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Session 3

16.30-18.00

Road Safety Plans and Strategies II

Chairman:

Andrew Pearce, GRSP

Australia's new approach to road safety: How is the Safe System approach being implemented?
Blair Turner, ARRB Group, Australia

Organising For Road Safety In Bangladesh: Some Challenges And Opportunities
Dr. Md. Mazharul Hoque, Department of Civil Engineering , BUET, Bangladesh

3 Step Generic Procedure To Assess Road Safety: A Case Study of Egypt
Dr. Khaled Abbas, Roads & Transport Authority, Dubai, United Arab Emirates

Effective Road-Safety policy making in lower-income countries: Ten principles from social systems thinking
Alfredo del Valle, Universidad Alberto Hurtado, Santiago, Chile

Road Safety Strategies of Abu Dhabi Municipality
Rauf Iqbal, Municipality of Abu Dhabi City, United Arab Emirates

Session 4

16.30-18.00

Highlights of road safety in Europe - FERSI endorsed research

Chairman:

Evangelos Bekiaris, Hellenic Institute of Transport, Greece

Driving Under the Influence of Drugs, Alcohol and Medicines: DRUID Project
Horst Schulze, Bundesanstalt für Straßenwesen (BASt), Germany

Integrated system for safe transportation of children to school, Safeway2school
Magnus Hjälmdahl, VTI, Sweden

Naturalistic rider studies for the analysis of riders' behaviour and safety (2BESAFE)
Stéphane Espié, INRETS, France

PROmoting real Life Observations for Gaining Understanding of road user behaviour in Europe (PROLOGUE)
Stella Nicolaou, CERTH/HIT, Greece

SAFERIDER: Can Based Architecture on 2-Wheelers Domain
Roberto Montanari, University of Modena & Reggio Emilia, Italy

Integrated Safety & Security for transportation hubs – SAVE ME
Maria Panou, Hellenic Institute of Transport, Greece

3 STEP GENERIC PROCEDURE TO ASSESS ROAD SAFETY: A CASE STUDY OF EGYPT

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ABSTRACT

A 3-step procedure to assess road safety conditions is developed and applied to Egypt as a prototype example. Assessing road safety culture represents the first step in judging the road safety situation in a developing country. This can be represented through 14 aspects, namely: Political, Institutional, Safety Lobbying, Safety Research, Engineering, Accident Management System, Evaluation, Behavior, Legislation, Enforcement and Standards, Emergency, Education, Mass Media, Coordination and Cooperation. These were applied to describe and assess the road safety condition in Egypt. This is followed by comparing severity indicators among several countries in an effort to determine the road safety position in Egypt. The third step involved compiling and analyzing accident records for five main rural roads in Egypt. Most of the highly contributing causes are driver related including loss of control of driving wheel, over speed, misjudgment of traffic gap, sudden slowing/stoppage. Two other vehicle related causes are frequently mentioned, i.e. tire burst and vehicle turnover/turn off the road. The paper concludes by developing an integrated road safety programme composed of 16 fields of actions namely: institutional, land use planning and management, travel demand management, road infrastructure improvement, legislation, traffic-related, accident-related, vehicle-related, driver-related, traffic police-related, enforcement, educational, mass-media, community related, health-related and research-related measures. These should complement each other and work together in a supportive way to tackle the particular road safety problem.

1 INTRODUCTION

The road environment in many developing countries is known to be relatively unsafe, and uncomfortable. Several factors contribute to this situation; some are related to the unsatisfactory design and layout of roads, sidewalks and road furniture. Other problems are related to the poor condition of vehicles that travel on the roads. Most importantly, there is a general trend among drivers and pedestrians of non-compliance with traffic rules and regulations. The situation is further aggravated by a deficiency in traffic legislation and a lack of serious enforcement.

World Health Organisation (WHO) ranks road accidents as the 9th leading cause of mortality and disease. It forecasted that by the year 2020, if programmes are not implemented, road crashes will move up to third place of leading causes of death and disability facing the world community, see WHO, 2004. Studies carried out by the Overseas Unit of the British Transport Research Laboratory (TRL), the French National Institute for Transport and Safety Research (INRETS), and WHO 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% to 2% 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.

In this context, it becomes inevitable that developing countries ought to pursue all possible means to prevent road accidents and relieve their severity, hence achieving acceptable road safety levels. Such prevention has to be based on a proper diagnostic assessment of the road safety situation. Towards this end this paper starts by developing a conceptualization of the road safety pyramid, its components and affecting factors. The road safety pyramid is represented by five components, namely traffic exposure; traffic safety culture, dangerous incidents; accident, severity and damage risk rates as well as accident and casualty based severity rates. In addition, the pyramid shows a categorization of the main factors contributing to the occurrence of road accidents.

The paper develops a three-step procedure to assess road safety conditions. In the first step, a set of generic criteria that can be used to describe and compare the road safety culture is proposed. The second step involves a review, detailed categorisation and computation of the main road safety indicators. Finally, the third step for assessing road safety is concerned with compiling and analysing accident records and identifying accident causes. The developed procedure is applied for Egypt as a prototype example representing developing countries. More than 40 criteria are identified and applied in an attempt to semantically assess the road safety culture in Egypt. Deaths per million vehicle kilometers are obtained for Egypt, three other Arab countries and 6 of the G-7 countries. These were compared in an effort to determine the road safety position of Egypt. Accident records collected in 1998 for five main rural roads in Egypt are compiled and analysed to recognise accident causes. More than 26 causes are identified. These are categorized under six main categories, namely driver related, pedestrian related, vehicle related, road related, environment-related causes and other causes.

Furthermore, the paper concludes by developing an integrated road safety program composed of 16 fields of actions. Each of these contains a number of recommended policies, measures and actions targeted to improve road safety not only in Egypt but also in other developing countries. These are also categorized in accordance with the concerned authority/agency responsible for implementation. The paper concludes by suggesting further road safety research that is needed in developing countries.

2 DEVELOPING ROAD SAFETY PYRAMID

Road safety can be conceptualised as a pyramid composed of five main components at different levels, see figure 1. Towards the base of the pyramid is traffic exposure representing the extent (intensity) and form (nature) of how road users are exposed to traffic. Several traffic related data can be used to represent the extent of traffic exposure. The two most widely used in road safety studies and international comparisons are Annual Average Daily Traffic (AADT) as well as Annual Average Vehicle Kilometers (AAVK). On the other hand, the form of traffic exposure can be defined as the way road users are exposed to the traffic environment. However, due to difficulties in measurement and data collection, the notion of form and nature of traffic exposure is not usually taken into account in most road safety studies.

The second level of the road safety pyramid represents what could be referred to as the prevailing road safety culture. In this research, road safety culture is defined as the cultural environment in which road safety issues are dealt with as well as the level of awareness of the various stakeholders involved with road safety issues. The third level of the road safety pyramid represents the extent and nature of occurring dangerous incidents, see Tight et al., 1998. This can be expressed in terms of number and severity of incidents such as near misses, conflict points, evasive maneuvering, etc. The fourth level of the road safety pyramid represents traffic risk rates. These are indicators relating frequency of accidents, casualties, fatalities,

injuries as well as damages to various exposure measures. Such indicators when computed are representative of probability of accident occurrence. Finally, towards the top of the traffic safety pyramid are what can be referred to as severity rates. These indicators are meant to express probability of an accident resulting into fatalities or a degree of injury or the probability of an accident casualty being a fatality or an injury. These are computed by relating the number of fatalities or injuries either to the number of accidents or to the number of accident casualties.

In developing the road safety pyramid, factors contributing to the occurrence of traffic accidents were identified. These can be grouped into four main categories. Such categorization is based on the nature and time frame of the effect of these factors (causes) on the five components describing road safety. The identified causes include:

(a) Deeply rooted causes of accidents, casualties and damages. These are causes related to the pre-effect of unsafe land use planning and management on traffic exposure extent and form.
(b) Root causes of accidents, casualties and damages. These are related to the pre-effect of unsafe transportation planning and management on traffic exposure extent and form.
(c) Direct causes of accidents, casualties and damages. These can be further categorized into four groupings, namely road related, user related, traffic management related and vehicle related. These four factors are known to be directly contributing to the occurrence of both dangerous incidents as well as actual road accidents with varying severity.
(d) Post causes of accidents, casualties and damages. These are related to factors occurring after an accident took place. Such factors include the effect of accident site management, ambulance and emergency management, medical treatment and trauma management. Such factors may reduce or increase the possibility of a slightly injured victim becoming severely injured or a severely injured victim becoming a fatality.

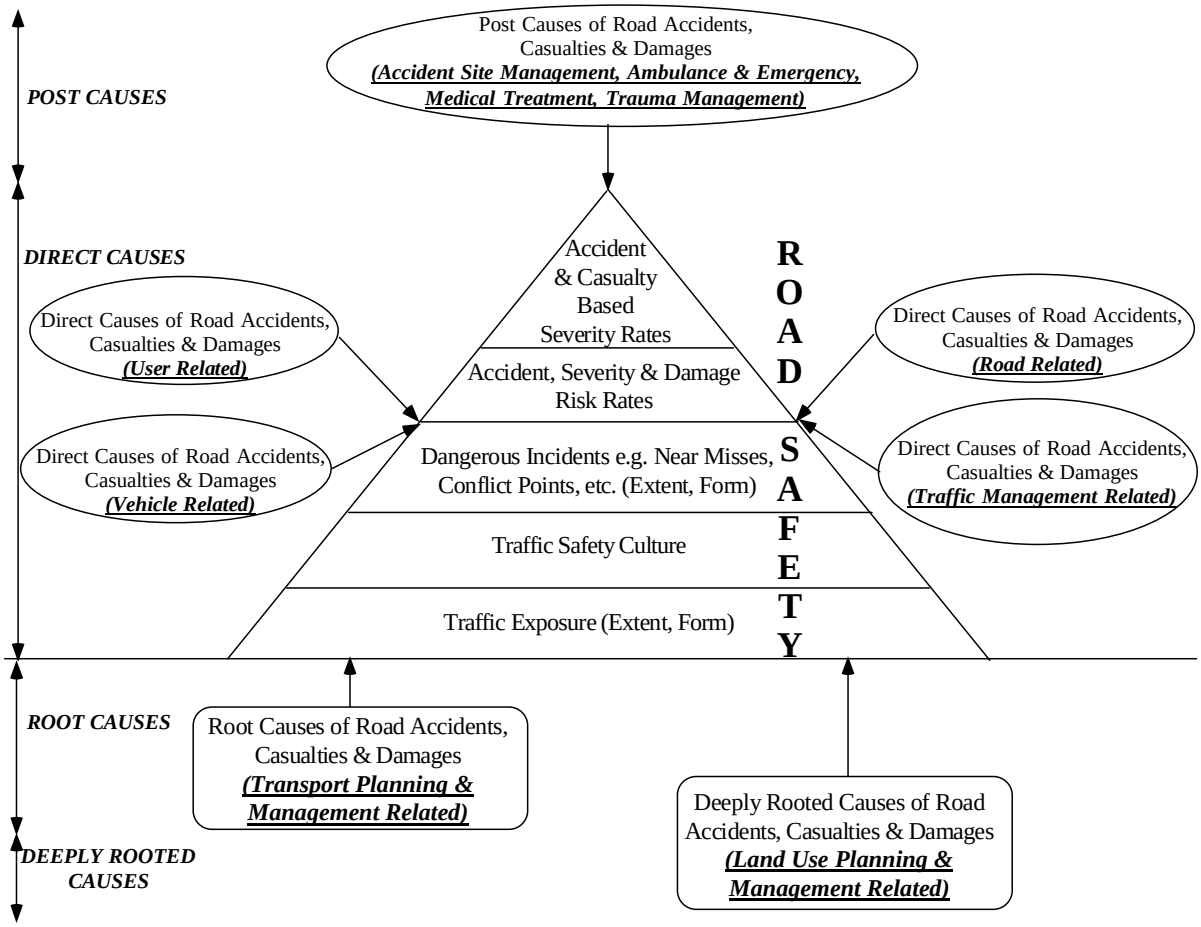

Figure 1: Conceptualisation of road safety pyramid: Components and affecting factors

3 ASSESSMENT OF ROAD SAFETY CULTURE

According to Vasconcellos, 1996, unsafe traffic conditions in developing countries have to be analysed in the context of physical, political, technical and enforcement environments. In this research, the notion of road safety culture is introduced. Assessing road safety culture represents the first step in judging the road safety situation in a developing country. Road safety culture can be represented through 14 aspects, namely:

Political	Accident Management System	Emergency
Institutional	Evaluation	Education
Safety Lobbying	Behavior	Mass Media
Safety Research	Legislation	Coordination and Cooperation
Engineering	Enforcement and Standards	

These aspects are further disaggregated into 40 suggested criterion. The applicability of using these aspects and their related criteria in assessing road safety culture is demonstrated, in Table 1, taking Egypt as a prototype case study. The table shows the semantic description of status of each of these criteria in Egypt.

Table 1: Semantic assessment of road safety culture (environment & awareness) in Egypt

Aspects of Road Safety Culture	Assessment Criteria	Semantic Assessment
Political	Awareness of decision-makers and politicians of road safety	Fully aware, medium priority, relatively limited intervention.
	Goals, policies, targets, objectives on road safety	Almost not existing.
Institutional	National road safety body	An institute for Traffic Accident Research was established in 1994 as part of Ministry of Interior traffic police. However limited funding, resources and political support are hindering its operation.
Safety Lobbying	Road safety lobbying	Exist but uncoordinated
	Involvement of international road safety research organizations	TRRL (Overseas Unit) involved in 1987 through 1990.
	Non government organizations concerned with road safety	Egyptian Society for Road Safety (limited educative & informative role)
Safety Research	National road safety research project	1. 87-90 study, Sponsored by Egyptian Academy of Science Research & Technology (EASRT) in conjunction with UK Transport Research Laboratory & Egyptian Academics. 2. 96-99 study, Sponsored by EASRT with Egyptian Traffic Police Department & Egyptian Academics.
	Other road safety research include studies on road & vehicle conditions, road-user behavior, traffic characteristics, legislation/enforcement	Limited individual, uncoordinated & unsponsored research at concerned university departments & specialized institutes.
	Road safety experts/academics	Few transport/traffic academic experts are present in Egypt with some specialised in traffic safety
Engineering	Locally developed highway standards	First Egyptian Highway Code was issued in 2000 including safety and quality aspects.
Accident Management System	Accident reporting system	First EASRT study produced 4 detailed & comprehensive booklets (accident, technical, medical, economic). These were used during study period. Then detailed recording stopped between 90 to 96. Another simplified form was designed in 1996 by second EASRT study. Traffic police is currently adopting the new form.

	Quality & quantity of completed forms	Lot of underreporting exists especially for damage only accidents. Most information in the forms is completed. However, it is usually the case that this is done by traffic police officers in their offices, sometime hours after accident occurrence.
	Maintenance of accidents data-base	Started in 1997 by the Traffic Police department as part of the second research project using a specially designed Oracle based software.
	Dissemination of accident data	Very tight and controlled dissemination.
	Accident analysis system	Started in 1997 by Traffic Police department as part of second research project using a specially designed reporting system based on Oracle.
	Identification of accidents locations	Black spot identification carried out by traffic police
	Identification of victims patterns	Can be done but currently limited attention.
	Diagnosis of direct accidents causes	Sometimes undertaken.
	Diagnosis of root accidents causes	Does not exist.
	Identification of potential countermeasures	Exist but limited.
	Costing of safety countermeasures	Exist but limited.
	Valuation of traffic accidents	First national study included a detailed collection of accident costs and accident valuation based mainly on lost gross output and a value added to account for intangibles.
	Pre-evaluation of safety countermeasures	Rarely undertaken.
	Post-evaluation of safety countermeasures	Exist but limited.
Evaluation	Inclusion of accident reductions as benefits in highway appraisals	Not taken into account.
Behavior	Road users' respect of traffic rules	Limited.
Legislation	Traffic legislation	Not strict enough. An improvement was recently passed including enforcement of seat belts and helmets. Other improvements are still needed.
Enforcement & Standards	Vehicle inspection	All vehicles have to be inspected. However, limited safety evaluation criteria are included & corruption exists.
	Driving test pass rate	High but recently more stringent.
	Driving test theoretical part (Signs)	Well observed.
	Driving test theoretical part (Highway Code)	Relatively neglected.
	Driving test practical part	Involves limited maneuvering on a test area.
	Special training for traffic police	Exist.
Emergency	High speed emergency service	Relatively good. On road medical centers and emergency hospitals exist. One hospital being established with helicopter rescue service (private & government efforts).
Education	Separate road safety syllabus for school education	Some road safety related children books were developed. However, still no formal road safety education at schools.
	Children traffic parks	Exist as a component of a limited number of private recreation parks.
Mass-media	Radio and television programs on road safety	Exist but limited.
	Road safety posters and leaflets	Almost do not exist.
Coordination & Cooperation	Liaison between traffic police and road engineers	Exist but not coordinated.
	Road safety week	Sometimes, not regular.

4 ROAD SAFETY INDICATORS: PURPOSE AND CLASSIFICATION

Absolute numbers of traffic accidents, casualties, fatalities and damages do not represent indicative figures to be used for assessment and comparison of road safety. The most meaningful indicators are relative values. These are known as road safety indicators. Computing road safety indicators represents the second step in the assessment of the road safety situation in a developing country. Road safety indicators serve several purposes, namely:

- Identification of safety problems and their intensities
- Determination of road safety levels
- Comparison of road safety levels
- Design of effective accidents' countermeasures
- Evaluation of accident countermeasures

The literature also shows that there are several types of exposure measures that can be used in the computation of road safety indicators and hence in the evaluation of road safety, see Chang, 1982. As shown in figure 2, seven groups of exposure statistics are suggested to be utilized in the computation of road safety indicators, namely:

(a) National based exposure measures
(b) Traffic based exposure measures
(c) User based exposure measures
(d) Distance based exposure measures
(e) Time based exposure measures
(f) User-distance based exposure measures
(g) User-time based exposure measures

Definitions and mathematical formulations for each of these road safety indicators are presented below.

Static exposure indicators: These represent degrees of static exposure to accidents. This is done by computing the relativity of static national based exposure statistics, such as area, population, registered vehicles, licensed drivers and road kilometers, to each other as follows:

Static exposure indicator (Type 1) = Licensed drivers/ Population
Static exposure indicator (Type 2) = Registered vehicles/Licensed drivers
Static exposure indicator (Type 3) = Kilometres of road/Land area
Static exposure indicator (Type 4) = Kilometres of road/Population
Static exposure indicator (Type 5) = Kilometres of road/Licensed drivers
Static exposure indicator (Type 6) = Registered vehicles/Kilometres of road

Dynamic exposure indicators: These represent degrees of dynamic exposure to accidents. This is done by computing the relativity of dynamic based exposure statistics; such as traffic, number of users, travelled distance, journey times, user-distance and user-time; to static national based exposure statistics as follows:

Dynamic exposure indicators (Type 1) = Traffic exposure statistics/National exposure statistics
Dynamic exposure indicator (Type 2) = User exposure statistics/National exposure statistics
Dynamic exposure indicator (Type 3) = Distance exposure statistics/National exposure statistics
Dynamic exposure indicator (Type 4) = Time exposure statistics/National exposure statistics
Dynamic exposure indicator (Type 5)=User-Distance exposure statistics/National exposure statistics
Dynamic exposure indicator (Type 6) = User-Time exposure statistics/National exposure statistics

Accidents' risk indicators: These represent the number of accidents relative to selected exposure statistics. These are computed as follows:

Accidents' risk indicators = Number of accidents/Exposure statistics

Severity risk indicators: These represent the numbers of casualties or fatalities or injuries relative to selected exposure statistics. These are computed as follows:

Severity risk indicators (Type 1) = Number of casualties/Exposure statistics
Severity risk indicators (Type 2) = Number of fatalities/Exposure statistics
Severity risk indicators (Type 3) = Number of severely injured/Exposure statistics
Severity risk indicators (Type 4) = Number of slightly injured/Exposure statistics

Damage risk indicators: These represent the number of damage only accidents relative to selected exposure statistics. These are computed as follows:

Damage risk indicators = Number of damage accidents/Exposure statistics

Accident based severity indicators: These represent the numbers of casualties or fatalities or injuries relative to the number of accidents. These are computed as follows:

Accident based severity indicator (Type 1) = Number of casualties/Number of accidents
Accident based severity indicator (Type 2) = Number of fatalities/Number of accidents
Accident based severity indicator (Type 3) = Number of severely injured/Number of accidents
Accident based severity indicator (Type 4) = Number of slightly injured/Number of accidents

Casualty based severity indicators: These represent the numbers of fatalities or injuries relative to the number of casualties. These are computed as follows:

Casualty based severity indicator (Type 1) = Number of fatalities/Number of casualties
Casualty based severity indicator (Type 2) = Number of severely injured/Number of casualties
Casualty based severity indicator (Type 3) = Number of slightly injured/Number of casualties

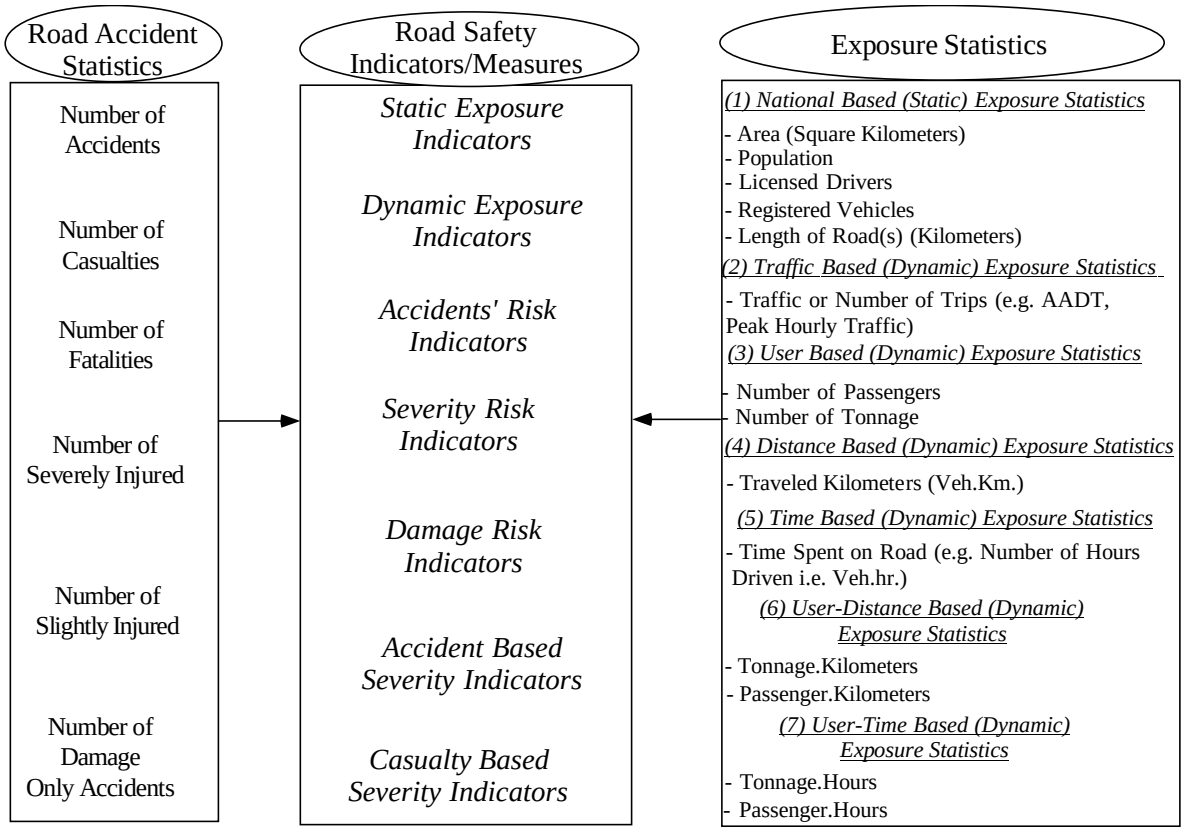

Figure 2: Types of Road Safety Indicators/Measures: Required Data & Basis for Computation

4.1 Fatalities per 100000 People

Currently the statistic most often used to compare road safety records around the world is the number of persons killed for every 100000 people, see IRF World Road Statistics 2009. In this section, an attempt is made to draw data from this recent publication in order to conduct an international comparison of road deaths per 100000 people among Egypt, some Arab Middle eastern countries, and some of the G-7 countries, see Table 2. The table demonstrates how this severity indicator can be used in the assessment of road safety in Egypt comparable to other countries.

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The table shows that Egypt stands as having a significantly high rate of deaths per 100000 people than all of the selected G-7 countries. However, when compared to other Arab countries in the region Egypt stands to have the lower deaths per 100000 people However, caution must be used in drawing absolute conclusions about relative road safety among the countries as this indicator does not relate accident deaths to a real exposure measure. A better statistic to compare road safety records around the world is the number of persons killed for every 100 million vehicles-kilometers. The difficulty of obtaining such indicator lies in the availability of correct data or computation of vehicle-kilometers. Still, the above comparison shows the worsening situation of road safety in Egypt.

Table 2: Deaths per 100000 People: An international comparison (Source IRF, 2009)

Countries Safety Indicator	Japan	France	Germany	Italy	UK	USA	Saudi Arabia	Egypt	UAE	Jordan
Deaths per 10000 People.	5.2	7.49	6.02	8.64	4.83	13.68	26.32	16.29	23.46	17.35

5 ANALYSIS OF ACCIDENT CAUSES FOR RURAL HIGHWAY NETWORK IN EGYPT

Analysis of accident causes represents the third step in the proposed assessment of the road safety situation in a country. In this section, an analysis of accident causes on the rural road network in Egypt is presented. Two accident investigation programs took place in Egypt. The first was initiated in the 1980's, when a national study funded by EASRT was conducted, see EASRT, 1991. In this study, accident and traffic behavior data were collected for five main rural roads in Egypt and three major districts in Greater Cairo. The study was undertaken by the Traffic Police Department in conjunction with Egyptian academics and cooperation of the UK Transport and Road Research Laboratory. The accident management system developed by this study was not fully pursued due mainly to lack of allocated resources and the sophistication and length of the data collection forms. The second program, which was also funded by EASRT, looked at developing an accident management system with an easy to use accident-reporting form. The developed system was applied for the collection, analysis and reporting of traffic accidents for 14 sections of roads representing eight major rural roads in Egypt. The traffic police department in conjunction with Egyptian academics undertook this study. Data collection spanned over the period 1997 to 1998 and is currently being maintained by the traffic police department in accordance with the developed system.

Analysis of causes of accidents for rural roads in Egypt is based on accident data collected in the second study for year 1998. The developed accident reporting form contains 27 causes of accidents see Table 3.

Table 3: Share of accidents' causes for five main rural roads in Egypt (1998 Data)

Accidents' Causes	**Five Considered Main Rural Roads**	
User Related Causes (Driver)	Number	Percentage
Loss of Control of Driving Wheel	378	26.96%
Over Speed	174	12.41%
Misjudgment of Traffic Gap	167	11.91%
Sudden Slowing/Stoppage	110	7.85%
Un-careful Lane Changing	48	3.42%
Overtaking from the Right	37	2.64%
Sub-Total	914	65.19%
User Related Causes (Pedestrian)	Number	Percentage
Misjudging Traffic Speed While Crossing	45	3.21%
Standing/Walking on Road Shoulder	15	1.07%
Sub-Total	60	4.28%
Vehicle Related Causes	Number	Percentage
Tire Burst & Vehicle Turnover	204	14.55%
Tire Burst and Vehicle Turn Off Road	71	5.06%
Tire Separation	12	0.86%
Brake Deficiency	11	0.78%
Trailer Separation	7	0.50%
Non-operable Vehicle lights	3	0.21%
Reflective Mirrors Missing	2	0.14%
Deficiency in Window Screens	1	0.07%
Vehicle Overloaded	1	0.07%
Load Length Beyond Permissible	0	0.00%
Load Height Beyond Permissible	1	0.07%
Load Falling (Trailer Connection Defect)	2	0.14%
Sub-Total	315	22.47%
Road Related Causes	Number	Percentage
U-Turns	38	2.71%
Skidding Surface	4	0.29%
Dangerous Curve/Gradient	4	0.29%
Road Works	2	0.14%
Poor Road Condition	1	0.07%
Sub-Total	49	3.50%
Environment Related Causes	Number	Percentage
Bad Weather Conditions	41	2.92%
Sub-Total	41	2.92%
Other Causes	Number	Percentage
Sub-Total	23	1.64%
Total	1402	100%

A traffic police at an accident site can mark one or more of these as causes for an accident. These are listed and categorized in Table 3 into six categories, namely: driver related causes (6 causes), pedestrian related causes (2 causes), vehicle related causes (12 causes), road related causes (5 causes), environment related causes (1 cause) and other causes. The frequency and contributing percentage of each of the considered accident causes is also shown in table 3. Most of the highly contributing causes are driver related. These include loss of control of driving wheel, over speed, misjudgment of traffic gap, sudden slowing/stoppage.

Two other causes related to the vehicle are frequently mentioned, i.e. tire burst and vehicle turnover or turn off the road. Together, these six causes contribute around 83% of accident causes on the five roads. In general, driver related causes contribute around 59% to 73%. This is followed by vehicle related causes contributing around 23%. Pedestrian related causes also

contribute around 4%, while road related causes contribute only 3.5%. Environment and other related causes are in the range of 3.5%.

6 AN INTEGERATED PACKAGE TO IMPROVE ROAD SAFETY IN EGYPT AND OTHER DEVELOPING COUNTRIES

Based on the previous analysis, review, conclusions, author's experience and discussions with several experts and officials, the paper develops an integrated road safety program applicable for Egypt and other developing countries, see Table 4. Such program is composed of various policies, measures and actions targeted to improve road safety. These are categorized into 16 topical fields of action namely: institutional, land use planning and management, travel demand management, road infrastructure improvement, legislation, traffic-related, accident-related, vehicle-related, driver-related, traffic police-related, enforcement, educational, mass-media, community related, health-related and research-related measures. In addition, the table shows for each of the topical areas the concerned body, authority or agency that is thought to be most suitable to hold responsibility for implementation.

It is to be noted that these outlined policies and measures should not be treated separately. As a matter of fact, any package of road 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 road safety problem. The table attempts to list the fields of action in a priority fashion where the starting phase should focus on developing the institutional framework complemented by research and legislation. This is then followed by planning, establishing strong enforcement, educating and communicating to the public.

Table 4: Integrated program to improve road safety in Egypt & other developing countries

Field of Action	Policies, Measures & Actions Targeted to Improve Road safety in Egypt & Other Developing Countries	Concerned Authority
Institutional	• Establish a proper institutional framework to support and ensure continuity of implementation of road safety activities. This should have the necessary authority to enable it to work and coordinate all road safety efforts conducted by different ministries, authorities and organizations. This could take the form of a National Road Safety Council to cut across several government and nongovernmental bodies to advise government on policy formulation for road safety activities. Such council should have support at highest level in government and should also have a legal entity. • Establish a Road Safety Unit to implement programmes pertaining to road safety. Such 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 have provincial/district offices to provide in field backup	Prime Minister Cabinet
Research-Related	• Special grants to conduct road safety research offered and consistency maintained. • Organize national and international road safety conferences. • Easy and accessible dissemination of accident data to all interested organizations/individuals that need to use data particularly for research. • Conduct specialized research in transport & traffic eng. as related to road safety. • Organize training courses, seminars, and lectures for engineers, professionals and technicians in the areas of road safety. • Establish research linkages and contacts with international road safety organisations and research centers. • Develop and update specialised libraries through which access and dissemination of road safety research publications, information could be maintained.	Safety Research Institutes & Universities
Legislation	• Issuing laws that grant traffic police more enforcement authority. • Stringent penalties for violations should be adopted. Penalty package including warnings, penalty points, on the spot fines, off the spot fines, traffic driving license withdrawal, driving suspension, suspended imprisonment, driving license revoking	Legislative Bodies

	• Legislation penalising pedestrians for violating traffic rules and regulations, such as crossing carriageway at any location, should be issued. • Legislation to be developed that strictly and totally prohibits drinking and driving, driving with no seat belts or safety helmets. • Low speed limits should be established in urban areas especially in front of schools, and areas characterised by heavy pedestrian movements. • In general, traffic laws to be repeatedly updated. New offenses to be clearly defined and stringent penalties to be specified.	
Land Use Planning & Management	• Ensure compatibility of land use types along main roads. • Land allocated for residential activities to be separated from main roads. • Activities attracting heavy goods vehicles to be located on main roads. • Adopt a hierarchical classification for road network functional of land use. • Relocation & resettlement of urban sprawls existing at cities periphery and especially those around start and end of intercity roads. • Consideration of road safety aspects in selecting locations for originating and ending points of intercity roads. • Land use plans that minimise the travelling distances, thus encouraging more pedestrian walking rather than vehicle traffic, should be considered. • Choosing safe locations for schools, and allocating substantial space for school playgrounds. School entrances to be at lightly trafficked side-roads.	Ministry of Urban & Regional Planning
Enforcement	• Develop traffic court systems capable of promptly handling traffic violations and inflicting appropriate rulings. • Court system pertaining to traffic violations should be mainly looking at major cases of traffic accidents or traffic violations. Traffic police should be given more powers to inflict on-the-spot penalties. • Develop computerized databases to allow traffic courts to identify repeated violations and inflict proper and consistent rulings.	Judicial Authorities
Educational	• A strong commitment towards road safety education & training at schools is needed. Road safety to be a separate, graded subject at all schools. • Developing teachers' guidelines for instructing teachers on how to teach road safety for school children. • Construct children traffic parks to educate and train children of safe practices when dealing with the traffic environment.	Ministry of Education
Mass-Media	• Promoting and raising society awareness of potential traffic hazards. Media campaigns to concentrate on disseminating knowledge to the public regarding safe use of road environment, as well as attempting to change unsafe traffic attitudes. • An annual traffic week or a monthly traffic day should be developed. This involves concentrated mass media campaigns on road safety aspects, press articles, exhibitions, competitions, posters, leaflets and pamphlets. • Television and radio interviews with officials responsible for road safety such as traffic police officers, academics, engineers, doctors, and teachers.	Ministry of Information
Travel Demand Management	• Provision of public transport facilities that offer premium levels of service to encourage private-car users to switch to using public transport facilities. • Different forms of car-pooling should be encouraged. • Different forms of city traffic restraint to be practiced such as high parking fees, restricted parking areas, city entry tolls, staggered license plate entry.	Traffic-Engineering Department*
Road Infrastructure Improvement	• Incorporating potential reductions in traffic accidents as benefits when conducting feasibility assessment of constructing new roads. • Design of new roads to incorporate design safety criteria. • Stringent monitoring and quality control during construction of new roads and maintenance of existing ones. • Taking necessary safety precautions during road works. • Alignments of new intercity roads selected away from pedestrian & animal paths. • Removal of illegal encroachments within intercity road boundaries. • Construction of side barriers to prevent sudden crossings of pedestrians/ animals. • Construction of pedestrian bridges/tunnels to enable segregated pedestrian crossing of main roads. • Proper road shoulders constructed/maintained & used only for emergency traffic.	Ministry of Transport (Roads Authority)

	• Installation/improvement of road furniture (markings/channelisation/signing/lighting) • Construction and improvement of road supporting facilities along intercity roads such as rest areas, petrol stations, vehicle repair shops, motels, etc.	
Traffic-Related	• Local manufacturing of traffic signals, signs, markings, guard fences to be encouraged. A road safety industry can develop that manufactures, installs and maintains these road safety features. • Traffic calming measures to be widely adopted. These measures are meant to reduce the number and the severity of pedestrian/vehicle conflicts. • Warning signs & speed control humps to be placed in front of schools. • More use of intersection designs that are speed-self reducing. These include: roundabouts, curves at T-junctions. • Provision of adequate street lighting. • Maintenance of traffic control devices should be well programmed. • Sidewalks to be wide enough especially in heavily pedestrianised areas to allow for a more comfortable and easy movement for pedestrians. • Kerbs to be dropped at pedestrians crossings to ease the crossing. • Crossing to be staged, on wide roads, through central refuge islands to allow pedestrians to negotiate one traffic stream at a time. • Roads characterised by dense pedestrian movement considered for pedestrianisation. • Hazardous locations such as open gutters, open electricity kiosks to be fenced with visual and audible warning signs. • Introduce, expand & enhance traffic counting programs for all network. • Establish driver information system to inform & warn drivers of traffic & weather conditions, maintenance works, accident/incident occurrence, etc.	Traffic-Engineering Department*
Accident - Related	• Establish a group of road safety engineers and technicians. These should be trained for use of microcomputers for accident data coding, storage as well as for accident data analysis, identification of black spots, countermeasures scheme design and monitoring. • A reliable accident database is crucial for any safety improvement. Attention to be given to the whole process of accident data collection, storage, and analysis to systemize and ensure that it is functioning in an adequate and efficient manner.	Traffic-Engineering Department
Vehicle-Related	• Develop vehicle standards and specifications to include sufficient safety features. This is done in coordination with other concerned authorities. • Develop time schedules & programs for mandatory vehicle inspection in accordance with type & age of vehicles. This should determine road worthiness of vehicles. • Build special stations for technical inspection of vehicles. • Inspection procedures should be stringent so as not to allow any vehicles with serious defects to operate on the roads.	Traffic-Engineering Department*
Driver-Related	• Develop specifications/standards for driving schools. Drivers' instructors to be trained and tested. • More tight & stringent driving tests emphasizing practice & knowledge. • Design a national driving handbook. • Management of pick up and dropping of children in front of schools. School patrol crossings and community assistance should be encouraged. • School bus drivers should ensure dropping children on the road off side.	Traffic-Engineering Department*
Traffic-Police Related	• Traffic police to be well trained & equipped. Special training for traffic police officers to include abilities to conduct accident investigation, deal with accident reporting, assist in victims rescue, clear accident sites, etc.	Ministry of Interior
Community-Related	• Develop specialized training and educative adult programs to increase their knowledge of road safety aspects. These should be particularly targeted towards uneducated rural communities.	Other non-government organizations
Health-Related	• Quick emergency service using latest equipment for communication, well trained first aid officers, and high-speed mode for victim transportation. • More small well equipped medical centers that are specialized in dealing with accident emergency to be located in different areas so as to minimize time of transporting victims from accident sites to medical centers. • Training of traffic police officers on first aid & promoting public first aid awareness. • Coordination of accident rescue operations among traffic police officers, first aid and emergency officers and hospitals.	Ministry of Health

The above package was initially proposed by the author as a consultant to the UN and endorsed by the UNECA, 1997 report. It was further improved and translated into Arabic and proposed by the author to the Egyptian government in his contribution to the EASRT, 1999 report.

7 CONCLUSIONS

This paper started by developing a conceptualisation of components constituting road safety pyramid. In addition, a categorization of the main causes contributing to the occurrence of traffic accidents and their possible effects on road safety were presented. The paper developed a three-step procedure to assess road safety conditions in a country. First, a set of generic criteria that can be used to describe and compare the road safety culture was proposed. The second step involved a review, detailed categorisation and computation of the main road safety indicators. Finally, the third step for assessing road safety was concerned with compiling and analysing accident records and identifying accident causes.

An assessment of road safety conditions in Egypt was conducted through this three-stage procedure. In this context, Egypt served as a prototype example for developing countries. More than 40 criteria were identified and applied in an attempt to semantically assess the road safety culture in Egypt. Fatalities per million vehicle kilometers were obtained for Egypt, three other Arab countries and 6 of the G-7 countries. These were compared in an effort to determine the road safety position of Egypt. The comparison showed that Egypt stands as having a significantly very high rate of deaths per 100 million veh.km. Accident records collected in 1998 for five main rural roads in Egypt were compiled and analysed to recognise accident causes. More than 26 causes were identified. These were categorized under six main categories, namely driver related, pedestrian related, vehicle related, road related, environment-related causes and other causes.

The paper concluded with developing an integrated road safety programme composed of 16 fields of actions. Each of these contains a number of recommended policies, measures and actions targeted to improve road safety in Egypt as well as in other developing countries. These are categorized in accordance with concerned authority responsible for implementation.

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