



24th WORLD ROAD CONGRESS MEXICO CITY 2011

GENERAL REPORT AND DETAILED CONCLUSIONS



CONTENTS

Foreword	4
PREFACE.....	5
INTRODUCTION	7
GENERAL REPORT	9
Sustainability of road transport system (ST A)	9
Introduction.....	9
Preserving the environment.....	9
Financing, managing and contracting road system investments	11
Road system economics and social development	13
Rural road systems and accessibility to rural areas	16
Conclusions for ST A.....	17
Improving provision of services (ST B).....	19
Introduction.....	19
Good governance of road administrations.....	19
Road network operations.....	21
Improved mobility in urban areas	22
Freight transport and intermodality	24
Winter service.....	25
Conclusions for ST B.....	27
Safety of the road system (ST C).....	28
Introduction.....	28
Safer road infrastructure.....	28
Safer road operations.....	31
Managing operational risk in road operations.....	33
Road tunnels operation	35
Conclusions for ST C.....	35
Quality of road infrastructure (STD)	37
Introduction.....	37
Management of road infrastructure assets	37
Road pavements	39
Road bridges	40
Geotechnics and unpaved roads.....	42
Conclusions for ST D.....	43
Looking into the future	44

DETAILED CONCLUSIONS	47
Strategic Direction Session A	47
TC A.1 Preserving the environment	48
TC A.2 Financing, managing and contracting of road system investments	48
TC A.3 Road system economics and social development.....	51
TC A.4 Rural roads systems and accessibility to rural areas.....	53
Strategic Direction Session B	58
TC B.1 Good governance of road administrations.....	59
TC B.2 Road network operations	62
TC B.3 Improved mobility in urban areas	63
TC B.4 Freight transport and intermodality.....	66
TC B.5 Winter service.....	68
Strategic Direction Session C	70
TC C.1 Safer road infrastructure	72
TC C.2 Safer road operations.....	74
TC C.3 Managing operational risk in road operations	76
TC C.4 Road tunnel operations	78
Strategic Direction Session D	80
TC D.1 Management of road infrastructure assets.....	81
TC D.2 Road pavements	84
TC D.3 Road bridges.....	85
TC D.4 Geotechnics and unpaved roads.....	86

Foreword

The General Report of the XXIV World Road Congress was prepared under the supervision of the Strategic Planning Commission of the World Road Association (PIARC), which reviewed the drafts.

The General Report has been prepared by Héctor Bonilla (Mexican Transport Institute - IMT), with contributions from Guillermo Torres (IMT), Jorge Acha (IMT), Alberto Mendoza (IMT), Paul Garnica (IMT), from PIARC General Secretariat: Jean-François Corté, Byeong-Jin Lee and Yasuyuki Matsumoto, and from the Chairs of the Technical Committees.

Final editing of the General Report was made by Jim Barton, Mike Winter and Jean-François Corté.

PREFACE

The XXIV World Road Congress, held in Mexico City, marked the beginning of the second century of the World Road Association (PIARC). The slogan of the congress, *Roads for a Better Life*, reflected both the current achievements and the challenges still pending to improve the mobility of people and goods.

Great challenges

The second half of the 20th century saw the globalization of economics and transportation that is so closely associated with the international mobility of people and freight. Globalization has triggered a major thrust for exchanging assets, particularly goods. The execution of international commercial treaties and the integration of countries under schemes such as the European Union, the Free Trade Agreement in North America (NAFTA), the *Mercosur* in South America, the Latin American Association for Integration (ALADI) and the Asia-Pacific Economic Cooperation Forum (APEC) has been a common theme. These schemes promote as general objectives the free trade of goods, services and production, the adoption of common commercial policies, the coordination of macro-economic and sectorial policies, and the harmonization of legislation, for example. On the other hand, and considering the risks inherent to globalization, in the period 2008-2011 covered by this report, a major world economic crisis developed and its consequences are still being felt. Amongst these consequences is the economic slowdown, particularly in developed countries, although there are some exceptions from the emerging countries such as China, India and Brazil. Even though such crises force the need to perform in-depth analyses and to review the approaches of the currently prevailing global economic model, there is no alternative to roads as the predominant transport mode for the foreseeable future.

The future of transport is as part of an energy scenario of scarce fossil fuels. This reality is rapidly being established whether as a function of the available resources or as governments react to the need for climate change mitigation. Transport will thus be increasingly associated with a scenario built upon more sustainable energy alternatives with less environmental impact. The *Intergovernmental Panel on Climatic Change*, established by the United Nations and the World Meteorological Organization, is anticipating that the sun, wind, water and biomass will become the main sources of energy by year 2050, satisfying as much as 77% of the World demand, according to the report submitted in May 2011. In the meantime, long-term projections of the oil industry indicate that oil will continue to be the most consumed fuel at least until 2030. A growth in the demand for oil is projected at $\pm 1\%$ a year on average, promoted particularly by countries in the process of development, taking into account that 97% of such demand is due to the global transportation sector. It is necessary that sustainability, in the sense of exploitation of the road infrastructure, be assumed and considered by all nations at the time of setting up and implementing their development-related policies.

The United Nations, through the World Health Organization, has launched the *World Plan for the Decade of Action on Road Safety 2011-2020* that contemplates, among other factors, the improvement of road infrastructure and the behaviour of road users, the homologation of safety-related instruments and the introduction of control technologies, with the purpose of radically reducing the accident rates in roads and urban roads that presently produces 1.3 million deaths a year worldwide. The World Road Association participates as a collaborating partner in the topics of road safety outlined by the United Nations.

There is clearly some way to go before a satisfactory state can be said to exist in respect of the pandemic disease of corruption. As stated by Transparency International, the varied effects of corruption range from the political (loss of legitimate rights, creation of obstacles to democracy), through the economic (depletion of national wealth, diversion of public resources, distortion of competitiveness, dissuasion of prospective investors) and the social where damage is at its peak (undermining confidence, creating frustration, generating apathy, weakening society) to the environmental (lack of environmental legislation or non-compliance, promotion of plundering of natural resources, promotion of damaging infrastructure projects). Proposals have been made by various organizations to tackle corruption by creating agreements among authorities, civil society and the business sector, by eliminating the corruption ring one step at a time and by applying the principle of non-confrontation among the various players. The World Road Association, being aware of this sensitive matter, has included this topic in the terms of reference of its Technical Committee *Good governance of road administrations* and has dedicated a special session of the Congress to good governance and transparency in addition to what is to be delivered and discussed in the strategic theme on efficient customer-oriented services.

The current World view exhibits many challenges for the road transportation sector; these can, of course, be transformed into improvement opportunities. More social development is required on a wider and more reasonable scale so that welfare permeates through all levels of society. Boundless creativity is a *sine qua non* condition to help those challenges be converted into safer and more efficient, effective, economic, sustainable and modern solutions.

INTRODUCTION

The 2008-2011 Strategic Plan of the World Road Association

Since 1995, the activities of the World Road Association have been governed by a quadrennial strategic plan resulting from a process of consultation with its member countries and other stakeholders.

The strategic plan for the period 2008-2011 defined the organizational structure of the different technical committees in terms of four strategic themes:

Strategic Theme A: Sustainability of the road transport system.

Strategic Theme B: Improving provision of services.

Strategic Theme C: Safety of the road system.

Strategic Theme D: Quality of road infrastructure.

Strategic Theme A was established to cover the sustainability of the road transport system with the objective of encouraging the development of road transport policies and programs that result in beneficial community outcomes for sustainable and safe mobility in economic, environmental and social terms, with special attention paid to energy issues and the mitigation of the impacts on climate from the road transport system.

The objective of Strategic Theme B is to promote the improvement of the services provided to the community through the optimization of the operation of the road transportation system, the integration with other transport modes, good governance and a user-oriented approach.

Strategic Theme C seeks the improvement of the safety and efficiency of the road system, including with regards to the movement of persons and goods along the system, as well as in the effective management of the risks associated with the operation of the road transport systems and of their environment.

Finally, the objective of Strategic Theme D was centred upon improving the quality of the road infrastructure through the effective management of its assets pursuant to the expectations of the users and managers.

Programme of the congress

The congress comprised a broad range of sessions:

- The ***Ministers' session***, on the topic “*Sustainable mobility within social policy*”, chaired by the Secretary of Communications and Transport of Mexico, Mr. Dionisio Perez Jacome Friscone. Ministers from all over the world shared their points of view, in three round tables:
 - Round table 1: *Sustainable transport financing*, introduced by Mr. José Luis Irigoyen, Director of the Department of Transport, Water and Communications Technology of the World Bank.

- Round table 2: *Environmentally responsible development*, introduced by Mrs. Carole Coune, Secretary General of the International Transport Forum of the Organization for Economic Cooperation and Development.
- Round table 3: *Safe mobility*, introduced by Mrs. Anne-Marie Leclerc, President of the World Road Association.
- Three **keynote speeches** in plenary session:
 - A global perspective on road safety challenges and opportunities, by Dr. Etienne Krug, Director Department of Injuries and Violence Prevention, World Health Organization;
 - Prospective of public road policies in the road sector, by Mr. Dionisio Pérez-Jácome Friscione, Secretary of Communications and Transport of Mexico;
 - Lessons learned from the great earthquakes of Chile and Japan, by Mr. Mario Fernandez Rodriguez, Road Director, Ministry of Public Works of Chile and Mr. Shigenobu Kawasaki, Director for Road Engineering Analysis, National Highway and Risk Management Division, Ministry of Land, Transport and Tourism of Japan.
- Four **strategic direction sessions** chaired by the Strategic Theme Coordinators;
- Eighteen **technical sessions** prepared by the Technical Committees;
- Thirteen **special sessions** prepared by the Association with the participation of other international organizations;
- Three **workshops**, one on Airfield pavements, and two dedicated to a presentation of the functionalities and uses of the software for analysis of road investments and maintenance strategies HDM-4; and
- Presentation of the work of the Committee on Terminology, in the pavilion of the World Road Association.

Content of the general report

The purpose of this General Report is to present a comprehensive summary that reflects the outcomes of the works performed by the Technical Committees during the four-year period that started at the Congress of Paris 2007, as well as to deliver the conclusions of the different sessions of the Mexico 2011 Congress.

This report is structured in two parts. The first is the general report. It contains both the challenges and the objectives of each strategic theme as well as the topics discussed during the Congress and the medium-term future perspectives. This first part was presented by the Director General for Roads of the Secretary of Communications and Transportation of Mexico during the Closing Session of the Congress. The second part contains the detailed conclusions derived to a large extent from the discussions held at the technical sessions. This second part will only be published in the final proceedings of the Congress.

GENERAL REPORT

Sustainability of road transport system (ST A)

Introduction

In this section a brief description is presented of the work, during the period 2008-2011, of the Association's four Technical Committees of Strategic Theme A "Sustainability of road transport system": A.1 *Preserving the Environment*; A.2 *Financing, Managing and Contracting of Road System Investments*; A.3 *Road System Economics and Social Development*; A.4 *Rural Road Systems and Accessibility to Rural Areas*. Topics that were discussed during the sessions of the World Road Congress related to this theme are also identified.

Special Sessions 2, ***What are the perspectives for road transportation systems in different parts of the world?*** and 3, ***Integration of road networks and other surface transport modes at continent level and modal shift***, complemented the Technical Committee's sessions and were intended to provide an overall view of the major challenges and perspectives for the road transportation system in the different continents taking into consideration the differences of economic and social development and of geographic context.

Preserving the environment

Technical Committee (TC) A.1 was tasked with addressing the challenges related to the reduction of the environmental impacts arising from roads and road transport. These challenges concern all countries. Consideration of how these challenges may be addressed requires consideration of a series of methods and actions, from global policy and national regulations to local practices. The committee devoted its attention to the following topics.

Climate change

Climate change is one of the most serious threats facing the world today. There is compelling scientific evidence that the global climate is changing and that the primary cause is the release of greenhouse gases resulting from human activity. Government at all levels has a responsibility to address climate change issues.

Whilst transport is a key driver of the economy, it is also a significant contributor to greenhouse gas emissions. An estimated 10% of all anthropogenic emissions come from road transportation, 23% of the world-wide emissions of carbon dioxide (CO₂) are derived from combustion of fossil fuels and road transport contributes with 17% of that 23%. Most of the CO₂ emissions generated by road transportation are produced by vehicular operation (~95%). The transport sector is 95% dependent on oil, accounting for 60% of all oil consumption.

The subject of climate change and of reduction in carbon emissions, is a relatively new one. Therefore many governments, particularly and largely those in the developing countries and countries in transition have either no such specific policies, so far, or they are in the very early stages of development. In view of the fact that the subject is relatively new, it is very difficult to establish best practices at this point in time. However, leads taken by some countries in specific areas can be quoted as good practices for others to consider.

From the review of different countries' plans, policies and initiatives for mitigating the impacts of roads and road transport on the climate and adapting road transport systems to climate change, TC A1 derived different conclusions including:

- Success approaches demand the forming of robust plans with firm reduction targets and strong monitoring and transparent reporting;
- Global reduction of transport emissions will be the result of a combination of multiple approaches and solutions, such as technological advances, improved planning and delivery of infrastructure, behaviour changing and fiscal measures;
- Climate change must be addressed as a risk issue so that we can protect infrastructure whilst we learn to manage and reduce emissions;
- The development of common whole life approaches to the issue of carbon accounting and management is necessary to ensure that decisions can be made on sound information.

Environmental monitoring

Awareness that environmental impacts induced by roads constitute an important part of a sustainable approach to the provision of a transportation infrastructure is now generally high. The construction, operation and maintenance of infrastructure has consequences on nature, landscape, water and air quality, noise propagation and other environmental fields. Therefore impacts should be carefully monitored. The Technical Committee sought to clarify what is encompassed in the concept of environmental monitoring from current practice in different countries.

Most often, monitoring is project-related and focussed on the efficiency of mitigation measures. Network level monitoring is oriented at researching the wider impacts of roads. The very definition of environmental monitoring was subject to interpretation, since monitoring is often confused with mitigation.

Case studies show that monitoring can be of significant value in each environmental field. Different examples demonstrate how monitoring has contributed to show trends and influenced policies.

Alternative energies

The topics of the generation and use of alternative energies and reduction of impacts on the environment offer potentially multiple economic, social and environment benefits. Case histories were identified on the recovery of photovoltaic energy, micro-generation of wind and hydraulic energy as well as the exploitation of thermal energy of pavements. The planning of new roads or the rehabilitation of existing highways provide the opportunity for the investigation of the potential for renewable energy production on the road estate, together with opportunities to reduce direct energy consumption. However, further trials of those technologies are necessary to infer recommendations.

Special Session 13, ***Future of automobile transport (technology and usage) and its impacts on road infrastructure and operations***, highlighted the necessity of a better collaboration among government agencies and the automotive industry to generate technological development that improves the use of the vehicle, reduces energy consumption and the amount of CO₂ emissions.

It is also necessary not only to invest in strategies that increase the number of electric vehicles but also invest in an infrastructure that can support the increasing number of them. At present there is an unbalance between the demand of electric vehicles and the construction of the adequate infrastructure for them.

Financing, managing and contracting road system investments

Funding and public financing of road transport infrastructure have been challenging for several decades in many countries. Road authorities everywhere have been expected to deliver more with less. All authorities have involved the private sector in their endeavour to meet this challenge.

The private sector roles, the contractual arrangements and their procurement to delivering road services, and the funding instruments formed the key issues addressed by Technical Committee A2.

As traditional funding sources, e.g. fuel tax, are shrinking and/or diverted to meet other government priorities, some authorities have introduced new funding instruments, while some others have extended existing instruments to new areas.

Private Sector Roles

Private sector roles vary in depth and breadth of complexity from one country to another and in terms of their degree of application by tier of government (federal, state and municipal authorities) and by ownership, financing and funding.

The last two decades witnessed two major developments in private sector involvement: 1) private financing using the public-private partnership modality, particularly for additional infrastructure and services, and 2) road asset management including involving virtual ownership by the private sector for operation of existing infrastructure and services.

Naturally different arrangements with different scopes and scales and at different speeds of involvement have been observed as different countries have different legal and regulatory frameworks, road network conditions and needs, human and financial resources, private sector capacities and capabilities, etc. A lesson here is to borrow and to adapt to maximise success and benefits.

Contrary to belief of many authorities, paradoxically, more private sector involvement requires more public sector knowledge and skills to extract maximum services, benefits and value from the private sector.

Funding and financing

Road users make huge payments and these can be classified as follows:

- Acquisition, with taxes imposed on the acquisition of a new vehicle, taxes on importation of vehicles, taxes on the registry of a vehicle and taxes for the sale of the unit.
- Ownership, with the payment of an annual tax for the possession of a vehicle and another on the insurance policy.
- Use of the vehicles, with taxes on fuels, tolls, charges to users and taxes on the maintenance of vehicles.

Increasingly other stakeholders, e.g. real estate developers and businesses, are being tapped for additional funding. Also some authorities have extended acquisition and ownership taxes to new items, such as additional tax for air conditioning and differential ownership tax by location of where the vehicle is kept.

With the exception of payments for tolls and charges to users, in most countries, payment of taxes derived from the acquisition and ownership of vehicles are seldom assigned to programs of road expansion. This income is used to cover other priority budget needs.

In the case of road infrastructure with private participation, payment of tolls is used to pay for the capital employed to construct the project and the maintenance and operation expenses. When tolls are applied to national routes, the income is often also retained by the authority.

Road authorities should not blindly focus on earmarked or hypothecated funding. Inadequate earmarked funding will not keep up with needs for timely maintenance and capacity expansion. Diversification of funding sources and education on the importance and contribution of an efficient road network to society are key considerations to securing adequate funding.

Whilst real estate development gains have been exploited to help pay construction costs of transport projects in the past, converting them into a PPP payment stream lasting 25-30 years remains untried. Its attractiveness must have fallen quite significantly with the meltdown of real estate prices in many countries, including the USA.

Schemes for service contracting

The private sector participates with the authorities responsible for the development of the road network through activities such as design, construction and rehabilitation of the infrastructure. More recently, its involvement has extended to the operation and maintenance and in some countries, the private sector has been financing roads and it has become a 'virtual' owner of public roads. For operation and maintenance services, traffic authorities have been involved with the private sector through various contractual agreements. Different authorities responsible for the road networks have also used various contracting procedures to guarantee the services of the private sector. Key contractual provisions and contracting procedures range from traditional list of unit prices to design, construction, financing, operation and maintenance.

Within the latter procedures, the scheme of projects with public-private participation (PPP) was evoked during the session of technical committee A.2 as well as in Special Session 10, ***Practical experiences in Public Private Partnerships (PPPs) in developed and developing countries***, where mention was made of some of the aspects to be dealt with by the authority such as the application for environmental permits and the acquisition of the land where the new infrastructure will be built. The term for the enforcement of contracts for construction, maintenance and operation of the infrastructure ranges from 25 to 35 years.

Simple contractual arrangements, e.g. list of unit prices, provide road authorities with strong control and opportunities to many small-medium suppliers. Whereas complex arrangements, e.g. DBFO, require large economic suppliers reducing inputs by SME and reduces control and flexibility of the road authority.

Typical methods for public contracting include open procedure, restricted procedure, negotiated procedure and competitive dialogue. Whatever the procurement procedure adopted, with some contracts lasting 10 or more years and the private sector partner becoming the virtual network owner, choosing the right partner to the public sector is critical. In Australia, applying behaviour science and role playing simulation to assess and pick the most suitable private sector partner is experienced. This is very far from the typical passive desk-top appraisal in most tender evaluations currently being deployed and warrants wider examination and adoption by other road authorities.

Road system economics and social development

Two themes constituted the subject matter of Technical Committee A.3:

a) a review of approaches (both appraisal methods and ex-post practices) to the assessment of social impacts related to road projects; and b) the identification and evaluation of road-pricing effects.

Approaches to the assessment of social impacts

Ex-ante evaluations, being defined as the evaluation determining the changes that can be attributed to a road project, are increasingly undertaken with a greater emphasis on the need to assess social impacts. In practice, the evaluation is often constrained by a project-based approach instead of a strategic approach. Fundamentally, there is no generally accepted international definition of “social impacts” that allows, for example, a clear distinction between social, economic and environmental aspects. Regarding the approaches used and promoted by international funding institutions, if the practices remain influenced by the cost/benefit method in spite of its limitations of such an approach with respect to the social dimension, the trend is to combine cost/benefit methods with multi-criteria analyses. This requires reference documents to define a full social impact assessment framework, and studies to test various methods for valorising social impacts of road projects in certain countries.

Procedures and guidelines already exist such as those of the African Development Bank for an integrated assessment of social and environmental impact, incorporating methods addressing cross-cutting topics such as poverty, population, environment and gender.

The European Investment Bank’s policies require that road projects are environmentally and socially sustainable.

This trend towards multi-criteria analyses and the current difficulties were clear from Special Session 1, ***Sustainability of road transport. Where are we heading? How do we assess sustainability?*** which also identified the increased implication and influence of civil society.

The World Road Association could, as a forum, bring closer the points of view of developing countries and International Financial Institutions with regard to methods and criteria for road projects assessment. *Ex-post* evaluation, on the other hand, remains, for the time being, a rather limited and rare international practice that is neither systematic nor compulsory. France has probably the most advanced practice presently, while in the United Kingdom, ex post assessments have been set out in recent years, in the framework of the NATA (New Approach to Appraisal) policy.

Accountability of road projects lacks transparency in the explanation of the determinant factors leading to public decisions related to infrastructure development. Road administrations should organize and strengthen the evaluation process; this also constitutes an opportunity for improvement in the delivery of transport services.

Organization of training sessions on the methodology of ex-post assessment and general concepts of evaluation targeting senior officials of road administrations would be most beneficial.

Assessment of road-pricing effects

The work of TC A.3 *Road System Economics and Social Development* includes a worldwide description of the evolution of road-pricing systems and of their various objectives such as funding of new or existing infrastructures, road demand management, and mobility management in both urban and interurban areas. A review is presented of the impacts derived from the implementation of pricing systems such as those related to travel time, mobility patterns, environment, economy, accessibility, equity issues and public opinion, amongst others.

With respect to international approaches to road-pricing, TC A.3 identified certain trends, some of them innovative. These included tolls which grants revenues for road investment and maintenance (i.e. the funds are hypothecated), the national vignette systems to provide access to the main road network with enough flexibility to co-exist with other networks, tolls collected per distance travelled, tolls paid for exclusive high vehicle occupation lanes, and area pricing or urban tolls that are becoming increasingly popular to reduce congestion problems.

In relation to the impacts of urban road pricing, TC A.3 reports effects such as a reduction in congestion ranging from 10 to 20% and pointed out that the other types of tolls (vignette, tolls on infrastructures, tolls charged to heavy vehicles, exclusive lanes and dynamic toll lanes) are less effective in lowering the total traffic demand. On the other hand, it is possible for traffic to be diverted to alternate routes so that the total traffic demand of the corridor remains unchanged or in some cases it may even increase. Other characteristics are also to be considered when evaluating a road pricing scheme such as traffic detours into other systems, transport mode change (from private vehicle to bicycle or walking) and time of travel.

The environmental impact comes as a direct consequence of the road usage: emissions of contaminant gases are of particular importance in urban areas along with noise emissions (however here a large change in traffic is necessary for people to perceive either a decrease or an increase of the noise level).

It has been recognised that urban pricing has effects on land use, particularly upon the location of commercial and residential uses but that such effects are difficult to evaluate and take place in the long-term.

Social acceptability is the most critical determinant for a road-pricing project to become successful particularly in the case of area pricing. Public information on the assumptions, methods and models used to carry out the evaluation is however scarce, whilst they are often fundamental to the understanding of the results. The promoters of the evaluations should make this information available.

Special session 11, ***Road User Charging Schemes - lessons learned and future prospects***, presented a series of cases from countries (France, Germany, Norway, Singapore, Switzerland) that have developed and implemented road user charging schemes for different purposes together with a synthesis of lessons learned from different cities regarding acceptability of congestion charging in urban areas.

Rural road systems and accessibility to rural areas

Sustainable rural roads

The report produced by Technical Committee A.4 *Rural Road Systems and Accessibility to Rural Areas* highlights the importance of rural roads on the social and economic development of nations, as well as the need to incorporate such roads into the national network in order to meet the accessibility and mobility needs of the rural population and to provide access to services and markets for the rural communities.

In addition to the provision of road infrastructure, its proper maintenance is of major importance. The lack of roads in good condition increases the costs of transportation and hinders the delivery of health and educational services, amongst others, to the rural population with the consequent major increase of costs for human development. As a result, local and national economies are hampered.

In the planning process, more attention is paid to issues of accessibility and mobility of the population. The importance of roads in the economic and social growth of the rural zones is also better acknowledged than has hitherto been the case. Recent studies have evaluated the positive impact of investments in rural roads and in the development of poor countries. In Asian and African countries the studies have demonstrated a close relation between the costs of extending the road network and the increase in income from the economic activity that depends upon the network. In India, it was found that investment in rural roads represents the largest positive impact in reducing rural poverty and in the increasing the income of the rural poor.

Budget limitations challenge the capacity of the country to confront large infrastructure projects and are an incentive for innovative approaches to the delivery of a sustainable road management.

Studies have been carried out to evaluate the impact of rural road maintenance projects in, for example, Morocco, Peru, Brazil, Vietnam and Tanzania, in association with the World Bank, the Asian Development Bank and other organizations. The results in many cases have been limited due to the lack of a baseline or of control data. In general, it has been difficult to identify the benefits received from specific projects because they were focused on a single objective and as a result the broader outcomes were not identified and accounted for.

A promising approach is the use of micro-enterprises to undertake the routine management of secondary and minor roads by the national governments, regional governments, or municipal administrations responsible for ensuring that such works are effectively carried out. Experiences of this type with significant effects on rural roads and social benefits from India, Brazil, Venezuela, Colombia, Peru, El Salvador, Ecuador, Guatemala and Canada are described in the report from TC A.4.

From the experiences gained in recent years in Latin America as well, as in other regions, it can be concluded that the implementation of a new model of road maintenance is a priority, particularly when predicated on the prevention method. The strategies should be compatible with local needs and circumstances so as to determine the most suitable management model.

From surveys carried out to date, the method developed by Peru and Ecuador has been regarded as the most complete. The method is based on integrated road management and defines a long-term road traffic plan in which planning and the cost of road-related actions imply the contribution of users and beneficiaries of the organizations.

Besides Peru and Ecuador, several other Latin American countries such as Venezuela, Colombia, Bolivia, Nicaragua and Guatemala, amongst others, have implemented a pilot plan of a model for the maintenance and technical management of roads. The pilot plan was developed with support received from various international and local organizations such as the International Labour Organization (ILO) with sponsorship received from the United Nations for Development program (PNUD). This model is based on the operations of specialized micro-enterprises focused on the use of intensive labour that have a structure low in operating costs, therefore converting them into a feasible alternative to the conventional and more expensive systems of maintenance equipment.

This model of road management is supported by a series of publications issued by OIT for its project 'Promotion of labour-intensive technologies in public investments of Bolivia, Ecuador and Peru'. The project is in line with the OIT policy through the Employment Intensive Investment Program (EIIP) that operates in three continents (Asia, Africa and Latin America).

Special Session 5, ***Sustainable rural roads networks***, illustrated with the presentation of country case studies current approaches to 1) Accessibility and planning of the development of rural roads, and 2) Issues of decentralization, as regards decentralization of responsibilities and resources for management of rural roads, as well as the financing, legislative and/or regulatory aspects.

Conclusions for ST A

There is compelling scientific evidence that the global climate is changing and that the primary cause is the release of greenhouse gases resulting from human activity. Government at all levels has a responsibility to address climate change issues. Whilst transport is a key driver of the economy, it is also a significant contributor to greenhouse gas emissions. Successful approaches demand the forming of robust plans with firm reduction targets and strong monitoring and transparent reporting

The development of common whole life approaches to the issue of carbon accounting and management is necessary to ensure that decisions can be made on sound information

Financial strategies used by different countries depend to a large extent on the objectives of a particular country in road transportation and on the system intended to be supported.

Deficiencies still exist in the schemes of financing in comparison to the national needs. The role played by the private sector continues to expand in some countries to help mitigate the lack of public funding. However, it is important to recognise that, contrary to the view in many authorities, greater private sector involvement requires more public sector knowledge and skills to extract maximum services, benefits and value from the private sector.

The concept of social impacts is a 'dynamic' notion depending on the level of economic development. It can therefore become important to distinguish amongst the social aspects to be evaluated in developed countries and those more pertinent to those countries in development.

No examples of *ex-ante* evaluation of social impacts being required by legal or regulatory measures have been uncovered. Rather, the evaluation of social impacts is performed by other instruments (legally required) such as the environmental impact assessment, or otherwise by the self-initiative of the road administration.

The *ex-post* evaluation – whether by systematic approaches or otherwise – is far from being common practice among member countries of the committee. Furthermore, in most of the cases in which the *ex-post* evaluation is carried out, the assessment is focused on impacts that are not necessarily of a social nature.

Tolls paid at main roads, singular structures or networks, to finance new or existing infrastructure, are widespread and will continue expanding. It can be observed that tolls are increasingly applied to existing infrastructures so as to guarantee funds for its maintenance, particularly in countries under development, but also in Europe and for heavy vehicles.

Toll rating due to traffic congestion has been progressively extending, particularly in urban zones and, to a lesser degree, on major road routes, even in those where tolls are already imposed. These tolls can adopt different approaches: static (with predefined fixed tolls) or dynamic tolls.

Rural roads play a crucial role in economic and social development. Recent studies have evaluated the positive impact of investment in the development of rural roads of poor countries. These studies show that one of the most profitable investments of a country is, beyond any doubt, ensuring the sustainability of road maintenance.

Improving provision of services (ST B)

Introduction

The work relevant to this strategic theme was performed by five Technical Committees: B.1 *Good governance of road administrations*; B.2 *Road network operations*; B.3 *Improved mobility in urban areas*; B.4 *Freight transport and intermodality*; and B.5 *Winter service*.

Good governance of road administrations

The approach of Technical Committee B.1 to governance reflects the belief that to deliver public value to the community road administrations need more than robust systems and a strong culture to prevent, detect and enforce corruption. Road administrations also need to ensure that they understand and engage their customers and stakeholders and have the human resources that can support the tasks the organisation needs to achieve.

Good governance is having the right people, acting with integrity and transparency, with the right skills focusing on and involving the customer in delivering better public value.

As scarce literature is available on this subject, the TC decided to base most of its work on the analysis of case studies.

The committee proposed a case study framework and the public value model as a coherent way to take into account each of the aspects involved in good governance.

Best practices of good governance

One of the results of the work is the development of a cyclical model, which describes the procedure for preventing or advancing corruption at various stages including reciprocal interactions and induced effects. The “cycle of integrity” is focusing on the improvement of the institutional integrity and comprises the three main stages: prevention, identification, enforcement of corruption.

The need to take targeted action to promote institutional integrity in corporate governance and to act decisively against corruption is increasingly recognised as a priority for all sectors worldwide. This is especially true for the roads sector that is proven to be vulnerable to corruption. Following the analysis of the case studies and a questionnaire survey, a series of tools – the so called “toolkit of anti-corruption measures”- are proposed aiming at institutional integrity, prevention, identification and enforcement against corruption.

Special Session 08, ***Good governance and integrity***, focussed on issues of achieving and demonstrating accountability and transparency. Initiatives taken by countries, development banks and industry to promote integrity as a core business value and establish sound governance arrangements have been presented. Strong wills and coordinated actions of the different stakeholders are necessary to achieve noticeable progress on this issue.

Improvement of services rendered to users

Society is changing fast and so are customer needs and demands. In order to deliver services adapted for evolving needs, the public sector must be more responsive to customer input. To ensure the public feels it is getting 'value' for its investment, the public road customers need to be heard. Road authorities need to understand that a customer-oriented approach is key to their success. This involves more than listening to the customer's needs, but also incorporating that input into transportation processes and deliverables. This has been the focus Technical Committee B.1 on 'Customer Orientation' that has investigated and documented the power of understanding and incorporating customer needs.

Human resources for the future

The committee developed case histories to describe the actions that have been carried out in various parts of the world to identify and tackle the deficiencies in aptitudes (both at the national level and within road administrations) and also to search for the best way to attract, hire and retain suitable talent. Since the identification of the abilities necessary for the organizations may demand some time, the committee examined how road administrations can be associated to the academia to gain influence in the curriculum and to potentially increase the number and proficiency of persons educated in relevant topics.

Organisational capacity is essential to deliver what the authorising environment and the public want. The case study approach adopted has tried to provide genuine examples of how road administrations are dealing with meeting their human resource needs now and into the future, with a focus on the following subjects:

- Skills gap identification both at the macro level across industries and countries and at the micro level within individual road administrations and their staff;
- Recruitment, attraction and retention of the skills identified as essential for the delivery of the outcomes and services provided by a road administration;
- Increasing the pool and quality of potential supply through partnering with education and influencing curriculum.

Road network operations

Technical Committee B.2 *Road network operations* looked for strategies to reduce congestion and/or mitigate its effects through the use of intelligent transportation systems (ITS) and the joint management of road corridors.

The committee compiled case studies related to congestion and corridor management strategies, explored the future development of communications among vehicles and infrastructure and reviewed the Association's ITS Handbook.

Congestion is understood as the situation in which the demand for space on a road exceeds the road capacity. However, this excess of demand varies, not only spatially, but also temporally in terms of time and duration. Additionally it can be seen differently depending on the level of service offered and on the expectations of the users. For travellers, the most important requirement is the reliability of the road system, particularly with respect to the expected journey time. Congestion also has adverse impacts on the environment, in energy consumption and emissions, in social welfare and on the economy.

To achieve better use of the existing infrastructure a systems approach is required that incorporates high-level strategies, including alternate transportation modes. In several regions, it has been observed that this approach, in combination with new technologies, may generate effective solutions to the increasing problem of congestion.

As far as recurrent congestion is concerned (i.e. that occurring from an excess of demand of the road system) solutions may combine the application of tolls during congested periods, regulation of traffic lights, the provision of real-time information to drivers, the use of other transport modes, and the provision of improvements in the capacity of the road network.

Intelligent Transport Systems (ITS) provide operators of road networks with tools to maximize capacity, improve safety, foster the use of alternate modes, and help manage the programs of maintenance and operations.

TC B.1 has updated the Association's ITS Handbook and made it freely available on-line so that the handbook can be used by anybody in the world, including college students. The handbook is organized around various practical questions in the field of traffic management, incident management, and traffic operations in addition to ITS technologies and services for congestion and corridor management.

The development of more intelligent interconnected vehicles and the relationship between those vehicles and the infrastructure, open new opportunities for better management of the road network. Working with the International Federation of Automotive Engineering Societies (FISITA) the committee established a joint task force (JTF) to take this initiative forward. The JTF took evidence from road operators and administrations, the motor industry and from transport professionals to produce a report, which summarizes the current development of intelligent cooperative systems, identifies key issues to be resolved so that wide scale implementation may begin and finally presents recommendations for the different stakeholders.

The work of this JTF and the current research on connected vehicles in the U.S.A. were presented in Special Session 12, ***Intelligent Transport Systems (ITS) for safer and more efficient traffic management***, together with presentations on promising developments in vehicle and communications technology from FISITA and ERTICO and examples of successful deployment of ITS for traffic management in different countries.

Finally, strategies for road network operation should be considered together with other modes to enable a joined-up and cooperative approach to transportation and mobility. This includes cooperation on a daily basis to make the service more efficient and more effective.

Improved mobility in urban areas

Integration of the different transportation modes

Strategies to achieve better integration of transportation modes can be classified in two groups: those related to the supply, that seek to enhance their coverage, and those related to demand that seek to influence the choice of the users toward one or the other mode.

Strategies related to demand include promotion of public transportation, bicycle riding, pedestrian transportation, intermodal transportation and actions oriented to the more efficient use of automobiles such as car-sharing. Amongst the strategies relating to supply mention should be made of improving the utilization and assignment of the capacity – measures to effect this end include increase of the vehicular capacity supplied, improvement of temporary traffic flows, reduction of incident-related impacts, and a more efficient handling of road works and maintenance.

Special Session 4, ***Large cities: integration of the surface transport modes***, has showcased examples of strategies adopted by large municipalities in different countries (Mexico-city, Zürich, Montréal) and of specific measures to facilitate surface public transport (Tokyo, Bamako) or for the integration of the road infrastructure in the environment (Greater Paris – A86 Duplex tunnel).

Planning of land uses and road transportation

Primary factors affecting mobility within suburban areas and thence the need for and supply of transportation include the population and the density of employment, the density and pattern of transportation infrastructures and human behaviour.

Labour productivity and regional accessibility are closely related in terms of the potential for the population to access employment opportunities and to the ability of companies to source qualified employees.

Improvements to mobility make a substantive contribution to linking goods and consumers, thus driving the economy and creating employment opportunities and improving welfare of the populace. However, transportation networks should seek to achieve environmental efficiency in terms of emission of carbon dioxide per passenger-kilometre, social equity, economic accessibility, and ensuring the long-term viability of the system.

Special session 6, ***Transport and land use planning - How well integrated are they?*** presented the approach taken by the World Bank and in different countries at state or regional level. Then focussing on urban contexts, case studies of three large cities Madrid, Paris and Tokyo illustrated how urban growth and the development of transportation systems interact.

Non-motorized mobility

Two different elements favour this type of mobility: topography, and the size and density of the urban area. However, even with only 50% of flat land, a high rate of non-motorized mobility can be achieved. Nevertheless, an extended city, with low housing and employment density generates a low density of people walking or riding a bicycle.

The physical condition of the network also affects the behaviour of cycle riders. They are much more sensitive to poor quality pavements. When exclusive lanes for bicycles are available cycle use increases.

Other factors influencing the success of non-motorized transportation are the implementation of an integrated transportation policy, public sensitivity, legal and financial incentives and programs such a 'Rent a bike'.

Among the objectives to be achieved in the next ten years a larger modal participation, improving safety for pedestrians and cyclists, construction of bike lanes and fostering the rental of bicycles have a high priority.

Freight transport and intermodality

Efficient, safe and sustainable freight transportation is a vital service for any economy. Technical Committee B.4 *Freight transport and intermodality* worked on the three topics described below seeking to achieve more efficient, safe and environmentally-friendly freight transportation. Actions focused on the identification of effective measures for road authorities to suitably manage freight transportation along the main road corridors and in urban zones, as well as to contribute to the building of more efficient intermodal freight terminals.

Efficient, safe and sustainable freight transport is vital for any economy and society. During recent decades, there has been very substantial growth in the freight transport sector, especially on roads. TC B.4 has analysed strategies and measures to master the great challenges, which are connected with the growth in road freight transport, focussing on three topics; management of strategic freight corridors, interfaces of road freight transport with other modes, and urban freight management.

Common for all three topics is that public authorities should take the responsibility for coordination and interaction between the large numbers of stakeholders involved in planning, financing and operation of freight corridors, intermodal freight terminals and urban freight systems.

Management of strategic freight corridors

Authorities should assume a role of supplier and coordinator of the strategic management of freight corridors. Efficient operation of the infrastructure and a customer-oriented approach are key factors of success. This may require a wide spectrum of actions such as infrastructure works (reduction of bottlenecks, construction of safe parking areas and buffer zones for the deleterious effects of traffic), traffic management through the use of information and communication and other ITS technologies, a suitable regulation of freight, and efficient procedures at border crossings, amongst others. The work of freight movers also depends on the information about rules and conditions for driving in different countries as well as on the existence of attractive and safe rest areas along the freight-moving corridors.

Interfacing road freight transportation with other modes

Intermodal freight transportation contributes to a better utilization of the transportation system capacity, to an increase in safety and to a reduction of negative effects on the environment. Efficient intermodal terminals and maritime ports are crucial to achieve an attractive and competitive intermodal transportation.

To have more efficient intermodal terminals, the authorities should assume the responsibility for the coordination and interaction among parties involved in the planning and operation of these terminals, to guarantee ownership of the land where the intermodal freight terminals are located, to guarantee enough space for expanding the terminal whenever possible, to provide good access by road to the terminals, to carry out a comparative evaluation to support and certify the quality of the services provided by the terminal, to back up the integration of the intermodal terminals and to promote the public-private partnership (PPP) for future development of the terminals where feasible. The authorities should also guarantee a sound competition among terminal operators. An intermodal terminal transport network strategy and policy (with main hubs and regional terminals), which might also provide a basis for funding, should be developed.

Urban freight management

Studies and good practice in many countries show that there is a need for public governance within urban freight transport because there are many stakeholders with different objectives and perspectives regarding urban freight in terms of efficiency, environmental impacts and safety. Central governments should take the responsibility for harmonizing policy measures through guidelines for urban freight transport. Local public authorities should take the responsibility for making plans for urban freight management based on discussions with all stakeholders. All stakeholders should be involved from the beginning in surveys, analysis and discussions about urban freight issues. It is important to create favourable win-win conditions for the authorities, logistics and freight transportation industry. Balancing measures for urban freight transport systems to create economically efficient, environmentally friendly and liveable society is essential as in many cases a single measure is not enough to obtain a successful result. Plan-do-check-act procedure is essential for monitoring and evaluating the results to give feedback to the original plan.

Winter service

Meteorological events such as snowfall, ice, hail, blizzards and others such as avalanches, continue to cause major impacts on roads. Climate effects are not bound to disappear even if the degree in which they affect the roads varies from one year to the next. What is rapidly changing is how roads are operated and maintained. Expectations of drivers, traffic volume, amount of resources, technological information and knowledge of climatic conditions continue to evolve and influence the actions to achieve an efficient, reliable and sustainable transportation system for persons and goods.

Management systems of winter transportation and information provided to road users

The development of winter service management systems (WSMS) eased the way for decision making when dealing with more integrated and complex road traffic. Data generated by the WSMS are combined with other sources of information and technology such as data retrieval, information on national weather forecasts and national protocols of road authorities to decide how to take action, to manage the traffic, to provide better dissemination of information, to provide recommendations for treatments, and the preparation of reports following a storm. These capabilities of the service based on very precise weather and pavement temperature forecasts make this approach an integrated decision making system and it is currently the most advanced means to support winter maintenance activities.

Communication with users of the road

From the answers of 25 countries and states to a questionnaire, a technical report of TC B.5 provides a global vision of current practices regarding dissemination of information to road users related to road maintenance in general and specific information related to winter traffic. The report not only considers automobile drivers but also other road users such as bicycle riders, pedestrians and motorcyclists.

Sustainable development and winter traffic in roads

This TC report discusses how the concept of sustainable development can be applied to winter service. A review is presented of the main social, environmental and economic criteria considered in the operations and strategies applicable to winter service on roads. This document also provides some perspectives on the development of an evaluation procedure in which the relevant parameters related to winter traffic are integrated.

Identification of impacts of climatic change during winter on traffic and road infrastructures

It is necessary to deal with the general trends that are perceived from global climate models and to reduce the scale to regional climatic models for a better understanding of the impacts affecting winter traffic conditions. Risk assessment is also necessary in relation to the definition of service levels. These matters are captured in a report, which includes an overview of climate change, its impact on winter maintenance, its impacts on road infrastructure, and actions that can be taken to better prepare for the anticipated changes such as melting of permafrost and erosion of coastal roads.

Snow & Ice Data book on winter traffic – Edition 2010

There are many parameters that equate to effective winter service – e.g. safe roads fit for winter traffic; geographical and climatic restrictions; costs and benefits related to safety; mobility and environment; human, material and equipment resources; and private partners and systems to support decision making. The approach that each country takes in regards to each of these parameters is described in the *Snow & Ice Data Book*, which has been updated with some new countries, to reflect the most recent practices and the extent to which they vary from country to country.

Conclusions for ST B

Good governance is having the right people, acting with integrity and transparency, with the right skills focusing on and involving the customer in delivering better public value.

Transparency, integrity, active participation of users and hiring of duly trained public servants constitute the most important factors that must be addressed to render a better service to people using the road transportation system.

Institutional integrity is considered to be an important issue for the road sector on a worldwide basis requiring promotion among public and private corporations as well as specific actions to fight against corruption.

ITS represent efficient means to gain reduction of congestion and/or mitigation of its effects. To attenuate non-recurrent congestion, strategies such as the management of traffic accidents, alongside traffic management for special events and at areas of construction or of maintenance can be used. In the case of recurrent congestion, a combination of measures may be necessary including tolling during congestion periods, traffic management of urban roads traffic lights, real-time information provided to travellers, as well as planning and implementation of improvements in the capacity of road networks.

Other structural measures should be considered in order to achieve a better modal distribution of transport demand, consistent planning of land use and transportation, and increased use of non-motorized transportation modes such as cycling and walking.

Public authorities must take the responsibility for coordination of the many stakeholders involved in freight transport corridors, intermodal terminals and urban freight systems. Operation of the infrastructure in an efficient and customer oriented way is a key factor in management of strategic freight corridors. It is essential to secure land with enough space for intermodal terminals at strategic locations with good access to the road network. In urban freight there is a need for balancing measures, which can create win-win conditions for all stakeholders.

When dealing with winter transportation, acknowledgement is made of the increasingly important role played by the operation systems, and the extent to which information is managed (e.g. meteorological data, traffic, climate, etc.), communicated to road users, and used in a way to favour sustainable practices of winter maintenance.

Safety of the road system (ST C)

Introduction

Road Safety was given a prominent place at the congress with:

- a keynote speech on *A global perspective on road safety challenges and opportunities*, presented by Dr. Etienne Krug, Director Department of Injuries and Violence Prevention, World Health Organization;
- strategic direction session C, *A strategic approach for safety: putting knowledge into practice*;
- special session 9, ***Road safety: The UN Decade of action***; and,
- the two sessions run by Technical Committees C.1 *Safer Road Infrastructure* and C.2 *Safer Road Operations*;

Strategic theme C also comprised work of Technical Committees C.3 *Managing Operational Risk in Road Operations* and C.4 *Road Tunnel Operations*.

Special Session 9, ***Road safety: The UN Decade of action***, was the occasion for the presentation of the declaration adopted by the Council of the World Road Association relative to the commitment of the Association in support of the UN decade of action for road safety. From the panel discussion it appears clearly political will should exist and produce a general vision for society to achieve progress.

Safer road infrastructure

The fourth objective of the declaration approved during the First World Ministerial Conference on Road Safety: Time of Action, held in Moscow in November 2009, reads as follows: “*Make an effort particularly in the development and implementation of policies and solutions for improvement of infrastructures for the purpose of protecting all road users specially the most vulnerable ones*”. The report of the World Health Organization on the Global Status of Road Safety indicates that vulnerable road users constitute the largest percentage of the 1.3 million annual victims of traffic accidents. The design and operation of roads demands a complex system-oriented approach to be effective in achieving the results sought with respect to road safety.

Work carried out by Technical Committee C.1 during the 2008-2011 period encompass the following aspects.

The human factor in the design of roads

Instead of placing the blame for accidents on road users, it is now accepted that the most effective action is to adapt the technical elements (vehicles and roads) of the transportation system to the abilities and limitations of the users. The objective of the safe system approach is the development of a road transportation system that is best able to accommodate human error. It thereby accepts human error and assumes that not all traffic accidents can be prevented by education and police enforcement only. Such an objective is aimed at preventing serious human casualties as a result of driving mistakes. For a decade, the Association's technical committees on road safety have operated under a human factor system approach. Papers submitted to this session addressed how human factors knowledge should be integrated within the geometric standards and equipment for urban and inter-urban roads.

The Association's Guide on *"Principles Governing Human Factors: Spatial perception of the driving environment for Safer Road Infrastructure"* explains the relationship among the various characteristics of the road that may lead to problems, often subconscious, for drivers.

The study identifies three principal classes of human factors that relate to physical factors such as geometry, dynamics and breaking distances. These are:

- The rule of the six seconds: Sufficient time for driver
The driver needs an average of four and six seconds to completely modify his (her) driving plan. At a speed of 100 km/h this time represents a 300m long displacement for the change to be effective. An easily driven road will allow the proper adjustment of the driver's behaviour to the new situation.
- The rule of the visual field: Safe visual field
Driving a vehicle modifies the field of view more than any other type of human movement. A long straight road, whether the landscape is monotonous or highly contrasting, and other external factors affect the quality of driving.
- The rule of logic: Logical driver's perception
Drivers travel along roads with logical expectations and understanding, based on their experience and recent perceptions. Sudden anomalies interrupt a practically automatic chain of actions leading to the alteration of the drivers' perception and behaviour. Therefore, designers should attempt to assign a logical sequence to the road characteristics.

The concept of Human Factors intends to reduce the probability of operative (driver) errors, promoting simple and self-explanatory design of roads.

Improvements in road design for vulnerable users

Whereas guides, processes and recommendations for the design of motorways and inter-urban roads are well structured, organized and familiar to everybody, less material is available on the design of urban roads. Because of the growing evidence of accident patterns in the networks of urban roads, it becomes clear that risk analysis in roads could be improved. Most of the deficiencies in the surroundings of urban roads are related to vulnerable road users. The major problem of urban roads is that they are designed mainly for automobile drivers and the design of crossing areas is mostly based on their traffic capacity and seldom on the requirements of vulnerable users. Sight distance between vehicles and the vulnerable users is an important consideration to be taken into account, to guarantee suitable visibility between the vehicles and pedestrians/cyclists at crossings and pedestrian walkways. Restrictions of visibility decrease the chance of drivers to perceive and react with sufficient time when confronting conflicting situations. The specific needs of public transport users at tram and bus stops have to be integrated into the design of urban roads.

Urban development at roadsides

The most critical situation related to road safety is a mix of functions in areas where boundaries of the urban area and of the inter-urban area are not well defined – linear development alongside roads is a typical example. Urban development can be found alongside the roads with residential or commercial activities unchecked. These developments entail the most serious safety-related problems. They are responsible for the 'over-representation' of vulnerable users in traffic accidents and result from a lack of planning and inadequate investment strategies in road networks. Development of this type affects not only the safety but also the efficient operation of the road network. Speed decreases and duration of travel increases, therefore affecting mobility of people and of goods.

Road safety impact assessment methods (RSIA)

The former Technical Committee 3.1 on Road Safety developed the Association's *Guidelines on Accidents Investigations*, *Road Safety Audits* on safety deficiencies of road design and *Road Safety Inspections* on existing roads. A special catalogue on such safety deficiencies and countermeasures had been created. However, safety is often not considered with the necessary degree of importance in the planning stages of road projects for Land Use and Urban development. At present the methodology available for predicting the effects on safety of such planning is inadequate, the assessment of its impact on safety has become one of the objectives of the Global Plan of Action for the Decade of Road Safety 2011-2020. Therefore, the Association is working on the development of improvements for road safety audits and inspections and in the definition of the role to be played by road infrastructure safety management. This will be included in the revised Road Safety Manual prepared by the World Road Association.

Better safety at work areas of roads

Safety at work sites constitutes another crucial topic for the safety of road infrastructure, particularly in countries under development. Many serious traffic accidents take place at road construction sites because drivers are not prepared and workers lack proper protection. New guidelines to safely execute road construction works have been drafted by the TC.

Safer road operations

It is necessary to review road safety policies and plans to identify different mechanisms applied to advertising campaigns on road safety as well as to study and compare the cost-benefit analysis for investment in the road sector; these are the objectives set out by Technical Committee C.2.

Formulation of policies

Improvement of road safety in a given country requires the development of national policies taking into consideration a number of coordinated political, legal, educational and technical aspects.

Best practice is represented by a commitment to the long-term objective of zero casualties with strong intermediate goals that set the path to success. This commitment, assumed by top government authorities, will influence and sustain road safety management and policies on road safety and it will be clearly reflected in the proposals described in a strategy and action plan to reach ambitious intermediate goals.

The seven key factors associated with the institutional management of road safety are described as follows:

- Existence of a clear and robust approach to results within a jurisdiction (with an undisputed leader; a clear road safety decision-making hierarchy within government; well-defined roles, responsibilities and rendering of accounts for the key organizations on road safety; and the identification of capacities that need strengthening).
- Coordination among organisations and among other interested parties.
- Existence of suitable legislation.
- Financing and allocation of resources.
- Activities of promotion and motivation to create awareness and foster the implementation of change within government and the community. Committees on road safety that periodically attend informative sessions constitute an efficient tool to create awareness and commitment.
- Follow up, evaluation and dissemination of performance records on road safety.
- Investigation, technological development and agreements to transfer knowledge within the jurisdiction.

Social marketing

Improving the behaviour of road users should always be considered as a priority because human errors contribute to 95% of traffic accidents. Publicity on road safety is necessary to:

- Create awareness of threats posed by road accidents and of the vulnerability of certain road users.
- Educate road users on what is considered safe behaviour.
- Change attitudes and beliefs toward a more positive approach to road safety.
- Inform users of the roadway about changes in traffic regulations or in operating conditions.

Campaigns on road safety should therefore be considered as a sustained commitment and as an indispensable part of the strategy on road safety of any country. They will be more successful if engineering is associated with legislation or with police action. Fundamental aspects of road safety campaigns include the issue to be addressed, the target audience, the type of media to be used and the need for periodic evaluation of the effects of the campaign.

Economic evaluation

Investigations have been carried out on two matters: 1) state of the art of "*Cost-Effectiveness Analysis (ACE)*", *Cost-Benefit Analysis (ACB)* and *Assignment of Resources*", and 2) Economic analysis methods used by different road agencies for the development of investment schemes on road safety. Almost all countries are familiar with ACB or ACE for the evaluation of actions on road safety but the technical committee cited the existence of methodological or technical barriers as reasons for not applying it to road safety projects; the most common barrier to the use of economic evaluation tools is the lack of data.

Other common obstacles are:

- the difficulty of predicting the effectiveness of safety measures;
- ensuring that policy development is not politically led;
- the lack of dedicated resources from the state budget;
- that the safety-related programs have a long time horizon;
- that governments need further knowledge to use ACB and ACE criteria;
- the dominance of the intuitive approach when dealing with road safety;
- the difficulty of ethically assigning a value to life and comparing it with other parameters.

In terms of cost-effectiveness, speed control is the most frequent solution to appear amongst the five best measures to achieve road safety improvements. Measures for pedestrian protection are also common practice. Almost all the countries indicated that politicians assign further weight to the allocation of resources related to a larger number of casualties prevented than to the reduction of any other balance resulting from accidents.

Managing operational risk in road operations

Many parts of the world are exposed to significant risks from natural and man-made hazards. These factors, combined with the increase in population density and the development of properties in dangerous zones have increased the risks associated with such hazards.

TC C.3 has focused on integral risk management based on the entire risk cycle with a comprehensive investigation of risk advisory services, processes for decision making and safety issues.

Risk management for road networks

Risk management involves the standardized, systematic and organizational administration of the various risks likely to affect a company or other organisation, for the purpose of maintaining and increasing the corporate value or account rendering. Internal control is a management system and process built in-house in order to carry out its business properly and efficiently. Internal control and risk management, while having different backgrounds and developed through different routes, have similar objectives and goals in terms of understanding, managing and mitigating the various risks to which the organisation is exposed.

A fundamental quality of a road network is its robustness or resilience, which can be defined as the ability of the transportation system to support and handle important disruptions such as natural disasters and major accidents. The mission of the agency responsible for the roads is to provide a normal or minimum acceptable operation with sufficient margin of safety with respect to the magnitude of the damage consequences. For the framework of risk management to be complete, it is essential to include management of crises. It is obvious that the essential part of emergency management is to identify the risks and to prepare contingency plans to mitigate the consequences of an adverse event. An important element of any emergency plan is the establishment of organizations and structures that are prepared to manage adverse events.

The organization should be committed to address the management of risk proactively and consistently throughout the project. This action involves identifying and describing risk, defining risk ownership and assigned responsibilities, defining response strategies and specific actions, understanding the precursors to an event that might provide a warning and an increased likelihood of an event, making fallback plans, and ensuring that there are contingency reserves of time and cost to undertake such actions as are necessary when the risk manifests; these issues must, of course, be set within the context of the risk owner's tolerance of that risk.

Risks associated with natural disasters, climatic change, disasters induced by men and safety threats

Practical techniques have been developed to handle risks associated with heavy rainfall and earthquakes, which are typical of the natural disasters to be expected in many countries and regions. When inspecting roads after heavy rainfall, nine elements are included such as rock falls from slopes, geologic faults, cave-ins, presence of detritus, embankments, and detailed examination of the foundation of bridges and retaining walls. The results of the inspection can be classified in three groups, for subsequent generation of the corresponding countermeasures.

Inspection of the road infrastructure in the context of its ability to resist and survive seismic events is applicable to different types of structure including bridges, pedestrian bridges, embankments, retaining walls and tunnels. Results of the inspection are stored in databases and are widely applied to evaluate the seismic behaviour of the road infrastructure and to inform subsequent developments so as to improve the response of infrastructure subjected to seismic events.

There are factors of climatic change that will affect the transportation networks on the five continents, namely: temperature, rising of the mean sea level, (changing rainfall patterns and associated increases in the number and increase frequency of storms including heavy rainfall and high winds.

Social acceptance of risks and their perception

Each society has its own perception of risk and agrees on the risks, and the level of those risks, that are considered acceptable and those that should be rejected. Different cultures may apply various social and personal approaches to the key factors that affect the risk such as fringe benefits of the country, behaviour of users, and degree of penalizing incorrect behaviour, amongst others factors. Poor perception and estimate of the risk are determining factors affecting the conduct of drivers .

Determination of risk perception requires an understanding of the concerns of the society, effective communication about risks among the different groups and the development of methods to poll opinions on risk (social decision-making process).

Road tunnels operation

Tunnels are increasingly built to go through natural barriers or urban zones. Existing tunnels carry increasing traffic volume and a large number need to be reconditioned

Following the fires in the Alpine tunnels, a decade ago, the World Road Association has now produced via its Technical Committee in charge of *Road Tunnels Operations*, a comprehensive set of guidelines to address the wide spectrum of tunnel safety-related issues. This knowledge is now available to the public in the form of an electronic Road Tunnels Manual in different languages.

During the 2008-2011 cycle, Technical Committee C.4 *Road tunnels operations* has placed emphasis on the production of recommendations for operators and road users in order to improve safety. The different topics considered and the reports produced are listed below.

Operation of road tunnels

- Recommendations for organisational strategic tunnel safety management.
- Best practice for road tunnel emergency exercises.
- Recommendations on management of maintenance and technical inspection of road tunnels.
- Life Cycle Aspects of electrical equipment for road tunnels.

Safety in road tunnels

- Current techniques for risk evaluation for road tunnels.
- Assessing and improving safety in existing road tunnels.

Influence of user behaviour in road tunnels

- Recommendations regarding drivers training and information for road tunnels:..

Air quality, fire fighting and ventilation

- Vehicle emissions and air demand for ventilation in road tunnels.
- Design fire characteristics for road tunnels

Conclusions for ST C

Establishing policies and strategies to address road safety is critical to decrease the rate of human losses. To that end, countries should set long-term objectives aimed at improving safety and reducing fatalities. The experience gained by developed countries will be beneficial to those in the process of development.

Human factors should be integrated into the geometric standards of roads and urban roads and the self-explaining road should be a priority. Deficiencies derived from unplanned urban growth affect vulnerable users such as pedestrians, cyclists and disabled persons. Planning guidelines are proposed for the evaluation of the impact on road safety related to land use and urban development similar to environmental impact assessments. In addition, it is necessary to improve safety at construction zones of road works.

Reducing the risks associated not only with road accidents, but also with natural and man-made disasters affecting roads, is of importance for road operations. Good practices exist in risk management in road organizations as well as disaster management and technical tools have been improved. Quantitative risk assessment is a very important and indispensable step in risk management and supports policy decisions. The road sector is strongly affected by the public's perception of risk and social amplification of major events.

Following the fires in the Alpine tunnels, a decade ago, the World Road Association has now produced via its Technical Committee in charge of Road Tunnels Operation, a comprehensive set of guidelines to address the wide spectrum of tunnel safety-related issues. This knowledge is now available to the public in the form of an electronic Road Tunnels Manual.

Quality of road infrastructure (STD)

Introduction

Four Technical Committees: D.1 *Management of Road Infrastructure Assets*; D.2 *Road Pavements*; D.3 *Road Bridges*; D.4 *Geotechnics and Unpaved Roads* are contributing to the objective of Strategic Theme D, to improve the quality of road infrastructure through the efficient management of road assets, in accordance with users' expectations and the requirements of the road managers. Although new technologies and social and environmental developments are expanding, the area of interest of road authorities, the infrastructure and the management of those road assets are still of fundamental concern. The need for a more efficient investment of available funds implies the continuous improvement of techniques for the design, management and maintenance of the road network.

Management of road infrastructure assets

This theme was addressed by Technical Committee D.1 through the three topics described further below.

In addition, Special Session 7 was dedicated to ***Performance-Based Management of the Road transport System***. There is a strong trend towards the introduction of performance management systems. These management systems provide a good evidence-base for allocation of internal and external funding, however, the practice of resource allocation is very different to the theory. Early-adopters of Asset Management Planning have now enhanced their capabilities by including Performance Management in their governance structures.

Benchmarking of asset management methods

This topic refers to the identification of best practices related to the management of road assets taking into account the key aspects that should be evaluated by road authorities depending on their status of development. It was also intended to review the costs associated to the implementation of these systems for the purpose of recommending where the investments should be focused when selecting a system. It was sought to illustrate, by means of case histories, best practice for the authorities to adopt as well as to develop a comparison of costs of typical systems and to compare the costs with the investment in road infrastructure.

Case studies of management methods applicable to road assets were prepared by seven countries. The structure of each case study included the actual practice, plans for future developments, how the methodology had been developed and executed, how the investment in the management systems was justified, what benefits were expected and which have been achieved, what costs have been incurred and where within the organization, what lessons have been learned from the methodology used, what gaps there are in the present methodology, how these gaps will be filled, and which have been the most important management-related aspects that the methodology has been capable of resolving.

Data collection for road infrastructure management

Performance indicators related to the different elements constituting the road infrastructure are intended to assist road operators and road authorities in reporting on the condition and operation of their network as well as in defining better strategies for management of these assets. The objectives of the study were 1) to present an approach to identify or build these Indicators, by sharing the experience gained by several countries, and 2) to illustrate the implementation on a series of cases.

The report addresses the difficulty of matching data with manager objectives and criteria, and contains detailed entries of the methodology proposed for the purpose of assisting road authorities. These entries are related to:

- The definition of each category and sub-category of stakeholders.
- The list of expectations from these stakeholders, with priorities proposed by the technical committee.
- The type of High Level Management Indicators (HLMIs) that should be used, according to the committee, to manage such expectations.
- Detailed considerations related to the basic indicators that could contribute importantly to the development of such HLMI.

Allocation of resources across asset classes

A review has been made of different mechanisms of resource allocation used by countries in road infrastructure management. It also covers the process of priority assignment when making investment decisions between different infrastructure components (pavements, bridges and geotechnical structures, and so forth). The review identified the benefits and shortcomings of the hierarchy setting processes used for resource allocation, taking into account the differences among infrastructure elements.

A questionnaire was answered by 35 organizations from 20 different countries. The following conclusions can be derived from the responses to the questionnaire:

- a. Different methodologies are used by different countries for the assignment of resources, considering basically pavements and bridges and using data on the condition to motivate the allocation of resources when a predefined level of condition has been reached. The use of advanced methods, as optimized decision-making based on cost-benefit analyses (road authority and users/community) is limited and, if it is used, it is mainly applied to pavements alone.
- b. The most commonly used methodology to determine budget allocation among different classes of infrastructure is still the use of an historic distribution.

Road pavements

This theme was addressed by three Technical Sub-Committees: D.2a. *Road surface characteristics*; D.2b *Flexible and semi-rigid pavements*; and D.2c *Concrete pavements* - overlaps and synergies between the work of D.2b and D.2c were addressed through joint working groups.

Reduction of construction time and costs

Reducing the time and cost of construction can have a negative effect upon construction quality. Notwithstanding this, there are strong drivers in many countries to reduce both the time it takes to deliver major infrastructure projects (and to reduce disruption, such as traffic delays, attendant upon even relatively small projects) and the associated costs. Clearly time, cost and quality must undergo a process of optimization as is always the case with construction. Construction methods specifically targeted at reducing construction time and costs are investigated, strengths and weaknesses identified, and case histories presented.

Improved maintenance methods

Emphasis was first paid to the technical aspects and the performance or durability of modern methods of maintenance including surface and structural rehabilitation of different types of pavements. Second, the changes to maintenance strategies adopted by road administrations were investigated together with the impacts that these changes will have upon the future maintenance of pavements. The analysis carried out is supported by the responses to a questionnaire sent to Association member countries.

Road noise mitigation

There have been significant initiatives in many countries to reduce the environmental impact of noise both in terms of actions to reduce at source and also to reduce the associated costs. This has led to the development of a large supply of new products for road surfacings with notable results in noise reduction of vehicular traffic, particularly that of heavy trucks.

Monitoring of innovation

The technical committee has undertaken an analysis aimed at detailing a variety of aspects related to the monitoring and implementation of innovation, including:

- the implementation of policies favouring innovations by road administrations,
- changes in construction and maintenance practices necessary to increase durability, and
- the promotion of practices related to recycling and reuse of materials.

The importance of innovation in the competitiveness of companies was confirmed as well as the possibilities to increase the service life of pavements and to reduce the negative impacts of maintenance and construction activities on road users.

Adaptation to climate change

Several countries are concerned by the potential impacts of climate change on pavements. Guidance is provided on how to assess the vulnerability of road pavements to the direct impacts of climate change, identify and prioritize possible adaptation measures for road pavements that could be applied immediately or phased-in over time, so as to avert the negative consequences on the serviceability of road networks. A series of recommendations is submitted for the evaluation of the associated risks as well as different mechanisms to address the effects of such climatic changes.

Road bridges

Technical committee D.3 investigated the following five topics.

Inspection and Condition Assessment of Bridges

Inspections provide the base information on bridge condition, and hence the need for maintenance and its timing. The reliability of the condition assessment is limited by the accuracy of visual inspections and specific in-situ test results. As such, it is of critical importance to have a bridge inspection system that is reliable, consistent and detailed.

Recommendations are presented regarding the content of training courses for the accreditation of bridge inspectors. Data are presented on the accreditation programs and techniques for the evaluation of the condition of bridges used in different countries.

Non-Destructive Testing for Bridges

TC D.3 analysed the different non-destructive testing techniques used throughout the world, their applications, advantages and shortcomings. The most effective techniques for non-destructive testing of different structural elements made of different construction materials, taking account of costs, complexity and safety were investigated.

Large bridges, management, assessment, inspection and innovative maintenance techniques

Management of large bridges requires specific approaches. Information has been gathered with the help of a questionnaire on:

- maintenance strategies and condition assessment; particular attention was paid to cable-stayed and suspension bridges;
- innovative maintenance and rehabilitation techniques.

Management of the bridge stock

Road administrations have been surveyed regarding the approaches implemented for the management of the bridge stock. Information is also supplied on costs and the necessary expertise or knowledge for an efficient management of the stock

Responses from the countries surveyed also highlight several measures that could help in the prioritization of bridge projects. The experience and training of inspectors are critical to a successful implementation as well as the ease of understanding and usage by decision makers.

Adaptation to climatic change

As a first step, an investigation has been made among countries represented in the TC on how climate change is perceived and defined and on the existence of adaptation policies addressing climate change issues for bridges.

Whenever possible impacts have been identified. Knowledge is yet needed in order to define what should be the changes to design criteria for new bridges or the adaptation measures to consider for existing structures.

Geotechnics and unpaved roads

Technical Committee D.4 investigated three topics as presented thereafter.

Innovations in processing and use of local materials

The problem of the assessment of marginal local materials demands innovative approaches, suitable technical specifications and new technologies supported by past experiences. The objectives are discussed as follows:

- Perform a wider inventory of groups of “marginal” natural materials locally available and exploitable within different member countries;
- Establish on a common basis the technical solutions that have been defined, programmed or implemented at job sites to use and/or evaluate such materials;
- Share feedback of experiences and innovations;
- Exchange methods and specifications applied to these types of materials;
- Define how to cope with and manage risks;
- Highlight innovative techniques and methods applied or intended to be used;
- Define the performance required and the means to achieve it.

It can be concluded that in Europe the use of natural marginal materials in earthworks is common, like argillaceous rocks or rocks containing sulphates, sulphides or organic matter, which can be used with preliminary treatment and some construction provisions.

Innovations in construction and maintenance of unpaved roads in developing countries

This topic was addressed through the organization of an international seminar held in Cotonou (Benin). The seminar considered:

- The challenges and recent trends for the design and construction of unpaved roads;
- Maintenance of geotechnical structures and of unpaved roads
- Innovations and investigation

Adaptation to climate change

Technical Committee D.4 developed its previous work by drawing more on the anticipated effects of climate change by region and the probable events within the perspective of a better understanding of the phenomena and their impacts. The objective is to be able to better prepare and adjust the earthworks to ever changing conditions. The report prepared on this topic contains two parts:

Part I: Illustration of the main climatic effects expected with regard to geomorphological conditions of the Earth - It is intended, with the help of maps, to show how large scale climate effects and changes are spatially distributed. Charts of geomorphological zones, such as flat coastal zones and steep mountainous regions are cross referenced with climate maps; on these charts, the sites described in detail in part II are plotted.

Part II: Types of situation demonstrated by detailed case studies - The effect of significant climatic phenomena is described and illustrated. For each case, mention is made of both positive and negative effects on geotechnical structures. Possible solutions are also presented to overcome harmful effects. Special mention is made of the problem of uncertainty applicable to forecasts for long-term climate change.

Despite the abundant literature on climate change, it is difficult to find elements specific to road construction. It is important to define all possible scenarios in local conditions in order to take adaptation strategies for road structures relevant to the prevailing risks.

Conclusions for ST D

There is a strong trend towards the introduction of performance management systems. These management systems provide a good evidence-base for allocation of internal and external funding, however, the practice of resource allocation is very different to the theory. Early-adopters of Asset Management Planning have now enhanced their capabilities by including Performance Management in their governance structures.

The most commonly used methodology to determine budget allocation among different classes of infrastructure is still the use of an historic distribution; The use of advanced methods, as optimized decision-making based on cost-benefit analyses (road authority and users/community) is limited and, if it is used, it is mainly applied to pavements alone.

There are strong drivers in many countries to reduce both the time it takes to deliver major infrastructure projects (and to reduce disruption, such as traffic delays, attendant upon even relatively small projects) and the associated costs. Clearly time, cost and quality must undergo a process of optimization as is always the case with construction.

There exists the need for better technology transfer to developing and emerging countries for the optimum utilization of local construction materials and for effective low-cost techniques for construction and maintenance of unpaved roads.

International practice for evaluating the structural and functional capacity of pavements and bridges has shown advances in its development as a result of the use of new technologies and better methodologies for evaluation that include continuous training of human resources and commitment of road authorities.

Special mention is made of determining in further detail the different causes and effects derived from climate change on the road infrastructure so that road authorities are capable of implementing effective adaptation plans.

Looking into the future

ST A

The reduction of greenhouse-effect gas emissions is a subject on which consensus is yet to be fully reached. Work in this arena should continue as a major input to national plans, policies and initiatives in order that the mitigation of impacts on the environment becomes more efficient and effective.

Tolls on principal roads, individual structures or systems that are collected to finance new infrastructure or the improvement of existing infrastructure are widely applicable and they will continue to be used. Tolls are increasingly introduced for the use of existing infrastructure so as to guarantee funds for their maintenance. However, the global financial and economic crises challenge such financing mechanisms. There is a need for continuous monitoring and review of financing and contracting schemes for successful and cost-efficient involvement of the private sector including contracts for integrated services and public/private partnerships.

The assessment of social impacts in the decision-making process as regards transport infrastructure projects requires further research and harmonization of the definitions and methodologies.

The *ex-post* evaluation of projects, through systematic approaches or otherwise, is still not common practice and should be widely promoted in order to evaluate the sustainability of development.

ST B

Both institutional integrity and the fight against corruption are global priorities. It is therefore essential that specific objectives are established for their promotion among public and private entities in the road sector. Continued collaboration with the United Nations, Development Banks, industry and the civil society is required on these issues.

More work should be carried out on the analysis of the operation of the road transport system using a systems approach where authorities, concessionaires and the different categories of users interact taking a multi-modal approach.

Intelligent Transport Systems (ITS) have been proven to provide operators of road networks with tools to improve safety and the efficiency of road operations. Interconnected vehicles and connection between vehicles and the infrastructure open new possibilities, which need to be explored and encouraged for further progress in the utilisation of the existing capacity of the road system.

In urban areas, structural measures should be considered in order to achieve a better modal distribution of transport demand, consistent planning of land use and transportation, and increased use of non-motorized transportation modes such as cycling and walking.

Public authorities must take the responsibility for coordination of the many stakeholders involved in freight transport corridors, intermodal terminals and urban freight systems.

ST C

The UN Decade of action 2011-2021 for road safety provides strong encouragement for all countries drastically to reduce the number of fatalities and injuries from road accidents. Investigation, innovation and knowledge sharing should continue in order to find new ways of improving road safety.

The World Road Association's activities should specifically support the following pillars of the action plan of the UN Decade for Road Safety:

- Building management capacity,
- Influencing road design and network management,
- Influencing road user behaviour.

Recommendations are still needed regarding the implementation of national road safety policies and strategies, and for the setting of long-term and intermediate objectives,

Human factors should be integrated into geometric standards for roads, including urban roads. Deficiencies persist in urban roads that affect vulnerable users such as pedestrians, cyclists and disabled persons caused by unplanned urban growth. Attention should also be paid to increase safety at road works.

Risk assessment and management in policy development and decision making, road operation and emergency response is still in its infancy and should be deployed much more broadly in the road sector. Guidelines and examples of good practise should be drafted.

ST D

The adoption of robust Asset Management and Performance techniques will lead to transport authorities discharging their responsibilities more effectively. More work is needed on how this can be achieved.

Even though a general awareness of climate change is developing, most infrastructure administrations still lack a clear picture of the likely effects on road networks. Further investigations and analyses of impacts are needed.

Some countries that have proposed strategies to adapt to the effects of climate change but their implementation in practice is still unproven.

The social, economic and environmental drivers for recycling and management of appropriate waste materials should be investigated to identify key issues that will ensure the sustainability of the use of such materials in pavements with the goal of maximizing the long-term value of recycled products.

Drainage in unpaved roads continues to be an important topic and should be revisited, as poor design and lack of regular maintenance has severe consequences for the integrity of these roads and result in severe traffic disruption and high costs.

Work should be undertaken to identify the relative importance of each major contributor to the carbon footprint of road infrastructure. This would determine the most important aspects of the infrastructure in this respect and also help to identify the effects of contracting methods and the impact of reduced quality on the whole life carbon footprint of the road (i.e. construction, maintenance and rehabilitation).

Roads for a better life!

DETAILED CONCLUSIONS

Strategic Theme A: Mitigating the impact of the road system on climate change

Strategic Direction Session A

In recent years there has been a growing awareness of the impact of road transport on climate change therefore forcing the development of actions aimed at decreasing the amount of greenhouse-effect gases produced by the construction, maintenance and operation of roads. Among these actions, mention can be made of new legislation, measures to improve road operation, modifications to the behaviour of users and switching to other transportation modes.

In the case of the United Kingdom, a unifying political and legislative agenda has been adopted to cover its four administrations. The government has implemented a strategic framework for managing the impacts induced by climate change and it constitutes the basis of operation. The main instruments inherent to that policy are listed below:

- Climate Change Act 2008, legislation that creates a new approach on issues related to management of and response to climate changes, defining ambitious objectives to reduce by 80% the greenhouse-effect gases between now and year 2050, with an intermediate goal of 26% by year 2025.
- Low-carbon emission transportation, a strategy allowing the development of a route for a future system involving low carbon contents as well as the description of how to achieve a reduction of 85 million tons of CO₂, between 2018 and 2022, through new technologies and improved fuels.
- Plan for the reduction of carbon for the transportation sector, detailing who will create the carbon reduction policy and how to implement it.

Norway anticipates a reduction of CO₂ emissions ranging from 2.5 to 4 million tonnes in the transportation sector and it evaluates political measures and instrumentations for reaching of this objective. This sector offers the strongest potential for the reduction of this type of emissions, being aware that it constitutes the sector with the largest generation of gases. Among the measures analyzed, bio-fuels represent by themselves the largest contribution to the reduction of emissions and their progressive introduction could be translated into reductions between 1.7 and 1.9 million tons of emissions by year 2020. On the other hand, the two-fold increase in cycling represents a significant social and economic advantage. The implementation of some of these measures implies the utilization of economic and political instruments; other measures can be activated by individual actions and some others demand a combination of both.

The utilization of biofuels can be triggered by a decision to commercialize them through a regulatory instrument or by fiscal measure (taxation or other economic mechanisms).

Japan has decided to adopt a global approach aimed at reducing the CO₂ emissions in the different areas of the transportation system and, in particular, in automobile traffic. This includes measures to control the flow of vehicles, eliminating congestion and inducing the vehicles to ride at speeds with low-impact on the environment, investigations on driving techniques with low impact in the environment; improved fuel savings, transfer to other modes of transport, and more efficient and greener freight transportation.

It can be concluded that it is possible to reconcile economic growth with the reduction of CO₂ in the transportation sector.

In the United States of America, the Department of Transportation has committed itself to reduce the effect of the road transport system on climate change. Even though important measures have been applied for the purpose of reducing emissions, policies and global approaches continue to be developed along these same lines by formulating new and more effective standards for vehicles to control fuel consumption, as well as a new standard applicable to renewable fuels. These actions are complemented by encouraging low carbon emission options of, such as the use of public transportation, walking and cycling.

Research and development in the area of new technologies and fuels are expected to play a fundamental role so that the transportation fleet becomes capable of reducing its emissions significantly to confront the challenge that the climate change produces in the planet as a whole.

Within the framework of this strategic theme, inclusion is made of the topic corresponding to Special Session 01, *"Sustainability of road transport. Where are we heading, how do we assess sustainability?"* from which the following conclusions were derived.

In the subject of evaluation of road projects, important progress have been achieved ranging from a conventional cost/benefit approach to an evaluation taking into account considerations of a economic, social and environmental nature. The social dimension is important and requires further development; in fact, civil society plays an increasingly leading role and gains importance in government projects. It is convenient to evaluate other transportation alternatives at the whole urban system and to solve the needs of users that at present are far from being satisfied.

TECHNICAL COMMITTEES SESSIONS

TC A.1 Preserving the environment

For decision makers

On climate change mitigation and adaptation

Decision makers should recognize that:

- The scale of the challenge we face to reduce global carbon emissions sufficiently is immense and the road transport sector has a key role to play in these efforts.

- Success approaches demand the forming of robust plans with firm reduction targets and strong monitoring and transparent reporting.
- Global reduction of transport emissions will be the result of a combination of multiple approaches and solutions. This will include fiscal measures, technological advances, improved planning and delivery of infrastructure and behaviour change.
- The climate is already changing and we must also consider adaptation as part of our response. Climate change must be addressed as a risk issue so that we can protect infrastructure whilst we learn to manage and reduce emissions.

On the monitoring and evaluation of environmental impacts

- The environment is now commonly considered in the provision of roads but there is still scope to improve the integration of the environment within road design. It is only through such integration at the design stage that the environmental performance of the road can be maximised.
- The effective integration of environmental issues into road planning from the earliest stages is vital.

On road system energy

- The planning for new roads or the rehabilitation of existing highways provides the opportunity for the investigation of the potential for renewable energy production on the road estate to together with opportunities to reduce energy consumption.

Technical conclusions

On climate change mitigation and adaptation

Technically it must be recognized that:

- Reduction of traffic and use of lower emission vehicles are an absolute must.
- No solution should be rejected even the ones having a small impact. No step is too small when going in the right direction.

On the monitoring and evaluation of environmental impacts

- All project teams must have integrated within them all relevant environmental disciplines from the project outset.
- Our approaches to the environment must be rigorous, based on sound science and knowledge, from international to national and local.
- Establishing rigor demands the proper application of the techniques of monitoring so that we do monitor where necessary but we do not do it in a haphazard way.

- Any monitoring and evaluations activity must add value. Their focus should be areas of uncertainty. The focus should not be impacts which are well understood and where outcomes can be expected with confidence.
- We should concentrate in those areas where uncertainty persists and this must include the proper evaluation of the effectiveness of novel mitigation approaches,

On road system energy

- A range of technologies exist now to enable highways to create energy and/or reduce energy consumption.
- Technologies will become more viable economically as they become established but adoption will also need to consider environmental and social factors.

For national road authorities and the World Road Association

On climate change mitigation and adaptation

- The NRAs/PIARC should address the development of common whole life approaches to the issue of carbon accounting and management within the road sector to ensure that decisions can be made on sound information.

On the monitoring and evaluation of environmental impacts

- Greater effort should be focused on the dissemination of well-established assessment, monitoring and evaluation techniques to avoid duplication of effort, enabling national road authorities to focus on areas of difference and on innovation.

On road system energy

- The NRAs/PIARC should investigate the opportunity to increase the value of the transport corridor by exploiting the potential as a source/site for renewable energy generation.
- The World Road Association should consider the production of a handbook to explain the range of renewable energy techniques available relevant to highways and how these can be exploited to produce operational benefits and savings in carbon.

TC A.2 Financing, managing and contracting of road system investments

As a result of the work of the Technical Committee and of the discussion during the session at the Congress, the main conclusions can be summarized as follows.

There is not a single example of a country which does not need a road system which can offer a sustainable service to foster its economy. On the contrary, those countries which lack a sound road network face difficulties to achieve the economic sustainability sought by modern societies. Thus a reliable road network to provide mobility for people and goods is a must for all good governments.

However, to develop a sound and sustainable road network takes a lot of time, much money and future resources to achieve and, also, adequate maintenance. Furthermore, to achieve cost effective maintenance in the future will require decisive investments in the present.

Hence governance, or better said, proper governance is the first key issue for the adequate delivery of road systems.

This is a key issue for decision makers; they will have to take into account not just the cost and benefit of the road investment itself, but the added value that a sound network produces in all the country's economy; and, to obtain the highest added value possible, it will be necessary to coordinate all developments in an adequate long run planning.

So, Good governance is a necessary but insufficient condition to achieve appropriate service levels, affordability and value for money.

Although centralisation and decentralisation of road network ownership and management are closely aligned to the structure of government, there is no clear advantage or disadvantage of this issue in relation to the achievement of good governance. So, here is nothing to advise decision makers apart from what said above regarding governance.

The second issue to be considered comes after good governance is achieved is related to the evolution of travel demand. It is increasing in all countries, although recent economic difficulty has affected this pattern in the short-medium run.

Meeting heightened levels of road service demand requires commensurate funding. However, nearly all road authorities face increasing challenges to secure adequate funding and timely financing. The recent Global Financial Crisis which has financially weakened many governments has added pressure on funding and financing of road services. There is an important role to technicians; to forecast accurately future demand is a must to the goal of securing an adequate future funding.

Therefore, it is necessary to define, if possible, what is the best funding strategy to be used. The conclusion is that there is not an answer to that question. Funding strategies are heavily dependent upon a country's objectives, socio-economic characteristics, the road categories and the stage of highway development. All the funding strategies are varied throughout the countries and all have different pros and cons. Here is an important role to the World Road Association. All experiences must be shown, and organizations like the World Road Association are the right place to show them all. It is not a question of deciding which the best is, but to know what has happened to every strategy. What have been good experiences and what less good. What succeeded and what failed.

From a mere point of view of the road, better strategy is that related to pay for use, commonly known as toll, because it sets money directly to the road. On the contrary, those payments related to the road, but not to the use of it (oil, vehicle acquisition, etc.) sometimes are larger than the road expenditure itself. And those based on general taxpayers are insufficient and generally dependent on politics and economy. Also, it is not clear if earmarked (hypothecated) taxes are efficient. Sometimes if there is much money, it can produce an overinvestment in road, which is inefficient.

Although there has been an increasing use of tolls and direct user charges, road authorities are still facing major resistance to their adoption, and where it has happened other traditional payments have not gone down. Maybe a good strategy can consist of introducing tolling together with a reduction of other use related taxes. Also, it seems a good strategy to have as many different sources of funding as possible, because it reduces the volatility risk of funding.

But before the final funding of the road, it is necessary to first finance any investment to be developed. That is where the role of the private sector is becoming more important, and even in some countries, the private sector has become virtual owner of the road.

There is now a range of contractual options varying from traditional schedule of rates contracts requiring limited technical and financial capabilities to long duration, multi-facet contractual arrangements requiring all encompassing human, technical and financial capabilities, PPP's alliances. All have their pros and cons. Many can yield significant value for money, but requiring large economic bidders and hence could reduce the number of small to medium suppliers in the marketplace over the longer term with negative consequences, maybe not on the road but in the general economy of the country. Some can offer best solutions but at a higher cost. Some will also need very skilled personnel in the Administration. Also the abuse of private sector contracts can lead to a depletion of core skills and a reduction of competent and knowledgeable staff within their departments.

This means that the option chosen by a government must be over the basis of an analysis of every type of contract and not over just copying another administration or because it has been done that way for years.

Particular attention should be paid to learn the positive lessons from these opportunities to expand the funding pool.

The global financial crisis significantly reduced the capacity to pursue PPPs with major project financing requirements. Now that countries and economies are re-emerging from this financial crisis, project elements such as risk transfer and payment mechanisms which affect value for money, affordability and “bankability” need to be revisited.

TC A.3 Road system economics and social development

The Technical Committee session addressed two issues:

- a critical review of approaches to assessment of social impacts related to road projects, and
- a discussion on the road pricing effects and their evaluation.

The session was also an opportunity to hold a common reflection on major trends in road pricing worldwide, based on a review of recent pricing initiatives.

Approaches to assessment of social impacts

The review of approaches to assessment of social impacts of road projects focused on both appraisal methods and ex-post practices. Two different situations were made clear with regard to ex-ante evaluation: on one hand, the case of developed countries, where some innovative methods are being developed; on the other hand, the appraisal of social impacts in developing countries, for which the taking into account of social impacts during the appraisal of road projects is a sensitive issue, and where the appraisal is basically done following the requirements and practices promoted by international financial institutions (IFIs).

The main conclusions were the following:

- It is important to note, from the very beginning, that the distinction of which impacts have to be considered as “social impacts” is not evident. There is no generally accepted international definition of “social impacts” that allows, for example, a clear distinction between social, economic and environmental aspects. Even if this notion is “dynamic” and may be also dependent on the economic development of a country, it is recommended that a common understanding is arrived at.
- The need to better understand the social effects of road projects is well recognized. However, the practice of appraisals of social impacts that are sufficiently systematic and complete is still limited. Moreover, the practice is often constrained by a project-based approach (instead of a strategic approach) and its difficulty to fit in traditional cost-benefit techniques.

- In developed countries, the appraisal of social impacts is often done within the framework of other broader legally established strategic assessments (as the environmental impact assessment) that are at least “socio-economic” or “socio-ecological”. The appraisal of social impacts is also increasingly framed into the broader concept of “sustainable development”. In order to maximise synergies, the World Road Association should consider the convenience to combine under one single technical committee the review of sustainability appraisal of road plans and the investigation of new developments in appraisal of social (and economic and environmental) aspects.
- Analysing the practices of IFIs, we see a clear evolution in assessment methods that tend to pay more attention to social impacts. However, their socio-economic road projects appraisals are still nowadays too much influenced by the cost-benefit method, despite the fact that this method shows limitations when it comes to take into account the social dimension of road projects and their impact on poverty reduction in developing countries. Social impacts appraisal by IFIs should continue to make progress, using more and more adapted methodologies that, for example, combine the cost/benefit method and the multi-criteria analysis.

IFIs are also encouraged to consider more systematically accompanying measures to maximise the social benefits of road projects, such as building/rehabilitating adjacent socioeconomic facilities (schools, health centres, markets).

- Ex-post evaluation – either through systematic or unsystematic approaches - is also not a common practice in the member countries of PIARC. Moreover, in most cases in where ex-post evaluation is done, the assessment focuses on impacts that are not necessarily “social”. However, the participants in the session recognised the strong added value of such ex-post evaluations and encourage the national administrations to promote their practice. In order to ease its implementation process, simplified interim ex-post assessments could initially be produced shortly after opening (one to two years).

Audit and evaluation institutions independent from road managers could monitor the development of these ex-post evaluations. Road managers and road owners should nevertheless remain solely responsible for their production. The ex-post assessment results should be made public.

- The World Road Association, in cooperation with other international organisations, could promote the carrying out of social impacts assessments and disseminate best practices.

Consistent training sessions on general concepts of evaluation and on the methodology of appraisal and ex-post assessment of social impacts could be offered in many countries. The training should aim primarily at the hierarchy of road administrative structures.

The World Road Association could also volunteer as a forum to bring closer the points of view of developing countries and IFIs with regard to methods and criteria for road projects assessment.

Road pricing effects and their evaluation

The discussion on road pricing effects was based on the experience and the results of studies of a variety of implemented and envisaged pricing schemes. The pricing schemes addressed during the discussion included those for which the primary goal is to finance the construction and/or maintenance of road networks, as well as pricing schemes used mainly as traffic- or mobility- management, and/or as an environmental-protection tool.

The main conclusions - after an introductory presentation of the main observations in this matter and an open discussion with all the participants in the session - were the following:

- All pricing schemes (vignettes, toll facilities, urban pricing, mobility pricing) include an analysis of the new mobility characteristics when they are evaluated. The study focuses first on the changes in travel demand in the priced facility/area; other relevant mobility characteristics that are often considered include traffic diversion, transport mode change or time of travel. Public information on the assumptions, methods and models used to carry out the evaluation is however scarce, whilst they are often fundamental to the understanding of the results. The promoter of the evaluation should make this information available.
- Environmental impacts are – after mobility characteristics – the second group of pricing effects most commonly evaluated. The evaluation of environmental impacts usually concerns emissions of key air pollutants and noise. However, technicians should keep in mind that noise is not a relevant issue for the evaluation, because people would require very substantial changes in traffic flows to perceive a decrease or an increase in noise.
- Other impacts that are analysed less frequently typically refer to changes in safety, the economy and land use. These effects are difficult to assess a posteriori because they take place in the long term. However, such assessments should be encouraged.

Some of the points to keep in mind by promoters of new road pricing schemes and decision makers should be – on the basis of existing experiences – the following:

- Facility-based pricing of interurban road networks is not effective in lowering total traffic demand and, consequently, in reducing environmental impacts. Its main advantage is revenue generation. Certainly, from the environmental point of view, tolls applied only to heavy goods vehicles and that differentiate by vehicle emission class may favour the modernisation of the fleet (with higher environmental standards); however, they do not lead to a significant diversion from road freight transport to rail transport. HOT-lanes and other toll tariff adjustments practised in facility-based pricing may be relatively effective to manage road congestion. Social acceptability is not, in general, a critical issue if there exist free alternatives to the priced facility.

- Urban pricing – either cordon or area pricing - has significant reductions in travel demand (10-20%) and on air pollutants. The effects on safety can be either positive or negative. In most cases, expected negative impacts on the local economy have not been proven. Acceptability is a critical determinant for a successful implementation of the urban scheme: revenue neutrality or the use of revenue to improve alternative public transport may help greater social acceptance.

TC A.4 Rural roads systems and accessibility to rural areas

Isolation is a major constraint to development – the lack of access to basic services, goods and markets deprives people of opportunities to improve their living and working environment – it sustains poverty. The situation in rural areas is generally falling behind that of urban areas, contributing to increased rural-urban migration.

Rural road investments are essential for economic growth and poverty alleviation. However, improving access in rural areas requires an understanding of basic, social and economic access needs and constraints of the local people. Planning of rural roads must be undertaken in an integrated manner to identify limitations and opportunities in their environment in order to address local people's specific needs with alternative solutions to road provisions, service location and improved mobility of individuals.

It is widely known that poor maintenance is poor asset management and has tremendous negative impact on productivity of businesses and agriculture. Moreover, the delay in reaching social targets for human development manifested in the Millennium Development Goals (MDGs), particularly related to health and education, is devastating for some regions and countries. Improved awareness and knowledge dissemination, and involvement of all users, also those who are presently deprived from the road services, in monitoring and auditing rural roads investments will help better balancing between high level roads and rural roads development and maintenance.

It is also widely known that States face many conflicting interests, and budgetary constraints challenge a country's ability to meet its massive rural road infrastructure requirements. Rather than a constraint, this should be an incentive to adopt efficient social, technical, economical, managerial and environmental road development and maintenance methods that are fiscally viable, politically acceptable and sustainable.

In addition, priority should be given to periodic and timely investments in the maintenance of existing rural roads. These investments are even more critically important for unpaved roads as their durability is very limited without it, resulting in a high initial loss within just a few years. This is particularly valid in regions or continents like Africa where most materials are substandard and weak, and need improvements by various means.

For High Level Managers and Decision Makers

Administrations should no longer consider rural roads as a secondary subject and staff working on rural roads programs should be given much higher credit. Their officers should counteract the low-level recognition of rural roads so as to facilitate social and economic development, and to environmental protection, as means of subsistence by increasing financing to be able to reflect their degree of importance as a service to the people of a country.

Good practice planning tools for Integrated Rural Accessibility Planning should be considered for effectively integrating and accommodating rural roads as part of local planning. This will facilitate participation of local communities in identifying the options for the optimum best investment in rural road and the alternate investments such as location of services and mobility improvement.

International experience in decentralised management and the execution construction and maintenance of rural roads evidence large benefits in terms of solutions of quality, profitability and multipliers in the local economy provided local service suppliers (like micro, small and medium-size companies and communities) become involved. Administrations should keep on working in perfecting and documenting efficient methods for construction and sustainable maintenance of rural roads to guarantee adequate access and mobility of the rural population and to satisfy their basic needs, provide employments and related income and reduce poverty.

For the World Road Association

The committee has noticed that the increase in the investments applied to rural roads programs supports the recommendation that they should be assigned a higher priority. Administrations are responsible for confronting the challenge of provision of services on in an equitable manner. Therefore, the Association, together with member administrations, should no longer consider rural roads as a secondary issue. This fact should be recognized beforehand because the topic of rural roads should be regarded as a strategic matter. Therefore, the following technical issues should be studied:

- Impact assessments, rural roads investments and funding mechanisms;
- Processes of integrated rural accessibility planning processes and methodologies with the objective of multiplying the use of best practices identified;
- Management practices, sustainable mechanisms of delivery and capacity – centralised and decentralised organisations, private sector and society;
- Rural roads assessment methodologies and instruments for cost-efficiency evaluation and their harmonisation including themes related to pavement technology

The Committee has noted interest in furthering the knowledge and dissemination of information on technological alternatives related to the use of local materials and admixtures. It is recommended that the Association:

- works in the development of standardized tests, documentation and classification of admixtures;
- works in collaboration with administrations and associates in the development of a planning system to select types of admixtures for different conditions...

The Committee has noted with great concern the lack of an active participation by appointed members. It is recommended for that the Association encourage the participation of developed and emerging countries and of those in the process of development to tackle the challenges confronted by rural roads. Regional subcommittees can work and support these activities.

Strategic Theme B: Delivering integrated transport modes and services to customers

Strategic Direction Session B

The Strategic Direction Session of STB addressed "intermodal" and "congestion measures" under the title of "Delivering integrated transport modes and services to customers".

Financial aspects, approaches from both infrastructure development and communication technology

In consideration of financial limitation, a variety of approaches are implemented to improve performance of road networks through both developing infrastructures and providing information for promoting intermodal transport.

Cooperation between stakeholders

To promote policies on intermodal transport, close cooperation with the various stakeholders is crucial, as a lot of people are concerned in formulating measures and making a decision.

Policy and approach in consideration of city sizes

Comprehensive approaches from public transport such as railways, trams and buses, and from non-motorized mobility such as walking and cycling are important to reduce congestion in urban areas, taking into consideration city sizes.

Also, in the long term, we have to take ample consideration to coordination of transport policies and land use planning.

Innovative communication technologies including cooperative vehicle highway systems

Provision of information is necessary for promoting intermodal transport and using road network more efficiently. In this session we had some presentations, introducing current status of cooperative vehicle highway systems in ITS field, and describing future prospects.

This field includes state of art technologies on information exchange system among road users, and we should keep a close eye on this trend.

Nowadays, we can find a variety of contexts throughout the world, in terms of development of road network, land usage situation, rate of population growth, cultural aspect, and economic situation and so on; therefore, we should not take a uniform approach, but rather individual approaches in accordance with the context.

TECHNICAL COMMITTEES SESSIONS

TC B.1 Good governance of road administrations

Technical committee B.1 on Good Governance for Road Administrations developed the idea that good governance is having the right people, acting with integrity and transparency, with the right skills focusing on and involving the customer in delivering better public value. The following themes were presented during the congress session:

- An overview of the costs of corruption in the road sector and the case for integrity: the issues discussed overlapped and resonated with those presented at the special session on Governance. The session concluded that institutional integrity is an essential element of Public Value, enabling Road Administrations to maximize their effectiveness and benefits for society.
- The need for customer input and the critical element customer segmentation plays in any road agency: This session highlighted several observations and findings road administrators can use to assist them in ensuring the public feels it is getting ‘value’ for its investment by incorporating their input. The session also featured the concept of using customer input as a means of shifting organisational culture from a producer’s viewpoint to a user’s viewpoint.
- How to address the issue of the human resources for the future in the road sector: The key themes of this working group are connected parts of the supply and demand chain of human capital required for the broad operational functionality of a road administration.

For Ministers and other decision makers

Integrity / Corruption:

The road sector is especially prone to instances of corruption due to the complex nature of infrastructure projects, the multiplicity of contractors and stakeholders involved and the successive failure of public agencies and the private sector to confront and address the issue. The latter is now changing with a range of national and international treaties, laws and declarations launched in the last ten years;

There is no single solution to the issue of corruption, and most organizations will require a coherent, integrated package of measures appropriate to their circumstances.

Customer orientation:

Involving the customer is key to deliver better public value. Incorporating customer input will create a better, more responsive agency. With the agency's vision and mission as the central driver, partners and customers guide our efforts to plan, design, build, maintain and operate the transportation system;

There are many effective ways to collect and capture customer input. However the most important finding is to be sure to USE the input.

Human resources for the future:

- Human resources are a key part of capital investment and need to be thought in this way;
- Contracts requiring skills need to reflect the skills market (particularly in developing countries) and infrastructure maintenance and development contracts should be used to provide skills development and training to staff;
- Consider applying joint and coherent solutions and strategies across the sector (private and public) including campaigns to increase the pool of people interested in road based technical roles;
- Performance management system are useful to align personal and work development goals with organisation objectives and will lead to a successful organisation;
- Understanding of the skills gap is essential for any road administration.

Technical aspects

Integrity / Corruption:

Road Administrations must fully understand the costs of ignoring or failing to tackle instances of corrupt behaviour within their organization or by companies in their supply chain. These costs can be financial, reputational, operational and social and, in their ultimate form, can undermine the achievement of corporate objectives and outcomes;

Corruption also has real costs and consequences for individuals, especially as corrupt acts are a criminal offence in most jurisdictions, liable to a range of punishments;

The WG1 Cycle of Integrity and the parallel Toolkit of Integrity provides a useful framework for organizations to review, develop and monitor measures to prevent, identify and, where necessary, take enforcement action against acts of corruption by their staff, companies within their supply chain and other stakeholders.

Customer orientation:

Segmenting your customers provides you with a better understanding of what the customer really needs and wants;

There is a natural, stair-step progression in managing customer orientation: Informing, Listening, Dialogue, Involving.

Human resources for the future:

- Research what drives and motivates the young people of your region;
- Consider the whole student life cycle (primary, secondary and tertiary) and partnering with education to increase the supply chain of labour;
- Road sectors need to consider what their 'value proposition' is to prospective employees to be at the forefront of young people's decision making;
- HR for the future requires skills levels to be monitored.

For the World Road Association

Integrity / Corruption:

- The Cycle and Toolkit is applicable to organisations in Developed and Developing Countries. However, more work is needed to further evolve it for the societal (macro), project (micro) levels as well as addressing the issues of individuals' values, actions and behaviour; and
- There is a strong case for the promotion of business integrity, both for organisations and wider society and further work should be done in this important area in the next 2012 – 2015 work cycle of the Association.

TC B.2 Road network operations

Strategies for road network operation should take into account the global mobility of persons and goods through the different transport modes. A coherent vision of network operation needs to be developed amongst the partners involved in its operation for the purpose of proposing a global approach to government. Such cooperation includes an exchange of information on the availability of roads, recommended routes, interconnection between the different modes, waiting times and incidents so that travellers and transporters have access to coherent data to allow informed decisions to be made. Furthermore, administrators of the various modes should cooperate in their daily operations so as to be able to implement their own strategies with a coherent vision.

This includes interconnection with private service suppliers (for instance, traffic information service providers that use data retrieved from vehicles). Finally, it is important to focus attention on the needs of the users because they rapidly evolve with the introduction of new mobile communication services and through the development of social networks.

Thanks to real-time communication between vehicles and service providers, buses, trucks and automobiles are contributing to the improvement of the transport system. This relationship will be further developed in the future with the extension of data exchange between vehicles and infrastructure. However, the potential of this technology to support road safety, mobility and the objectives of environmental policies can only be achieved if some of the basic conditions are complied with. The vehicle for communication with infrastructure demands investment. No satisfactory business model has been found as yet that allows the private sector to invest independently of the public sector. It is possible that social benefits in terms of safety and energy saving are important but so far the demonstration of such benefits has not been sufficient and authorities are reluctant to take the first step. Cooperation between traffic authorities and the automobile industry should be continued and extended to the road industry (design of roads and equipment) and to the telecommunications industry including the operators. The Association is willing to show its leadership, in particular through the collaboration that it has established with FISITA (International Federation of Automotive Engineering Societies).

The Association has taken an important step forward in the capitalisation and dissemination of knowledge concerning ITS and network operations, through the on-line publication both the ITS and the Network Operations manuals. The committee has expressed the wish that this service is maintained and that the content is regularly updated in future. This is not possible if only the resources of a technical committee are available; it will be necessary to find an alternative means of supporting this activity.

For ministers, road administrators and decision makers

There is a need to develop cooperation among all parties involved in mobility. Nowadays, the fast development of private initiatives to offer travellers information services has strongly modified mobility. However, road authorities and road operators in general fail to engage with service providers and a closer collaboration is therefore required so as to profit from the benefits derived from these services. As a result, it is recommended that in the political sector initiatives are approved so as to develop an integral approach to the problem of mobility taking into account all modes and interested parties, and fully considering the initiatives of the private sector.

It is necessary to find a means of inviting more interested organizations, such as is the case of the automotive industry through FISITA, to collaborate in extending the initiatives to new organizations (the main operators of transport services and equipment suppliers, through their regional organizations, e.g. ITS America, Europe and Asia-Pacific).

Technical aspects

The committee has identified key indicators of success for the implementation of strategies for road network operations and tools.

In addition, to have a good approach it seems important to regularly monitor the activities related to network operation and to verify if the selected objectives assigned to each project are really achieved. It is necessary to establish key performance indicators (KPI) for network operations and to develop recommendations for good practices. A recurrent concern in road network operations is how to deal with freight transport, especially in urban congested areas, and how to induct changes in the paradigms of ownership and use of vehicles in order to achieve a better management of traffic.

The economic evaluation of the strategies and their implementation in projects constitute a requirement for financial institutions. It is highly desirable to develop a solid and comprehensive methodology for evaluation.

It is recommended to continue with the collaboration that has been established between the Association and FISITA. The Joint World Road Association-FISITA Task Force has carried out a detailed analysis of issues related to connected vehicles. However there remains a demand from the automotive industry to understand the role played by road operators and the benefits derived from a close collaboration with them. This can be carried out through the direct work of the Association's technical committees that might be interested in establishing a dialogue with engineers from the automotive industry, for instance in considering how to reduce carbon emissions and greenhouse gases generated by road transport, in monitoring the road conditions, in operating the road network and in managing the mobility of persons and vehicles in urban zones. It is necessary to create a commitment to disseminate the outcomes from the Joint Task Force to engage with parties who may not be familiar with these developments.

The Association's ITS Manual has been acknowledged as one of the few authoritative publications on this topic. Thanks to the financial support received from the government of Chile and to the technical assistance of experts from the Mexican Transport Institute and ITS Spain, a Spanish translation of the manual is available in CD-ROM version. With financial aid received from the U.S. Department of Transportation, editions in French and in English are available online for free download through the Web page of the Association. A Chinese translation is available in printed form.

The need for updating this Manual is becoming urgent. Experience with ITS methods is broadening and some techniques, such as Active Traffic Management are now mainstream. Therefore we recommend in the next cycle a Task Force is created to prepare a comprehensive update, working with other international organisations who have a close interest in ITS.

TC B.3 Improved mobility in urban areas

Papers were focused on comparing strategies for pedestrian and bicycle routes in 41 cities of the world, as well as strategies for balancing urban transport, with improved mobility and reductions in road congestion; the following conclusions were drawn.

The importance of integrating the different transport modes in a city, emphasizing the strengths of each to try to operate them in a harmonic and joint way was posed by member countries. Special mention is made of land use planning to correctly plan road transport.

Highlights of the results were presented from the comparison of strategies on pedestrian and cyclist mobility in 41 cities, placing emphasis on the positive correlation between the length of bicycle routes for every 100 inhabitants and the modal distribution of bicycles.

The results in the course of about ten years demonstrate that the construction of suitable provision for cycles increases the use of bicycles and pedestrian routes as a transportation mode in large cities.

When studying the cities it was observed that those localities having a pedestrian modal distribution of up to 20% are sustainably poor, whereas those ranging from 20 to 30% have intermediate sustainability and those with modal distribution in excess of 30% show a high sustainable mobility.

On the other hand, the use of bicycles at localities with a modal distribution smaller than 2% evidences a poor use of this transport mode, a modal distribution between 2 and 10% has medium to high use, and a modal distribution higher than 10% represents a sustainably high mobility. Therefore, it is fundamental to promote sustainable cities using bicycle routes, developing codes or regulations to share streets and common areas between vehicles and bicycles as well as clear rules to further bicycle use.

It is important to promote areas for pedestrians and bicycle routes in the downtown area and at well-defined areas, as well as catering for accessibility and equity, creating awareness among drivers on speed and its relationship with bicyclists and pedestrians. Preferably, bicycle routes should be separated from roads.

It is also essential to establish master plans to improve the use of bicycle routes, to eliminate physical obstacles and to improve the technical knowledge on their efficient use.

Among the benefits derived from urban transport using bicycles are included improved safety, and reduction of contamination and of vehicular congestion.

A city with 50% or less of flat surface may offer a good non-motorized mobility rate.

Mention was also made of various instruments to motivate the use of sustainable transport modes, such as campaigns labelled *One day without a car*, *Week of European mobility*, *Walk to school*, and *Pedal your way to work*, among others.

A good service of urban public transport has a positive correlation with walking.

Strategies should be studied to balance the different modes of transport so as to reduce congestion and improve mobility, and for this purpose an analysis should be made of the influence of vehicles and of the demand for services.

To improve urban mobility, on a massive and sustainable basis, lessons can be learned from BRT systems, that in the case of the *Metrobus* in Mexico City, moves 450,000 passengers a day. A similar system in Istanbul transports up to 750,000 users a day. These types of solution not only improve the movement of people but they also bring other benefits such as improvements in traffic flow and reduced environmental impacts.

The importance of changing the way of thinking was stressed during the session so as to be able to change the transport mode. The traditional approach has led to the present levels of congestion and unsafe roads in parallel with population growth and to increased levels of vehicle purchasing and of vehicular use on urban roads.

One of the major goals implies the improvement of the standard of living of citizens, satisfying at the same time the needs for improved mobility, increased safety, environmental sustainability and improvement of the cost/benefit ratio.

On a worldwide level, of the importance of effectively promoting public transportation as well as of the implementation of educational programs at schools, in addition to promoting bicycle riding and walking. The best way to enhance the beauty of a city is by promoting intermodality.

A better policy in the management of transport implies the accommodation of more persons in the same vehicle, to restrict parking permits in main streets and to synchronize traffic signals.

Some of the best lessons on mobility come from cities of less developed countries, such as Bogotá in Colombia.

Lessons comprise three principal topics: change the approach to transport planning, have a collaborative approach and develop innovative programs. This then implies the third need which is to have a holistic approach (complete systems), to strengthen a visionary leadership, to link policies to better practices, to develop proper tools, to collaborate, to speak the same language and to know the audience to whom the programs of sustainable mobility are addressed.

It was also discussed that the size of a city should not pose a problem to implement a bicycle-riding transportation program. Basically, any locality, town or city, is likely to benefit from an infrastructure program aimed at pedestrians and cyclists. Numerous cities demonstrate that a program of urban mobility through the use of bicycles may be successful provided it is suitably developed and the benefits are not limited to small or large concentrations of inhabitants.

TC B.4 Freight transport and intermodality

Efficient, safe and sustainable freight transport is vital for the economy. In recent decades significant growth has been observed in the freight transport sector. In many parts of the world, freight transport is increasing faster than the economy or passenger transport; the demand is growing much faster than the supply with resulting environmental problems. In addition, increased congestion is affecting the efficient and reliable distribution of goods and, consequently, has generated a harmful effect on local economies.

Technical Committee analysed the strategies and actions to deal with these challenges for freight transport; it is convinced that efficient management of strategic transport corridors for freight transport is essential, that efficient terminals are necessary for a better use of maritime and railway transport over long distances, and that an urban logistics management is necessary to allow sustainable flows of freight transport with good mobility for passenger moving.

For government and public authorities

Government authorities should assume leadership to facilitate and coordinate management of strategic transport corridors. Efficient freight transportation services require investments in infrastructure, maintenance and operations to reduce bottlenecks and improve accessibility. This may imply a wide spectrum of actions such as the construction of infrastructure, reduction of bottlenecks, construction of areas for safe parking and buffer storage facilities, traffic management using ITS-type solutions, a more intelligent use of capacity, proper application of regulations for road freight transport, processes and efficient management at border crossings, efficient services to road users, and good information for drivers.

To create more efficient intermodal terminals, government agencies should assume the responsibility for coordination and interaction among parties involved in planning and operation of the terminal, identify strategic sites for intermodal transportation systems, guarantee sufficient space for possible expansion of the terminals, provide good road access to the terminals, support benchmarking and quality certification of terminal services, support the integration of intermodal terminals in freight villages, and encourage Public-Private Partnership (PPP) solutions for the development of terminals where feasible.

Government authorities should also guarantee fair competitiveness among terminal operators. A strategy and a public policy should be prepared for a network of intermodal freight transport terminals (linking the main node centres with regional terminals) since this could also provide the bases for financing.

Central governments should assume responsibility for harmonizing public policies through guidelines issued for urban freight transport. Local public authorities should assume responsibility for preparing plans for management of urban freight transport based on conversations with all interested parties and the latter should also become involved at the outset of the studies, analyses and discussions. Balancing measures for urban freight transport systems to create economically efficient, environmentally friendly and a liveable society is essential as in many cases a single measure is not enough to obtain a successful result. One procedure with the *Plan-Execution-Verification-Action* scheme is basic for supervising and evaluating the results allowing feedback of the original plan.

Technical aspects

Efficient border crossings are essential for optimum freight transport along international corridors. The use of ITS-type solutions and of automated systems, with no documents and concepts of pre-releasing in combination with a suitable infrastructure are likely to achieve much more efficient procedures at border crossings.

Compliance with speed limits, route and operational restrictions as well as limits on weights and dimensions, are important to guarantee a safer travel along the roads. The use of technologies such as cameras from point to point, GPS monitoring and weighing while in movement guarantees an efficient and specific enforcement of the law.

Technical standards at international level should be developed for planning and design of interior terminals and maritime ports to allow harmonization of infrastructure standards. This is particularly important for strategic transportation corridors. Terminal management systems and automation contribute to increase productivity at terminals.

For the World Road Association

Many countries have the same challenges for management of freight transport corridors and coordination of intermodal terminals. A large number of cities confront similar problems in urban congestion and in environmental aspects partially due to freight vehicles. It is therefore essential to disseminate lessons learned from management of strategic freight corridors, to coordinate intermodal terminals and the governance for urban freight transport. The Association is willing to help public authorities promote good practices and exchange of knowledge and experiences.

Additional research on urban freight transport is necessary since there are still many unsolved problems in this activity. The same thing happens with intermodal transport, especially regarding methodologies and instruments for terminal network evaluation and ICT applications.

International cooperation is important so as to be able to share know-how and experience necessary for establishing efficient and environmentally friendly urban freight transport systems. The Association is open to promote investigation in important fields of freight transport and intermodal practices.

TC B.5 Winter service

For decision makers

Transport by road has considerably increased during the last decades and winter viability is a very important activity to support society and the economy. During difficult weather conditions circulation can be impaired creating hardships and reduced mobility.

Currently a majority of countries use private companies to ensure winter service, but the entrusted missions, the form of the contracts, the type of company to which one has recourse, the controls of works concerned, etc., differ notably.

These differences are related to their history, the importance and the duration of the weather perturbations, financial circumstances, potential political upheavals (countries in transition) and expanding roles for private companies to perform activities traditionally reserved for the administration.

Winter Service Management Systems (WSMS) have been developed in order to ease the winter service work for decision makers and road administrations. WSMS are essential and can address the changing demands in winter service, however they are complex to implement and require strong commitment from all levels of management.

These systems often bridge the transportation and meteorological communities. It has been demonstrated that the value of building relationships between these two communities goes beyond just data sharing, and is a critical element of success.

Climate change will also create new challenges for the decision makers. Some decisions can be easier to make with the help of models where different scenarios for the climate change can be used as input. Currently there are gaps in the modelling effort and questions of accuracy exist, however, there has been sufficient work to begin in this area. This is an area where more research is needed.

Sustainability is a critical concept and includes the full slate of social (safety), environmental and economic (cost-benefit) issues. A model that includes criteria and sub-criteria (evaluation, questions) and an analytical evaluation matrix has been created that moves these abstract concepts to measurable tools. The next step is to test this model.

Detailed information in short messages to road users, even to cyclists and pedestrians are essential to achieve good winter service. Variable message signs should be used to notify road users of key messages. At borders it is important to inform road users about local rules they might not be accustomed to.

Training of staff is essential to achieve good results in winter service. Different methods in delivering training should be evaluated and results presented in a guidance report.

Technical aspects

The levels of service must be very clearly defined and well understood by all parties. Procedures to identify levels of service for the road condition are to be developed by establishing indicators and methods of measurement.

In assessing the environmental impacts of winter maintenance operations, all factors should be considered, not just the chemicals used but also the environmental impacts of the spreading operations. These can include fuel consumption, emissions, noise, durability, recycling, energy use in their manufacture etc. Final judgements can only be made after analysing the whole process.

Road administrations are striving to improve winter operations to minimize the salt consumption. The efficiency of such changes in strategy is not known unless the impact on groundwater is investigated. Taking all effects into consideration requires a socio-economic model to assess the consequences for road users, road administrations and the society at large to changes in strategies and maintenance.

A lot has been done to support operators in winter road maintenance but there is still a need for further development and new methods in Road Weather Information Systems and Winter Maintenance Management Systems (WMMS) on a day-to-day level that integrates many different types of information to support transportation operations, including administration, crew call-outs, operations, and documentation.

Data, data standards, and data sharing are also crucial to successful deployment and expansion of WMMS.

There is a need to have better winter maintenance for pedestrians and cyclists during winter time to increase the possibilities to walk and cycle even during the winter and from environmental point decrease short car trips but also to decrease the number of injured during winter conditions.

Finally with the climate of the world changing we face new challenges to determine the impacts so we can pro-actively manage the change.

For the World Road Association

The road community at large and specifically the winter maintenance community needs to establish ways of sharing the success stories presented at the Congresses. There must be some means of following-up with colleagues to work through the many details that are only briefly mentioned during a Congress.

Through the International Winter Road Congress in Quebec we learned that many components of WMMS have been deployed and are being used. Likewise, we learned that only a few end-to-end systems exist at this time. Over time we will see an increasing level of complexity and integration of these systems, along with a variety of implementation approaches. While one would expect to see these different approaches across jurisdictions, there is a need to ensure consistency and not duplicate efforts.

Strategic Theme C: A strategic approach for safety: putting knowledge into practice

Strategic Direction Session C

This session was introduced with an overview of some of the key points covered in the National Reports submitted for the World Road Congress. In general, countries reported on issues related to methods employed to reduce injuries and fatalities on highways.

The Strategic Direction Session was divided into two panels. The first would share experiences from organisations and countries demonstrating a strategic approach to road safety. The second would devote itself to examples of how countries have migrated innovations successfully into practice.

Some key concepts addressed through the individual National Reports included the following:

- The value of comprehensive safety strategies (for example, in Ireland they have the Village gateway; in Vietnam they use road safety audits and black spots treatments, etc.).
- The importance of articulating clear safety goals (enforcement measures such as automated speed control; education campaigns including use of mass media to promote control and compliance with alcohol limits; and policy initiatives, like the Toward Zero Deaths approach).
- The need for measurements of success (quantifying the reduction in fatalities and crashes in relation to the times at which road safety interventions are executed)

The core of the session consisted of presentations illustrating aspects of the aforementioned concepts, focusing on either strategic approaches or implementing innovations.

The final conclusions that can be extracted of the whole session are the following:

- The multilateral donor community is giving increased priority to the inclusion of safety considerations in road development programs. Capacity building, demonstration and awareness programs, and monitoring mechanisms are areas of focus for the World Bank and similar institutions and will remain important to developing countries' ability to effect positive changes with respect to road safety.
- In many countries, the number of accidents and fatalities in highways has been reduced because of the implementation of multifaceted approaches, not singly focused efforts.
- It is important that efforts to improve road safety be supported by appropriate levels of investment.

- Some countries have experienced increases in roadway incidents and fatalities in recent years because of significant increases in the number of vehicles in use. These changes in the driving environment increase the urgency of attention to road safety, and emphasize the importance of concerted approaches that include engineering, education, enforcement, and effective response.
- Several countries have established ambitious goals and a vision of programs to achieve them. One example given was the Toward Zero Death strategy in the United States. This and other strategic approaches include efforts to change driver behaviour, work with agencies to improve vehicle safety, improvements in emergency medical response and partnership between competent authorities.
- Some countries, such as Spain, are making great efforts to reduce the accidents and fatalities. Some measures it described were its point system for drivers' licenses, the improvement of infrastructure, speed control, and clear goal setting.

There was also discussion about driver responsibility, the value of multidisciplinary approaches to assessing countermeasure needs, and the importance of education and example-setting for future road users.

Across the whole of the Strategic Direction Session, themes of government leadership, partnership with the full spectrum of interested parties, investment, and planning were prominent. The experience of the countries and organisations that participated in the session confirmed that high-level policy commitment combined with a multifaceted technical approach and sufficient investment can have positive impacts on road safety. Policy makers can draw from the discussions the type of commitment and strategic approaches that have been proven successes, road administrations can learn from the technical examples cited during the session as well as the experiences in coordinating with enforcement and emergency response agencies that have strong interest in road safety. International institutions can benefit from seeing the level of interest in countries and the quality of technical approaches that can have greater impact through their broader international use.

While there have been significant achievements to date in the area of road safety, participants in the Strategic Direction Session recognized that work remains to be done, that attention must remain focused on this issue, and that solutions must be sensitive to local circumstances.

TECHNICAL COMMITTEES SESSIONS

TC C.1 Safer road infrastructure

For decision makers

The systems approach for improved road safety demands the participation of multiple stakeholders: police, health sector, legislators, educators, budget planners, automotive industry, road administrators, urban developers and land use planners. All of whom play an important role in safety issues that are clearly related to human factors of users and to relationships and cooperation among the different stakeholders. The work of the committee was closely aligned with Pillar 2 in safer roads contemplated by the UN Global Plan for the Decade of Action for Road Safety and it also relates to Pillar 4 about safer road users. Five topics were discussed:

- Human factors (HF) in the design and operation of roads.
- Safety problems related to land use and urban development.
- Design principles for safety management of urban roads.
- Road Safety Impact Assessment (RSIA).
- Road work safety.

Technical aspects

Concepts related to human factors take into account factors triggering driver reactions as well as behavioural patterns that may lead to an accident. HFs are used by experts in road safety to determine the cause of driving errors leading to accidents. Many of the errors commonly observed result from the direct interaction between the characteristics of the road and the driver's response. A separation needs to be made between non-compliance with traffic rules and human errors, particularly at high risk locations. The golden rule of safe roads is the adaptation of the road and of its environment to the physiological and psychological capabilities of road users and their limitations. The Association has worked at the interface between road users and the roads themselves in the course of a decade. The knowledge was obtained by the former Technical Committee 1.1 through a comprehensive auditing of design guidelines in 11 countries: Australia, Canada, China, Czech Republic, France, Germany, Hungary, India, Japan, Netherlands and Portugal. It was concluded that only 30% of the demands of HF are included in such guidelines.

One presentation of the detailed analysis of accidents made it clear that an asymmetric perception of the right of way may increase the response time and plays an important role as the cause of accidents. It was recommended that the relationship among the characteristics of the road and the behaviour of the driver should be specified in order to prevent accidents. During the session, an innovative modelling tool was introduced to help visualize travel perception from the perspective of a driver in a real application in France.

Although the guidelines, procedures and recommendations for the design of motorways, roadways and interurban roads are generally well structured and are well known, only a smaller degree of orientation is available for urban roads conditioning. Most of the deficiencies in environments of urban roads refer to vulnerable users. Because of this, the committee accepted relevant recommendations such as the separation of the different users of the roadway (i.e. the construction of lanes parallel to the roads for safe mobility of vulnerable users) as well as the reduction of the traffic speed when approaching urban zones, using sustainable practices for its control. On the other hand, it was demonstrated that vertical signalling is not sufficient for speed control; additional visual indications are required as well as channelling to alert drivers on changes in the surroundings of the road so that the speed can be reduced.

Human settlements along inter-urban roads constitute a very serious problem of road safety, especially in developing countries where poor management of land use and urban development make the users vulnerable as evidenced by statistics of 1.3 million people dead per year and 50 million wounded.

The assessment of the impact of road safety is an important topic that influences decisions to improve the road infrastructure for the purpose of increasing road safety for all users of the road. Management of safety infrastructures is focused on four procedures, namely, Road safety impact assessment, Road safety audit, Road safety inspection and Network safety management. Safety impact assessment is bound to be applied during the planning stage, prior to drafting a design for the system and in parallel with the environmental impact assessment.

Safety at road works constitutes a crucial issue for the overall safety of the road infrastructure, particularly in the case of countries under development. Many serious traffic accidents occur at job sites because drivers are not prepared and workers lack adequate protection. Countries in the process of development are carrying out important improvements at their road networks because many workers and users of the road are exposed to risk during building operations.

The committee prepared a new guide on road work safety to ensure safety for road users as well as workers. It will become an important part of the new version of the Association's Road Safety Manual.

A systemic approach, complementary methodologies, structured reasoning and actions based on the understanding of accidents adapted to the local context need to be implemented to achieve sustainable safe roads. The following conclusions were presented at the end of the session.

For road organisations

Human Factors should be integrated into the already existing design guidelines to be able to recognize the influence of the spatial perception in road safety issues. These changes in the specifications often are not translated into an increase of construction costs. The organizations should also inform and train their designers to put into practice the design elements where spatial perceptions are already included.

The basic strategy of a Safe System approach at job sites is aimed at guaranteeing that in the event of an accident the energy of the impact remains below the threshold of possibilities of causing deaths or serious injuries. Road authorities should develop and implement safety standards for road works.

When planning road infrastructure a lower priority is commonly assigned to safety. However, safety management of the road infrastructure should have an effect on the decisions aimed at improving such infrastructure for the purpose of increasing safety among all users. Access control, investment strategies in the road network and planning of development should be taken into account to prevent congestions at roads. These provisions should be implemented by the administrators of the road network as a whole.

For the World Road Association

Considerations of urban design for roads should be integrated into the technical documents of the Association, in matters of road safety. The next cycle should continue working with human factors to update check lists of guidelines, the Catalogue of Design Safety Deficiencies and Counter Measures and the Technical Sheets of the Road Safety Manual.

Strategies for road infrastructure management need to be updated and, similarly to the development of guidelines for auditing and inspections of road safety, it is suggested that the Association prepare a guide for Infrastructure Safety Management. The engineering-oriented guide for the investigation of accidents should be updated.

The safety guide at job sites should be incorporated into subsequent updates of the Association's Road Safety Manual.

The influence of land-use policies and of urban development in road safety issues needs to be present and the Association should work in the legal objective of Pillar 2 of the United Nations Global Plan for the Decade of Action, particularly with respect to activity 1: "making road authorities legally responsible for improving road safety on their networks through cost-effective measures and for reporting annually on the safety situation, trends and remedial work undertake".

TC C.2 Safer road operations

National strategies and policies on road safety

The importance of the road safety policies and strategies that prevail in various countries was underlined and they were mapped with their respective level of performance. The reasons behind their approaches were discussed together with common critical problems on road safety and their proposed solutions. The scarce representation of countries with low to medium income (LMIC) in the response to this study became evident. Invited papers for this part of the session have enriched the discussion. Elements of innovation primarily for the United States of America and France were also shared.

Ensuring cost effectiveness in the intervention strategy

The results required of road safety strategies cannot be obtained if low levels of intervention are adopted in their execution. However, these interventions are usually resource intensive and as such they should represent efficient and carefully oriented decisions. The methodology commonly used for this purpose as well as new approaches were discussed. It was emphasized that a critical element refers to quality of the information which in turn should be translated into measurable cost-benefit indicators. Along these lines, the capacity and the disparity among high-income countries in comparison with those LMIC were underlined and corrective measures for this problem were suggested. The work of the committee will be valuable to many countries, particularly those labelled LMIC, with the intention of using it as a guide for planning and executing an efficient decision making process, as well as to evaluate investments in interventions of road safety.

Changing road user behaviour through road safety campaign

Relevance of road safety campaigns in different contexts was discussed through the use of case histories. Recommendations were provided on the best practices to efficiently tackle campaigns such as those involving the comprehension of sectors of the public, the use of scientific methods to help identify the best campaign approaches and the selection of media for the planned message and objective. Emphasis was placed on the fact that safety-related campaigns cannot operate independently and many complementary interventions are required, particularly their application. The requirement of evaluating the campaign efficiency is fundamental to guarantee continuous quality improvement and to have an assurance that its results are complied with, as well to justify investment of resources.

The role of the new Road Safety Manual

The plan to prepare a new Road Safety Manual edited by the Association was discussed in the session as well as its scope and perspectives. A request was made to provide adequate attention to the needs of LMI countries.

For the World Road Association

The need for a greater Association presence in LMI countries was emphasized for the purpose of orienting and leading efforts in matters related to safety in road operations. It was recommended to the Association that it explore new approaches for technical committees so that members of LMIC are not relegated or segregated from these works, because for many of them attendance to two meetings a year, in different places of the world, is practically impossible. For better performance, a regional approach should be applied to technical committees. Once a year, the main committee may convene for the purpose of updating and consolidating the information. This work scheme not only will facilitate participation and attendance but it will also guarantee that the work of the committee has a wide coverage.

TC C.3 Managing operational risk in road operations

It is of utmost importance, for developed countries and for those in the process of development, to reduce the associated risk related not only to road accidents but also to natural and human disasters affecting roads. The committee pointed out the particular need to integrate risk management with risk assessment, the decision making process, risk reduction and the tools for risk management.

For decision makers

Risk management is certainly having an ever increasing importance within the road sector. However, so far only a few road sectors have systematically adopted the techniques of risk management applicable to road operation. The dissemination of risk management knowledge to guarantee road safety and to improve road maintenance continues to be of major importance. Areas of important attention focused on gaining benefits from the systematic adoption of risk management are presented as follows:

- Evaluate quantitatively any kind of operational risk in roads. This represents the first and very important step for proper management of such risks and to support any political decision.
- Review and restore the organization of the road operation as a business through the techniques of risk management for the effective administration of roads.
- Strengthen the scope of disaster and organization policies, laws and regulatory guidelines with respect to preventive measures with the help of risk management.
- Be aware that in spite of better practices to mitigate risk, climate change is inevitable. The need for adaptation of the infrastructure to climate changes has become a topic of utmost importance in the last few years.
- Consider the public perspective of risk and the social amplification of the most relevant events in the development of the policy and the administration by road authorities.
- Cooperate with neighbouring countries, with all relevant internal governments and with non-government programs in the network systems and offer the opportunity of dialogue such as in the international seminar organized by the Association.
- Develop guides/manuals on risk management to implement and efficiently operate risk management within the road sector.

Technical aspects

The committee edited the series of publications described below:

A Guide to risk management in a road organization

The guide contains the fundamental theory of risk management and its tools. It also contains several case histories demonstrating the benefit of applying risk management not only for road administration, such as a road project and network operation, but also for the organizational administration aimed at supporting road authorities. At the same time, the guide includes crisis management, strictly not separated from risk management, for the road sector.

Risks associated with natural disasters, climate change, man-made disasters and security threats

The objective of this guide is to share methodologies that have been used to evaluate and mitigate such risks. The guide is focused on advanced activities that have been adopted by member countries; it also provides case examples and studies which establishes the foundation for future Association cycles in the important area of climate change adaptation.

Technical tool box

The committee upgraded the tools that were created by the previous cycle and they correspond to a data base of technologies useful for risk management. This cycle proposed to transform those tools into a user-friendly network application.

Social acceptance of risks and their perception

The committee adopted this topic of social acceptance of risks and their perception and prepared a report with an exhaustive review of the existing literature including available case histories of social acceptance of risks and their perception oriented to road operations.

For the World Road Association and international organisations

Finally, the following topics can be regarded as final comments to this session and they can be taken as recommendations to international organizations and the Association:

- Disclose not only risk management but also the administration of techniques for crisis control and emergencies during road operation.
- Develop risk management for organizational and performance administration of the road operation and issuance of policies.
- For transportation authorities, develop a process on how to systematize management of natural and man-made hazards, including climate change adaptations.
- Continuous action is necessary to assemble the best practices for the purpose of finding the definition of communication strategies in case of emergency and policies necessary for road authorities to prevent damages related to the perception of risks in the administrative action.

- That the Association develop a web-based knowledge database “Tool box” for risk management practices in road operations.

Finally, develop rapidly the ability to combine the emergency and the crisis with risk management practices for purposes of effectively confronting catastrophic disasters such as the ultra-low frequency earthquake and tsunamis that occurred in Japan in spring 2011, before their next occurrence.

TC C.4 Road tunnel operations

Since its creation in 1957, the Technical Committee on Road Tunnel Operations (formerly known as the Committee on Road Tunnels) has concentrated its activities on the fields of internal design, safety of users, equipment, operation and environment of road tunnels. It has voluntarily excluded from its scope subjects concerning construction, repair and maintenance of structures, which are dealt with by the International Tunnelling & Underground Space Association ITA-AITES, with which an excellent collaboration is maintained.

In overall terms, the Technical Committee on Road Tunnel Operations has addressed a wide range of safety topics since the major Alpine tunnel fires that occurred 10-12 years ago. These topics have concerned both strategic issues and particular physical elements of road tunnels.

During the 2008-2011 cycle, a lot of work has been undertaken to establish best practice in the area of tunnel operations and management for improving the safety of tunnels' users. To undertake this work, the Committee set up five working groups, each commissioned to investigate and report on specific aspects of the work under consideration. The working groups included C.4 members as well as a number of experts who were not members of the Committee. C.4 steered, reviewed, discussed and approved the documents produced by the working groups.

As a result, nine technical reports have been prepared during this cycle. The presentations and the discussions during the Committee session at the Congress addressed the various areas covered by these reports. In addition, the presentation of the Road Tunnel Manual, an online 'compendium' which organises the large quantity of information disseminated in these various reports and articles, has been completed.

Nevertheless, both a deeper approach into these 'old' topics and the identification and development of other emerging issues are necessary. The Road Tunnel Operations committee has taken stock of this situation and identified certain topics that would be worthwhile addressing in the next cycle, some of them identified by the general process of consolidating the guidance into the Road Tunnel Manual.

Technical aspects

Suggested new topics for the 2012-2015 period include sustainability of tunnel operation, which can be approached from different perspectives including costs, environmental aspects or other issues. This field should include not only operational activities, like maintenance, but also those aspects of the design and installation phases of a project that will impact and improve sustainable operations.

The collection of different experiences and case studies all around the world would be a useful task that hopefully could also lead to the publication of a report with recommendations on the topic.

In this sense, the continuation of the task on equipment life cycle, already covered during the last cycle, has been identified as a relevant issue that can show what would be reasonable expectations for the durability of equipment and systems in road tunnels.

Considerable work has been carried out during the last cycle with regards to fixed fire fighting systems (FFFS). New recommendations have not been made because there continue to be further developments and operating experience. This technologically evolving situation should be monitored closely.

For the World Road Association

The topic of road tunnel safety remains important and the collection and analysis of information gained from the operational experience in road tunnels should be considered. The analysis of the experience of incidents that are being collected daily by operators and tunnel owners would help to improve the procedures and methodologies applied. This interesting information (including statistics and analyses on real accidents) could be of great value as a basis for risk management.

In addition, further work could be done to tackle other safety challenges with great impact on the users: the identification of best practices to support persons with reduced mobility in tunnels and the preparation of recommendations on real-time communications with users.

Another proposal is to consider complex, urban underground networks with interchanges and multi-modal concerns. There are a growing number of these networks, which pose a range of additional challenges for design and operation compared to 'conventional' road tunnels.

From a strategic point of view, different opportunities to improve the dissemination of the knowledge gained by the Committee in the last cycles are available. Apart from the traditional approach of arranging seminars and workshops, the possible cooperation with ITA / AITES to provide training courses on road tunnel operations and safety could be explored.

Finally, the maintenance and improvement of the Road Tunnel Manual is proposed. This is intended to be a 'live' document, in order to be able to follow the frequent technological developments that are adopted from the design to the operation of the tunnels, and to be able to integrate easily the new reports that will be produced by the committee during following cycles. Consequently, further work is necessary to update permanently and expand the contents of this powerful tool.

Strategic Theme D: Managing road assets in the context of sustainable development and climate change adaptation

Strategic Direction Session D

This strategic direction session covered two aspects: the sustainable management of road assets, and climate change, sustainability, quality, and innovative specific solutions for materials and technologies.

The debates that took place and the analysis of the national reports delivered before the Strategic Theme D, gave way to a series of ideas and proposals to improve the quality of the road construction, maintenance and road asset management, from both technical and administrative points of view.

For decision makers

The following proposals were derived as conclusions:

- The sustainable nature of road infrastructures and road transport systems should become a serious concern in decision making processes. It should become a fundamental consideration in procedures for the development of master plans.
- Climate change has a direct effect on the quality of the road infrastructure and its behaviour in terms of time demands the development of robust action plans and of measures to adapt to the new, changing and unstable climatic conditions.
- Improvement of the technical quality should continue to be an important objective of governments for the purpose of satisfying the needs of users within the context of sustainable development.
- Maintenance of the existing road assets should represent a fundamental concern of road administrators and it has a major impact on the rational assignment of resources.
- The evaluation of budgets implies taking into account a sensible distribution of the budgets among the different categories of the road infrastructure and the various types of activities (construction, maintenance, modernization and improvement of roads).
- Coherent research policies comprising both fundamental investigation and developments for application should be promoted. An important objective within this context should be recycling of the materials of old pavements as an important solution to save energy and material resources and to promote the concept of energy renewal.

Related to technical aspects

- The efficient management of roads and bridges implies an improvement of data retrieval equipment and of information-related tools used for the optimization of activities for work planning, including the rational distribution of resources.
- The design and construction of road and bridge pavements has to take into account the idea of guaranteeing their sustainable nature and the adaptation to climate change so as to contribute to the mitigation of negative impacts on the environment.
- The operation of roads and bridges implies taking into account their operating conditions after being altered by climate change as well to guarantee the high quality of the roads within the context of satisfying the needs of users.
- Unpaved roads demand more attention so as to bring them to a higher level of quality and to lessen their impact on the environment.
- The development of technical and technological solutions with less energy consumption, based on an energy renewal approach, represent a challenge to road designers.

For the World Road Association and other international organizations

- To continue the Association's activities related to the continuous improvement of the HDM program. This has proven to be a very useful instrument for road administrators.
- To promote initiatives of involvement in the activity of training of road professionals.
- To develop participation of the Association in collaborations amongst members of different countries to carry out activities in design, construction, operation and maintenance of roads.

The quality of the road infrastructure within the context of sustainable development and adaptation to climate change needs to remain an important objective of governments, road administrators, road engineers and non-government organizations and associations.

TECHNICAL COMMITTEES SESSIONS

TC D.1 Management of road infrastructure assets

To have available a robust infrastructure is a fundamental requirement for solid economic development.

Maintenance of a safe and efficient road infrastructure to ensure mobility of the society is at risk due to the increase of traffic volumes, aging of the infrastructure, growing diversification of assets, greater community expectations and the advance of financial restrictions.

The need for a more efficient use of resources demands continuous improvement of techniques related to the design, management and maintenance of assets. It is important to better understand the infrastructure and its condition so as to schedule maintenance and distribute limited resources among the different assets.

Asset management systems

With respect to the comparative analysis of asset management methods, the following conclusions were drawn.

For decision makers

The implementation of an asset management approach should include a plan with long-term goals and objectives that evidences continuous improvements in the approach and in its commissioning. For successful implementation of asset management a strong commitment is required by the owner of the assets, firm leadership by decision makers who promote the approach and who assign investments for the development of the asset management team with personal development and training. The successful implementation of any approach whatsoever also demands contracting procedures to guarantee the required delivery of the service. Decision makers need tools and personnel that contribute to the necessary capabilities to reach decisions with limited resources.

For technical professionals

It is necessary for data to be up to date and adequate, and to have been obtained using technologies that deliver the expected levels of accuracy and reliability. Suitable analysis procedures and tools are required for proper decision making that produce foreseen results taking into account the legislation and the different risk levels assumed during the strategic, tactical and operational stages of the decision-making process so as to allow optimization among the different types of assets.

For road organizations

The principal aim of international road organisations should be to promote a consistent approach to asset management that supports improved decision making based on good quality data to enable a long term view to be used to manage and preserve the road network. Organisations should support the development of asset management in all types of road authority at different stages of development. The approach should be developed from a consistent definition of asset management.

High-level management indicators

Growing interest to maintain and operate transport infrastructure with efficient and sustainable bases requires the development of tools – and first of all of indicators – so as to be able to take into account as efficiently as possible sustainability criteria for decision making in asset management. These indicators can be used by different decision makers and experts and even by international organizations.

For decision makers

The committee strived to identify the existing management indicators and then to define those that are missing. A four-stage methodology was proposed that all road authorities may apply to identify the indicators that are really required to reach their objectives:

- Identify the groups of interest in road asset management.
- Analyze their expectations and define the priorities of them.
- Propose the definition of one or more indicators that measure the response of the network for each expectation.
- If no indicator is available, try to identify the basic parameters in which it could be based.

For technical professionals

The committee proposed detailed requirements for this methodology so as to facilitate its application by experts. These requirements include:

- A list of groups of interest in management of road infrastructure assets differentiating, when applicable, the various socio-economic categories.
- The analysis of the expectations of these groups, suggesting priorities.
- A proposal of High-Level Management Indicators (HLMIs) that can be used to manage such expectations.
- Detailed considerations about the basic data which could relevantly contribute to build these HLMIs, when not existing, and based on the knowledge and experience of its members, from literature and from some existing data bases.

For road organizations

The committee report does not provide an exhaustive list of indicators prepared for their use but it proposes a general and flexible methodology that could be promoted by international organizations so as to achieve a more consistent road asset management of world-wide importance.

Allocation of resources among the various types of assets

For decision makers

In general, approaches adopted by different countries to distribute resources among the various types of assets can be considered at a basic level. Those corresponding to pavements and bridges being the most advanced because data on condition are frequently used to generate budget allocations whenever a predefined status is reached. The use of advanced methods such as decision making based on benefit-cost analyses (ABC) to minimize the costs of the road authorities or the economic costs (administration and user/community) is limited and, whenever it occurs, it is principally applied to pavements.

For technical professionals

The method of choice in the future to distribute resources among the various types of assets could be a risk assessment based on probability and consequences of a failure.

For road organizations

It is earnestly recommended that any future endeavour planned by the Association in the subject of asset management take into account the activities that are currently performed by the ISO technical committee ISO/PC 251 – Asset Management that is in the process of developing the following international standards:

- ISO 55000 Asset Management – Overview, principles and terminology.
- ISO 55001 Asset Management – Management Systems – Requirements.
- ISO 55002 Asset Management – Management systems – Guidelines on application of standard ISO 55001.

General conclusions

The work carried out by the technical committee has proved to be relevant and useful for various road agencies. Lessons learned are being considered in the USA for infrastructure asset management and for the planning process based on long-term performance. In Europe, findings of the committee have been taken into account and applied in several ERA NET projects such as EVITA and SABARIS. During the seminar held in Namibia, it was clear that the work of the committee is also very relevant in the developing world where they are facing similar challenges albeit in different environments.

TC D.2 Road pavements

With respect to the reduction of times and costs of construction, it was concluded that the optimum method to illustrate the procedures for reduction of time, delays and construction costs should be based on studies of specific case histories or of other products and road construction procedures. Cost reduction case histories have been refocused to achieve “cost optimization”, that is minimising cost but without sacrificing quality or increasing the scheduled construction time. This outcome is based on actual data collected by 11 countries that are members of the task committee with results obtained from 20 studies of relevant constructions.

With respect to the improvement of maintenance methods, conclusions were focused on the importance of pavement management to optimize maintenance actions, using reliable indicators and permanent follow-up, with tools such as the HDM-4 model and the new manual for concrete pavement maintenance presented by Germany.

It was concluded from the papers received that noise produced by transport operation along roads is a factor that should be considered in both present and future projects together with atmospheric contamination and environmental problems. It was also concluded that a series of national and international policies is available for research projects aimed at reducing the physical impacts of environmental noise and that knowledge and experience should be shared among countries with the purpose of validating the results. Due to the evolution of the traffic spectrum, it becomes more relevant and necessary to include the noise produced by truck tires in mitigation studies for the purpose of contributing to the achievement of a sustainable infrastructure.

On the issue of innovation, it was concluded that it is important to acknowledge that investment in innovation is necessary to achieve benefits in the design, construction and maintenance of roads. It was also concluded, based on the reports presented and on surveys of various countries, that innovation policies that have excellent results and could be applied in other countries, albeit with appropriate adaptations, include the reduction in the exploitation of borrow pit materials by using recycled materials, an improvement in materials and design standards, reduction of construction times to minimize traffic interruptions among other things.

Finally, adaptation to climate change based on the already proven effects of climate change on road infrastructure were considered in the context of the likelihood that such changes are likely to continue in the future with increases in the global temperatures anomaly, consequent melting of the ice cap, alteration of freezing/melting cycles, raising of the sea level, storms, more severe heat waves and more frequent rains and floods. Such phenomena will directly affect the performance of the infrastructures by means of flooding, erosion, slope instability and a reduction of the load bearing capacity of road pavements. As an outcome of the surveys made it was concluded that the effect of the climate change can be mitigated by adapting the road to those effects; one example is painting with solar reflective pigments to block solar heat and thus significantly reduce pavement temperatures and permanent deformations; this will have an impact on the heat in urban areas and areas with large paved surfaces.

TC D.3 Road bridges

For decision makers

A survey made among countries represented in this committee revealed that most of the bridges range from 40 to 50 years in age. For this reason it is imperative that governments increase the budget assigned to inspection and maintenance of these bridges.

Technical aspects

To improve priority ranking in the application of bridge maintenance budgets a bridge management system adapted to the specific conditions and requirements of their road networks should be implemented.

The effective utilization of bridge management systems depends on the quality of the inspection method used and on the quality and quantity of data collected.

Experience and training of inspectors are important when seeking a successful application of the management systems. It is recommended that the training of bridge inspectors include both theoretical and practical components.

Non Destructive Testing (NDT) constitutes a useful tool in the evaluation of bridges.

The evaluation of the condition of bridges is an essential component of any generic assessment. It is recommended that countries use a five points rating system. “An overall rating system”, calculated using the weighted sums of the individual rated components, is considered to be the best approach.

No consensus was reached on a definition of long-span bridges since this concept varies from one country to the other. However, management of large road bridges normally requires a dedicated team. Monitoring, adapted to large bridges, is a useful tool for the management of preventive maintenance.

Although climate change will entail long-term effects, the relationship between damage and deterioration of existing bridges and climate change is not yet conclusive. Therefore, there exists a need to develop an in-depth knowledge of the various effects induced by climate change.

TC D.4 Geotechnics and unpaved roads

The committee reached a series of conclusions and recommendations.

For road authorities

Innovations in processing and use of local materials:

- Changeable materials especially those containing harmful elements present the greatest geotechnical risks. Improvements are still being sought to search for the presence of these elements (especially if they are present in small amounts), by recognition, specific tests, among others.
- The use of certain (marginal) materials, too dry or too wet, is linked to the theme of adaptation to climate change and deserves further study and research.

Recommendations: Research should be promoted in order to develop treatment methods adapted to these particular materials.

Innovations in construction and maintenance of unpaved roads in developing countries

- The most common road materials in Sub-Saharan Africa and South America are lateritic gravels but they are becoming increasingly rare along the main routes. The shortage of “good quality” road materials leads to an increase in construction costs and maintenance.
- The lack of maintenance of unpaved roads has very negative consequences in the long term.

Recommendations:

- There is need for a robust programme of works based on good knowledge of the state of the network.
- It is necessary to make an inventory of available resources (reliable database) or, in this case, to foster greater collaboration amongst the institutions who possess the relevant data;
- It is also necessary to promote research on the treatment of local materials.

Adaptation to climate change

- Despite the global consensus on the reality of climate change, there are still many road authorities who appear to care little for the impact that climate change could have on their infrastructure.
- It is very important to realize that local conditions should be taken into account and that they may differ significantly from the general major changes.
- The issue of climate change is dynamic and evolving.

The recommendation in this case is investing in knowledge by long-term programmes of research adapted to each country.

Technical aspects

Innovations in processing and use of local materials

- The survey launched by Technical Committee has identified families of materials considered marginal by a majority of those countries consulted.
- The materials which are most often encountered, particularly in Europe, are changeable materials such as argillaceous rocks and those materials composed of harmful elements such as sulphates, sulphides and organic matter. The use of these materials in fill is usually possible, with the specific conditions of mechanical pre-treatment if necessary and implemented through special design measures. Their use in specific fills, PST or in layers which require treatment with lime or binders is more difficult.
- The work of this session highlighted the technical advances leading to improved utilization of potential resources consisting of marginal materials while controlling project risks.

Recommendation: continuing research in this area will have significant economic benefits.

Innovations in construction and maintenance of unpaved roads in developing countries

Recommendation: It is necessary to be careful of imported techniques and products; some of which are totally ineffective in the long term. They must be used for the intended purpose and in optimum conditions.

Adaptation to climate change

- Processes related to climate change are complex because they vary in both space and time. On a practical level, it is difficult to give very precise recommendations given the state of knowledge for all possible situations.

Recommendation: the clear trends in climate change now allow design of adaptation of geotechnical structures, in particular by developing drainage measures and solutions to combat erosion.

For the World Road Association and international organisations

Innovations in processing and use of local materials

- The use of certain types of marginal materials needs to be improved.
- The use of lateritic materials or alternative materials, a critical economic issue, requires thorough study.

Recommendation: new exchanges between member countries during the 2012-2015 cycle would be very useful to further share knowledge on some of the materials families discussed in the report, especially through feedback and experience.

Innovations in construction and maintenance of unpaved roads in developing countries

- The high intensity of labour, HIMO, approach is available everywhere, it is cost-effective from several points of view but requires good management of the workforce in order to avoid creating further socio-economic problems and should be applied to appropriate projects.

Adaptation to climate change

- It seems that the majority of countries that are concerned about the effects of climate change need to develop a strategy against this reality rather than take concrete action.
- In the extensive literature on climate change, it is difficult to find specific items for road construction. However, the socio-economic domain has need of practical recommendations for the construction of safe and sustainable roads and for the adaptation of existing routes to these new conditions.

Recommendation: international organisations should serve as a platform for exchange of national experiences. This should be an on-going concern with long-term follow-up. For this to be effective, all technical committees who are concerned with this problem should work in a coordinated manner.