall as well as an in-depth accident data analysis. Meanwhile, the accident reporting form should be designed so as to ensure the easy and speedy completion of reliable and sufficient information concerning the reported accident. In most cases, it is the police officers or traffic police officers who bear the responsibility of completing these forms. Officers should be well trained on how to accurately complete these forms. They should be fully aware of the significance and importance of the different data items included in the form. The form should answer questions pertaining to:

- Where did an accident take place?
- When did an accident take place?
- Who was involved in an accident?
- What happened in terms of fatalities, injuries, damages?
- How did an accident took place?
- Why did an accident happen?

In terms of the last question it is always important to remember that an accident could happen as a result of any of the following elements or a combination of these elements:

- The road environment
- The vehicle
- The road-user

Thus it is important to establish the condition of the road environment at an accident location, as well as the type and condition of the vehicles involved, and finally the physical and mental state of the road-users involved in an accident, as well as their exact traffic manoeuvres during the accident. According to IHT (1990) there are six main data items that should be included in accident reporting, these are:

- basic accident description;
- road types;
- environmental features;
- driver features;
- casualty details; and
- traffic characteristics-related to time and location.

There exist several systems of accident reporting both in the developed and the developing countries. One of the most comprehensive accident reporting systems produced by TRRL is the police accident booklet for use in developing countries. This was initially tested and developed in conjunction with the Egyptian Academy for Scientific Research and Technology, see ASRT, 1991.

3.2 Accident Analysis and Investigation

Once accident forms are completed, a logistic system must exist whereby these forms are collected from various police stations and sent to the accident data analysis office. These forms are then accessed by specialised data entry personal whose role is to code the forms and store the coded data into a computerised data-base on road traffic accidents. It is vitally important to maintain this accident-data base and keep it updated.

Accident data can be manually analysed. However, with the rapid progress in computer hardware and software it became now relatively easy and cheap to acquire micro-computers with an easy to use (user friendly) accident investigation package installed to perform all the necessary analysis. One of the most popular accident analysis and investigation systems for developing countries is MAAP a microcomputer accident analysis package developed by TRRL, see Hills (1984). The first step in the accident analysis process is concerned with the identification of:

- accident prone locations (i.e. where do accidents usually happen?); and
- victims patterns (i.e. to whom do accidents usually happen?).

It is through this general overview of the scale and characteristics of accident data, that some preliminary actions might be taken in the form of low-cost engineering countermeasures to relieve the black spot areas from the road network. Most importantly, based on this general overview, decision would be taken as to the direction of the in depth accident investigations such as investigation of particular types of accidents, or investigation of accidents occurring to vulnerable road users, ..etc.

3.3 Diagnosis of Direct, Root and Post Causes of Accidents

Once the direction of the in-depth accident investigation has been decided, it is vital to assess the exact magnitude and nature of the particular accident problem. This can be done by establishing patterns of safety indicators such as accident risk and severity indices. In depth studies of all the direct, root (underlying) and post causes of accidents should be then carried out. This involves the following set of studies:

- Studies on urban planning and transportation planning/management
- Studies on road environment condition
- Studies on vehicle condition
- Studies on road user behaviour
- Studies on pedestrians and vehicles traffic characteristics
- Studies on traffic legislation (rules and regulations) and their enforcement
- Studies on health-related issues pertaining to accidents severity.

These in-depth studies are meant to complement each other in answering two basic questions:

- Why an accident has actually happened?
- Why an accident might still happen in the future?

A macro classification of accidents causes and countermeasures is displayed in figure 5. The figure shows that accidents causes and hence countermeasures can be categorised as root causes, direct causes and post accident causes. Post accident causes are mainly related to accidents emergency and rescue service, medical treatment and in general trauma management. Figure 6 details the root and direct causes leading to accidents. These are mainly traffic -related activities, and participants leading to positive and negative outcomes. As shown in the figure that the road environment, the vehicles, the drivers, the pedestrians and the traffic police all interact together in the form of traffic on the roads, pedestrians walking on sidewalks or along kerbs or crossing roads and traffic police enforcing these interactions. Two types of outcomes result from these interactions. The first is the positive outcomes in the form of mobility and accessibility to people and goods. The second type is the negative outcomes that are mainly in the form of traffic-related environmental hazards, traffic congestion, delays, parking problems, and conflicts eventually leading to the occurrence of accidents.

3.4 Setting of Safety Goals/Objectives

Safety goals or objectives can be either qualitative or quantitative (absolute/relative). These should be clear and well stated. The setting of safety goals depends on three major inputs:

1. The in-depth diagnosis and assessment of accidents direct, root and post causes
2. The available resources in terms of human, time and financial resources
3. The mission statement, the policies (global objectives) and the targets leading to the setting of the safety objectives. These would also show whether the adopted integration approach is the Integrated Approach Within the Road Safety System or whether it is the Integrated Approach Among the Road Safety System and Other Systems. Figure 7 shows a typical proposed example of a mission statement, a global traffic safety policy, safety targets, and safety goals that can be achieved using the first approach. On the other hand, if the same traffic safety policy, targets and goals are combined with other environment-related and/or traffic management-related policies, targets and goals, then these can be achieved through the second approach of integration.

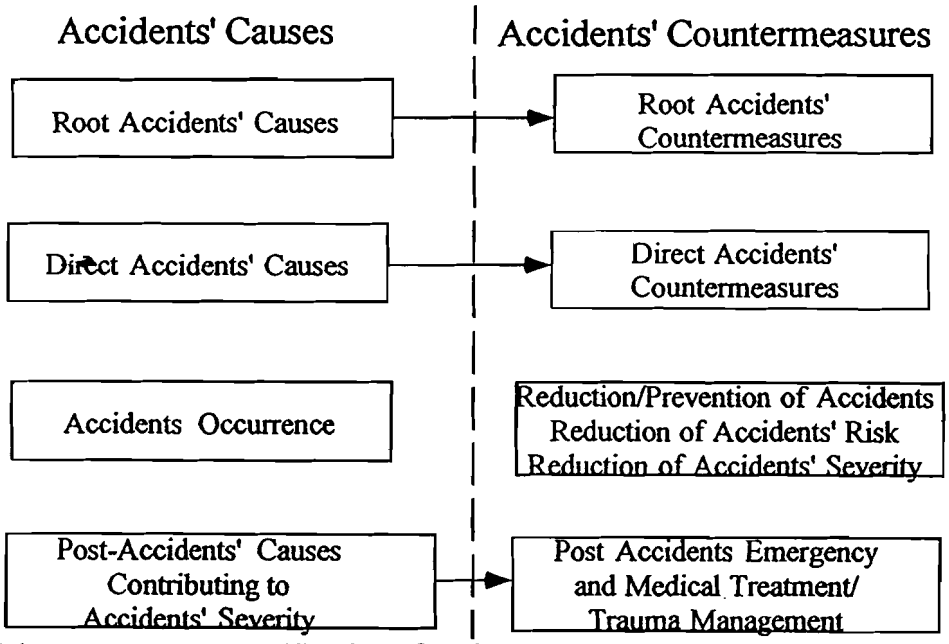

Figure 5: Macro classification of accidents causes and countermeasures

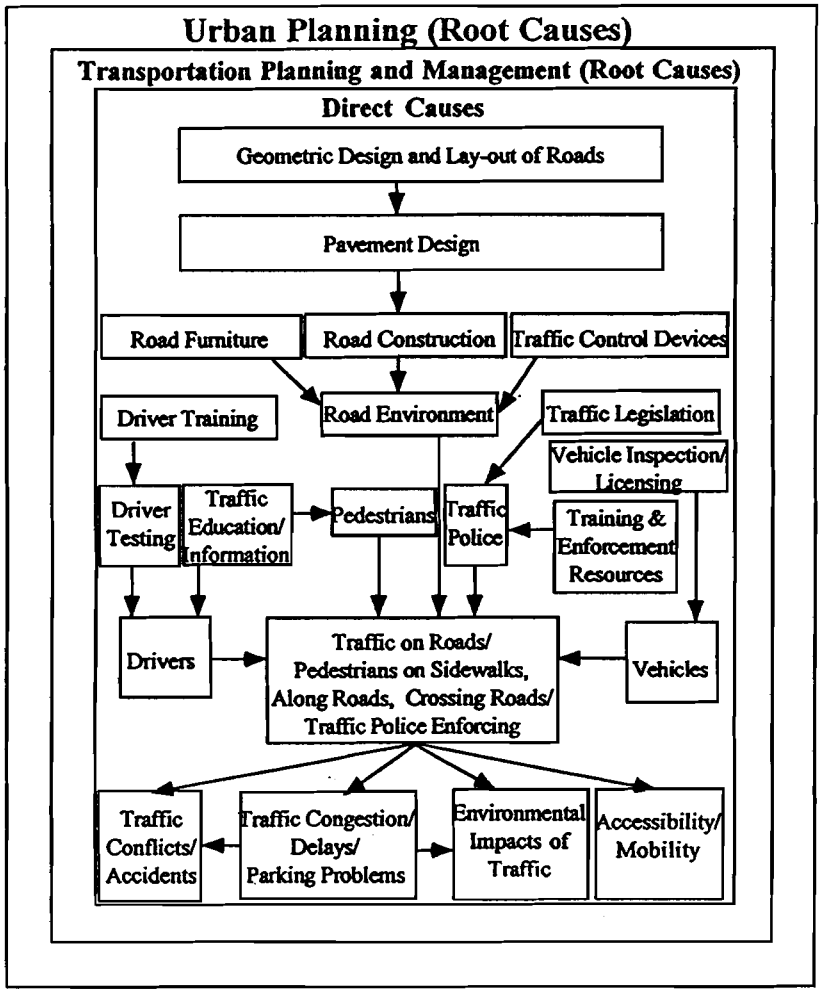

Figure 6: Traffic-related activities, participants and outcomes

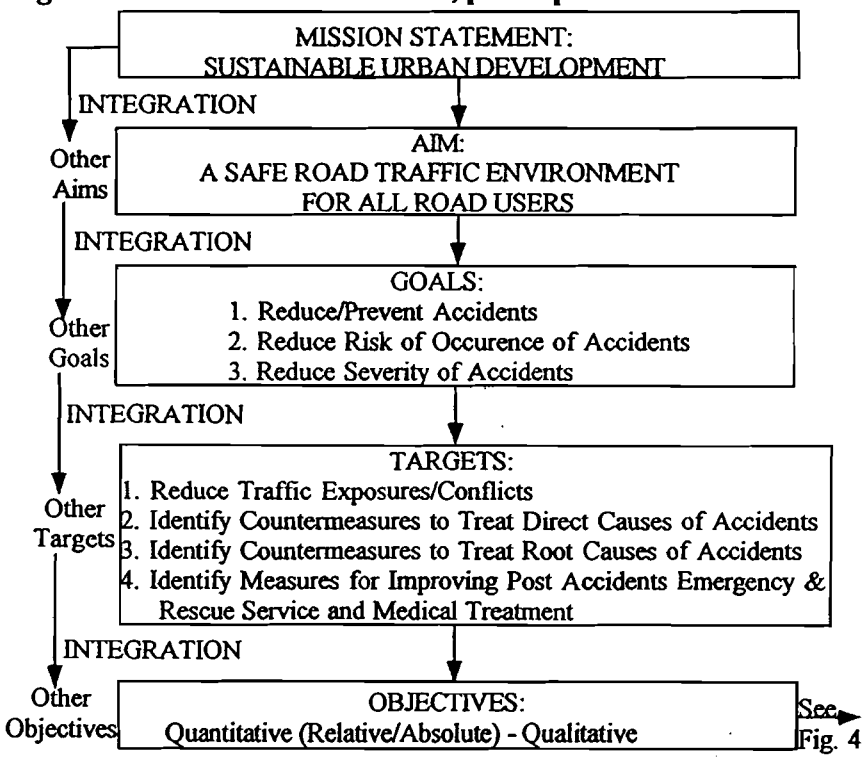

Figure 7: Traffic safety policy, goals and targets

3.5 Identification of Potential Safety Countermeasures

Based on the thorough diagnosis of the different types of accident causes and taking into account the traffic safety objectives required to be achieved, potential individual and subgroups of traffic safety countermeasures can be identified. These should be chosen so as to be specifically directed towards alleviating some of the accidents causes as well as relieving some other causes. Towards this end, three values expected to result from the implementation of these countermeasures should be determined:

- Expected reduction in accident numbers
- Expected reduction in accident rates (risk)
- Expected reduction in severity rates

The international road traffic safety literature is full of research publications and manuals that can help to identify potential safety countermeasures and their expected effects. "Although research findings from developed countries can provide some guidance, the inevitable uncertainties surrounding their transfer to developing countries emphasise the need for caution and appreciation" Hills and Jacobs (1981). Manuals and guidelines have also been produced specially for developing countries, see UNECA (1989) and Ross et al. (1990). However, still each country should look carefully at these countermeasures and select and adapt (not adopt) some of these measures to suit its local conditions (physical and cultural). Additionally and most importantly countries should gradually develop an information data base describing the measures that have been applied and their effectiveness within the country's environment.

Costs of identified individual or subgroups of traffic safety countermeasures should be estimated. Costing should include all types of costs such as capital and maintenance costs, staff costs, and a component of fixed costs related to accident data reporting, storage and analysis. A determination of expected costs to be incurred as a result of implementation of countermeasures should be reached. Sometimes as a result of costing a particular countermeasure or a subgroup of countermeasures, one realises that it would not fall within the available resources. In this case, other countermeasures should be looked upon that both satisfies the safety objectives as well as fall within the available resources.

3.6 Valuation of Traffic Accidents

In order to carry out an evaluation of proposed safety countermeasures, one has to determine, in addition to the expected costs, the expected benefits. As our objective is mainly to prevent accidents from occurrence, benefits would be simply equal to the costs incurred if such an accident would have not been prevented and hence would have occurred. Several methods exist for the valuation of accident prevention costs including:

- The gross output (human capital approach)
- The net output approach
- The life-insurance approach
- The court-award approach
- The implicit public sector valuation approach
- The value of risk-change approach (willingness to pay approach).

The papers by Hills and Jones-Lee (1981) and by Silcock (1982) give a comprehensive description of each of these approaches and a comparison among them. Obviously each of these approaches would give a value to an accident prevention different from the other method. However, several criteria should be taken into consideration when selecting which accident valuation method to use, namely the objective of the evaluation as well as the ease of application in terms of data availability and validity of assumptions. In general, it is recommended that developing countries apply the gross output approach as it is well suited to the objective of maximising the wealth of a country. The gross output approach would include the following cost components:

- Present value of the loss of the victim's future output
- Medical treatment costs
- Damage to vehicles or other property costs
- Administrative costs including insurance, police and court
- Other costs including the delays to other vehicles at the scene of the accident.

It is further recommended that sums are added to reflect the pain, grief and suffering of those involved in road accidents. The willingness to pay approach is another recommended approach, however it is difficult to apply due to insufficiency of data.

Multiplying the expected number of accidents to be prevented, as a result of implementing safety countermeasure(s), by the accident prevention value would produce the benefits expected as a result of implementing the countermeasure(s).

3.7 Development of an Integrated Package of Safety Countermeasures

As other activities and functions, this stage of developing an integrated package of safety countermeasures is considered to be vitally important. It entails prioritising different individual or subgroups of safety countermeasures. This prioritisation can be based on criteria such as:

- economic appraisal;
- potential in working together to achieve the preset traffic safety objectives/goals within the available resources.
- ease of implementation and maintenance;
- level of support and political acceptance, see Silcock and Walker (1981).

In this stage appraisal of the proposed countermeasures is carried out. This involves weighting the expected benefits against the expected costs. Cost-benefit analysis is suited for doing this type of appraisal. Several forms of cost-benefit analysis exist. The selection of a particular form would depend on several factors such as the scale of the project, the objective, and the time frame expected for benefits to materialise. In all cases it is also recommended to substantiate the cost-benefit analysis with a multi-criteria analysis that can consider the intangibles associated with accident prevention benefits, the possibility of unacceptable effects on traffic environment, the likelihood of increase in other accident types, ..etc.

Most importantly at this stage is that when considering the selection of a package of safety measures to bear in mind whether traffic safety is dealt with as a system on its own (active strategy) or whether it is dealt with as a system with other systems working together to serve several objectives/goals/targets/policies and a particular mission statement (reactive strategy). A prioritisation technique that can be applied at this stage is known as the "Goals Achievement Matrix". Once countermeasures are prioritised, some are selected and packaged together in an attempt to develop an integrated package of safety countermeasures. People involved in this stage would be representing a multi-disciplinary of agents and organizations with sometimes shared/overlapping objectives or alternatively sometimes conflicting objectives.

3.8 Operation and Implementation of Program of an Integrated Traffic Safety Package

An action program for the implementation of the integrated safety package ought to be developed. This entails splitting the implementation of the safety package into parallel and sequential stages and time framing these stages. It also requires establishing the necessary contacts and preparations with the various agents and organizations at the different levels through which the integrated safety package would be implemented. All in all, this is meant to coordinate, harmonise and guarantee the smooth implementation of these stages of the developed integrated safety package through the various organizations.

This stage involves the operation and implementation of the action programme. This operation involves the supervision, and coordination among the multi-disciplinary agents and organizations at the different levels to implement the developed safety package in accordance with the action program.

3.9 Dynamic Monitoring and Post Program Evaluation

Throughout the implementation of the safety package it is vital to monitor over time the actual effects of the implemented components of the safety package (incurred costs and achieved benefits). In addition monitoring would involve assessing progress in the stages of the implementation action program. Monitoring serves two important purposes:

1. Realisation of any unexpected effects (positive/negative) as a result of implemented components within the safety package as well as identification of any deviations from original implementation action program.
2. As a consequence of (1), modifications in the form of alterations or adjustments can be undertaken both in the safety package and/or in the implementation action program.

Monitoring should continue after the complete implementation of the action programme by a period of time equal to the time frame taken in the evaluation of countermeasures so as to allow for the whole and full expected benefits to materialise.

After the implementation of the safety package, and the complete realisation of the potential benefits, it becomes necessary to evaluate the whole safety package. There exist several ways to carry out this evaluation, all are considered indicative and all are important to be taken into consideration, some are listed below.

- Effectiveness measures: these include cost effectiveness and benefit effectiveness
  Cost effectiveness = Actual costs / Expected costs
  Benefit effectiveness = Actual benefits / Expected benefits
- Efficiency measures = Actual benefits / Actual costs
- Before and after studies and statistics, mainly involved with comparing the safety scene after the implementation of the safety package with it before implementation.
  Percentage reduction in number of accidents =
  [(Accidents before - Accidents after) / Accidents before] * 100
  Percentage reduction in accidents rate =
  [(Accidents rate before - Accidents rate after) / Accidents rate before] * 100
  Percentage reduction in accidents severity = [(Accidents severity before - Accidents severity after) / Accidents severity before] * 100
- Regression and correlation between safety countermeasures as independent variables and accident reduction/prevention as dependent variable.

3.10 Development of Information Base on Safety Countermeasures/Packages

As the above described process would be repeated in future for different locations as well as for other types of accidents, it is indispensable to keep record and document all the information gained during this process. Vital information include:

- description of safety countermeasures
- cost details incurred in implementing countermeasures
- effectiveness, efficiency, and before and after statistics of implemented countermeasures.

4. ADVANTAGES AND LIMITATION OF THE PROPOSED APPROACH

The developed framework is thought to achieve and sustain improved traffic safety situations, leading to a reduction of accident risks. This can be mainly attributed to the approach:

- Including a comprehensive and detailed analysis of the accident problem (i.e. identifying the root, direct and post causes of accidents)
- Having the potential to integrate safety goals with other inter-related goals and objectives
- Developing integrated packages of traffic safety countermeasures
- Encouraging the coordination of the various parties involved in the implementation of integrated packages of traffic safety countermeasures
- Developing an information base of the applicability and effectiveness of traffic safety countermeasures

The main limitation of this approach lies in the difficulty of coordinating all these activities which cut across a multi-disciplinary of organisations. This entails an institutional arrangement that is capable of fulfilling this task. A conceptual view of such an arrangement will be discussed.

5. FIELDS OF ACTION FOR IMPROVEMENT OF TRAFFIC SAFETY

Policies and remedial measures that are meant to improve and sustain traffic safety can be categorised under 12 fields of action, namely:

1. Institutional;
2. Urban and transportation planning;
3. Educational;
4. Training;
5. Road and traffic engineering;
6. Vehicle engineering;
7. Legislative;
8. Enforcement;
9. Information;
10. Health-related measures;
11. School-related measures;
12. Research-related measures.

These measures should not where deemed necessary have to be treated separately. As a matter of fact, any package of safety countermeasures should include measures from each of these fields of action. These should complement each other and work together in a supportive way so as to tackle the particular traffic safety problem, see figure 8. Institutional measures are particularly discussed due to their overall significance in developing integrated traffic safety packages.

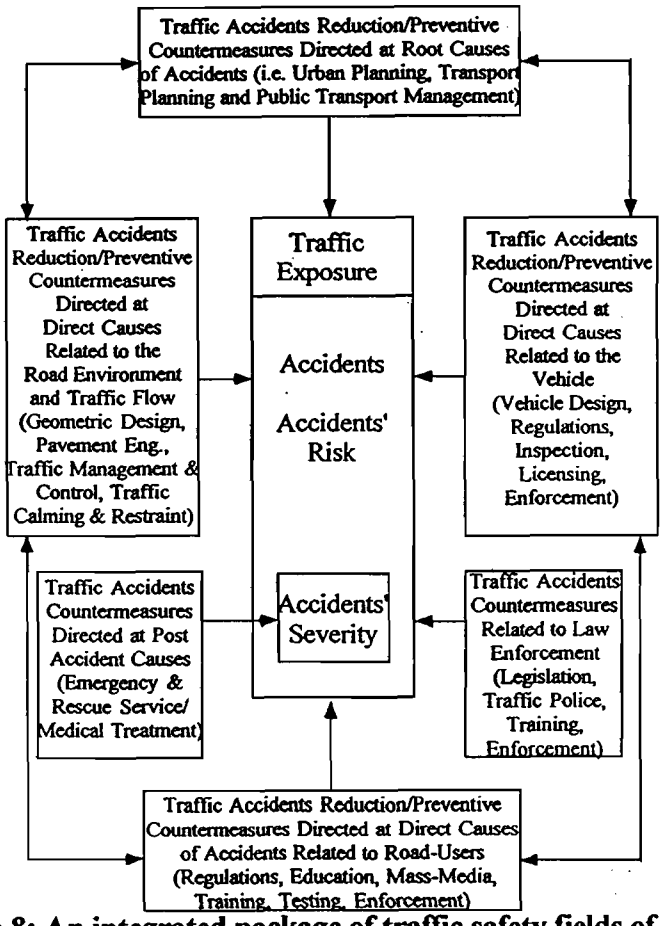

Figure 8: An integrated package of traffic safety fields of action

6. INSTITUTIONAL MEASURES

An institutional framework should be put in place to support and ensure continuity of road safety activities. At the national level there is a need for setting up the following bodies:

- A National Road Safety Council to advise government on policy formulation for road safety.
- A Road Safety Unit to implement all programmes pertaining to road safety.

6.1 National Road Safety Council

The National Road Safety Council membership would cut across several government and non-governmental bodies. This council should have support at the highest level in government and also have a legal entity. Members could be drawn from:

- Ministry of Transport
- Municipalities and Local Authorities
- Ministry of Education, Schools, Parents
- Ministry of Justice
- Ministry of Public Health
- Ministry of Interior (Traffic Police)
- Ministry of Defense
- Traffic Safety Experts and Academics
- Ministry of Information (mass media including television, radio, newspapers)
- Other non-government organizations,
- Road user groups,
- Private companies (insurance, oil, car assembly and manufacturing companies)

6.2 Road Safety Unit

The Road Safety Unit could be located under ministerial cabinet of one of the most concerned ministries with safety such as the ministry of transport, or the ministry of interior. The unit should draw expertise from various institutions in the country such as transport academics, traffic police, road safety experts, psychologists, doctors, educationist, social workers, etc. The unit should also have provincial/district offices to provide a field backup.

One of the main tasks of the unit would be to promote road safety through the community and to help and encourage the formation of non-government voluntary organizations who are interested in road safety work.

6.3 Other Supportive Activities and Organizations

Certain steps, and activities are usually needed in order to set the right scene for the decision-makers and politicians to act towards the establishment of such bodies, see figure 9. Traffic safety lobbying as well as traffic safety research are vitally important in convincing decision makers of the importance for setting such bodies. Other organizations: international, inter-governmental and non-governmental, and the donor community also have a major role to play in support of road activities through inter-alia, technology transfer through twinning arrangements, research, training and funding.

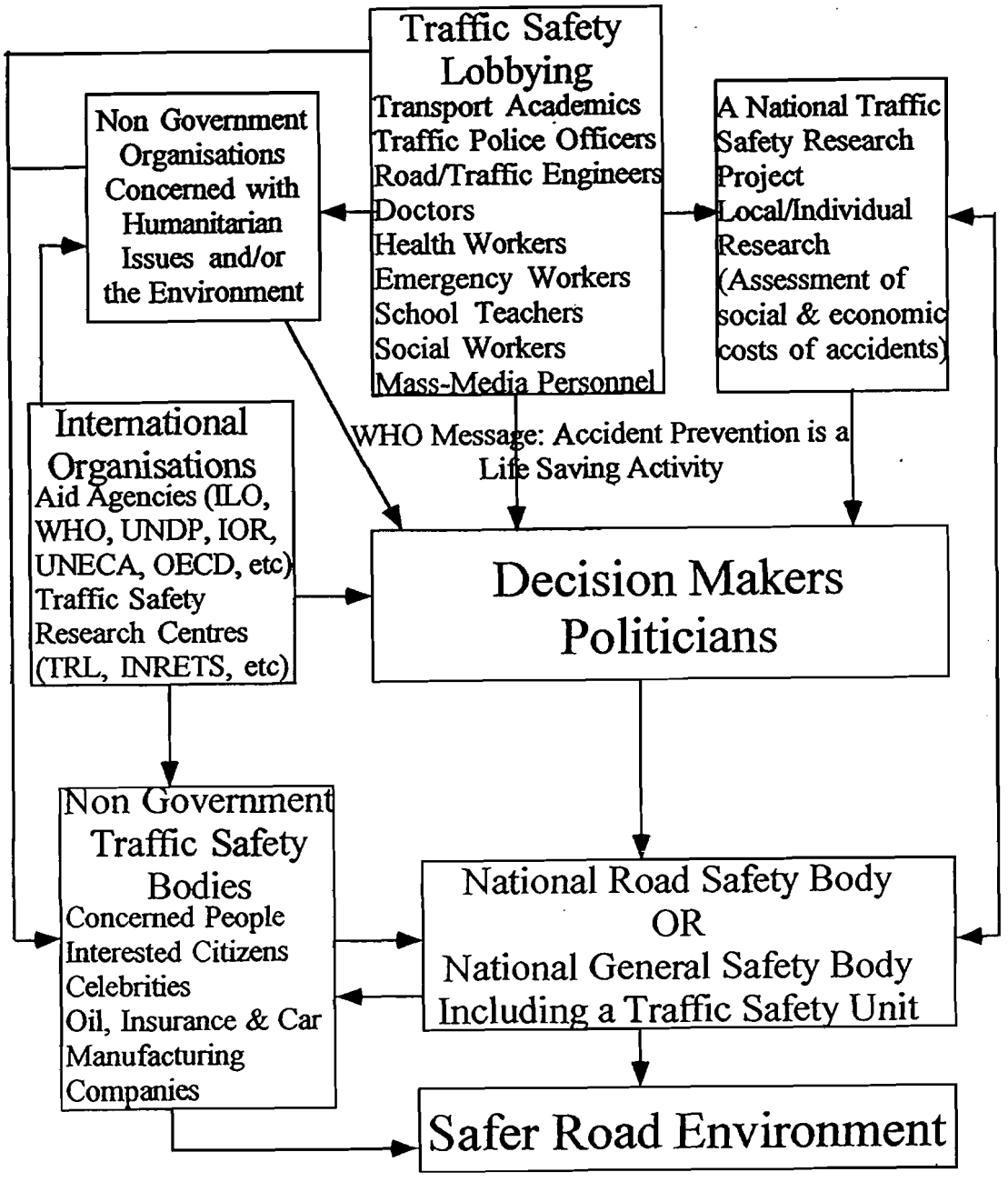

Figure 9: Actions towards establishment of a national safety body

7. CONCLUSION

The paper reviewed the development of traffic safety approaches. It presented a conceptual proposal for a comprehensive and detailed framework of all the functions and activities that ought to be pursued to achieve a sustainable management of traffic safety.

Activities involved within the developed approach include: design of accident reporting system; accident analysis and investigation system; diagnosis of direct, root and post causes of accidents; setting of safety objectives; identification of potential safety countermeasures; evaluation of traffic accidents; development of an integrated package of safety countermeasures; operation and implementation of a program of an integrated traffic safety package; dynamic monitoring and post program evaluation; development of an information base on safety countermeasures and packages.

The paper explored each of these functions/activities and showed their sequence and dependencies within the proposed framework. The developed framework is thought to achieve and sustain improved traffic safety situations, leading to a reduction of accident risks.

The paper concluded by laying down 12 fields of action under which policies and remedial measures that are meant to improve and sustain traffic safety can be selected. Institutional measures were particularly discussed due to their overall significance in developing integrated traffic safety packages.

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REFERENCES

Abbas K. A., and Bell M. G. H. (1994) System Dynamics applicability to transportation modelling, Transportation Research, Vol. 28A, No. 5, Pergamon Press, U.K. pp. 373-400.

Carlsson G. and Hedman K. O. (1990) A systematic approach to road safety in developing countries, World Bank Report, Infrastructure and Urban Development Department.

Egyptian Academy for Scientific Research and Technology (ASRT) (1991) Road traffic accident analysis, Final Report, Transport and Communications Research Committee.

Hills B. L., and Jacobs G. D. (1981) The application of road safety counter-measures in developing countries, Traffic Engineering and Control, 22(8/9), pp. 464-468.

Hills B.L. (1984) A microcomputer road accident analysis package for developing countries, First African Road Safety Congress, United Nations Economic Commission for Africa/Organisation for Economic Cooperation and Development, Nairobi, Kenya.

Hills P. J., and Jones-Lee M. (1981) The costs of traffic accidents and evaluation of accident prevention in developing countries, Proceedings of the 9th Planning and Transport Research and Computation (PTRC) Summer Annual Meeting, Warwick, U.K.

Institution of Highways and Transportation (IHT) (1990) Highway safety guidelines: Accident reduction and prevention, IHT Report, International Edition, London, U.K.

Jacobs G.D., Sayer I.A., and Downing A.J. (1981) A preliminary study of road user behaviour in developing countries, Transport and Road Research Laboratory Supplementary Report 646, Transport and Road Research Laboratory, U.K.

Organisation for Economic Co-operation and Development (OECD) (1990) Integrated traffic safety management in urban areas, OECD Report, Paris.

Ross A., Baguley C., Hills B., McDonald M., Silcock D. (1990) Towards safer roads in developing countries: A guide for planners and engineers, Overseas Unit, Transport and Road Research Laboratory, U.K.

Silcock D. T., and Walker R. T. (1981) The evaluation of accident countermeasures for application in residential areas, Transport and Operations Research Group Report No. 39, University of Newcastle upon Tyne, U.K.

Silcock D. T. (1982) The procedure adopted in various countries for estimating the cost of traffic accidents or valuing their prevention, Transport Reviews, 2(1), pp. 79-106.

World Health Organisation (WHO) (1989) New approaches to improve road safety, WHO Technical Report, Series 781, Geneva, Switzerland.

United Nations Economic Commission for Africa (UNECA) (1989) Road safety manual on low - cost engineering countermeasures, UNECA Report, Addis Ababa, Ethiopia.