MANAGING OPERATIONAL RISK IN ROAD OPERATIONS

29 September 2011 (am)

TECHNICAL COMMITTEE C.3
MANAGING OPERATIONAL RISK IN ROAD OPERATIONS

INTRODUCTORY REPORT

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EXECUTIVE SUMMARY

Many parts of the world are at significant risk of natural and man-made disasters. Modern industrial practices, dependencies on critical infrastructures make countries further vulnerable to not only a wide range of natural disasters but also serious man-made disasters. These factors, combined with increased population densities and property development in hazard zones, have heightened countries' disaster risks as follows:

1. Natural disasters include typhoons, cyclones, hurricanes, flooding, tornadoes, drought, wildfires, earthquakes, volcanoes, landslides, ice storms, and dust storms that all contribute to disease epidemics.

2. Man-made disasters include critical infrastructure threats, oil and chemical spills, building fires, mechanical equipment explosions, and terrorism.

TC C.3 lays special emphasis on integrated risk management with expanded research into risk assessment, decision-making processes, reduction of risk and risk management tools. More specifically TC C.3 has the three terms of reference:

1) Introduce Risk Management Techniques in the Road Sector
2) Risks Associated with Natural Disasters, Climate Change, Man-made Disasters and Security Threats
3) Social Acceptance of Risks and Their Perception

Since the beginning, TC C.3 has been making considerable efforts to achieve its objectives, by organizing eight TC C.3 meetings including two meetings to be held in Japan and Mexico City, and two international seminars in Iasi, Romania and Beijing, China.

To formulate and improve various risk management strategies for the future, TC C.3 will prepare the technical session for the World Road Congress in Mexico City considering the following points:

1. General Report on TC C.3 Activities during 2008-2011
2. Working Groups' Activities
   1) Introduce Risk Management Techniques in the Road Sector
   2) Risks Associated with Natural Disasters, Climate Change, Man-made Disasters and Security Threats
   3) Social Acceptance of Risks and Their Perception
3. Case Studies of Risk Management in Different Countries
4. Some Topics Selected from Call for Papers

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1. INTRODUCTION

1.1. Foreword

The Technical Committee on Managing Operational Risk in Road Operations (TC C.3) is one of the 17 Technical Committees. TC C.3 lays special emphasis on integrated risk management with expanded research into risk assessment, decision-making processes and security issues. More specifically TC C.3 has the three terms of reference,

1) Introduce Risk Management Techniques in the Road Sector
2) Risks Associated with Natural Disasters, Climate Change, Man-made Disasters and Security Threats
3) Social Acceptance of Risks and Their Perception

To accomplish its mission, TC C.3 is actively engaged in various activities such as launching an international survey, collecting good practices of risk management, developing technical toolbox for risk management and organizing international seminars.

1.2. Strategies, Outputs and Activities

According to the terms of reference for TC C.3, there are three issues as shown in Table 1.1, and the three working groups that are responsible for each issue have been established. The first meeting of TC C.3 was held in March 2008. Since the first meeting, the members of TC C.3 have gathered twice a year from all over the world. They share their experience with each other in efforts to deepen the knowledge about risk management for roads. TC C.3 collects good practices of risk management, and has been developing a technical toolbox for risk management. In addition, an international survey on risk management for roads was carried out.

Table 1.1 Terms of Reference for TC C.3

Issue 1 - Introduce Risk Management Techniques in the Road Sector	
Strategies	Outputs
Analyse the use of risk management techniques by road authorities and identify best practice. Identify case studies that exemplify the benefits of using risk management in different aspects of the road sector.	A guide to assist road authorities in the use of risk management. Case studies that demonstrate the value of using risk management.
Issue 2 - Risks Associated with Natural Disasters, Climate Change, Man-made Disasters and Security Threats	
Strategies	Outputs
Identify approaches being used to assess the risks associated with natural disasters, climate changes, man-made disasters and security threats. Identify strategies that are being applied to reduce or mitigate the risks associated with these circumstances.	Share methodologies that have been used to evaluate the risks associated with natural disasters, climate changes, man-made disasters and security threats. Case studies documenting strategies that have been effective in avoiding or mitigating these risks.
Issue 3 - Social Acceptance of Risks and Their Perception	
Strategies	Outputs
Identify and evaluate studies of the public's perception to risks in the road system and the factors that effect those social reactions. Study methods that are used to measure people's acceptance of risks.	Report on factors affecting social reaction to risks in road related activities. Produce guidelines that road authorities can use to measure the public’s perception of risks.

2. INTERNATIONAL SURVEY AND SEMINARS

2.1. International Survey

TC C.3 carried on an international survey to understand the current status of risk management implementation in practices in member countries. The survey consisted of questionnaires related to three main themes; 1) Risk management for network, 2) Risk management for projects, 3) Risk associated with natural disaster, climate change and man-made disasters, and 4) Social acceptance of risks and their perception. The survey collected the answers from 20 countries.

The results of the survey show the followings;

1) The application of risk management for network can be categorized into three major fields, natural disaster management for network, critical component analysis for network, and safety management for network.
2) The risk management technologies have been implemented into various kinds of road project management.
3) Only few countries have started to consider the effect and adaptation to the road system from the climate change, although many countries implemented risk management techniques against natural disasters.
4) Some countries have studied social acceptance of risks mainly in road safety area. However, there are no studies on the policy decision based on risk perception.

2.2. International Seminars

1) 1st International Seminar

The 1st international seminar jointly organized by TC C.3 and the Government of Romania was held at the City Hall of Iasi, Iasi, Romania during November 5-7, 2009. About 140 participants attended this seminar; 100 from Romania and 40 from overseas including Australia, Canada, China, France, Italy, Japan, Malaysia, Mexico, U.K. and U.S.A. In the Opening Session we welcomed a keynote speaker from the World Bank, who discussed the importance of risk management for road agencies. Then, 22 papers were presented regarding risk management for roads in the following four Technical Sessions:

Session 1: Introduction of Risk Management Techniques
Session 2: Good Practices of Risk Management Techniques for Highway Systems and Projects
Session 3: Management of Risks Associated with Natural and Man-made disasters and Climate Change
Session 4: Social acceptance of Risks and Their Perception

In addition to the international presentations, various studies on risk management, road safety and construction technologies were reported by the Romanian attendees. They were very helpful to understand the current situation of Romania with relation to risk management for roads.

The Seminar provided an ample opportunity for all the participants to share the knowledge and new ideas on risk management for roads. The proceedings of the seminar are available from the PIARC web site (http://www.piarc.org/en/).

2) 2nd International Seminar

The 2nd international seminar was conducted at the Grand Skylight CATIC Hotel in Beijing, China on November 11-13, 2010. This seminar was co-organized by TC C.3 and the Ministry of Transport, People's Republic of China. The seminar focused on the risk and emergency management for roads, and was approximately attended by 190 participants; 150 from China and 40 from 16 countries including Burkina Faso, France, Italy, Japan, Malaysia, Mexico, Sweden, U.S.A. and Viet Nam.

We had three keynote speakers, one from the U.S.A. and two from China, in the Opening Session. 21 technical presentations were made in the following four Technical Sessions:

- Session 1: Introduction of Risk and Emergency Management Theory and Techniques in the Road Sector
- Session 2: Good Practices of Managing Risks Associated with Natural and Man-made Disasters and Climate Change in the Road Sector
- Session 3: Good Practices in Contingency Planning and Emergency Response to Natural and Man-made Disasters and Climate Change in the Road Sector
- Session 4: Social Acceptance of Risks and Their Perceptions in Road Related Activities

In the seminar a special emphasis was laid on presentations on emergency measures after disaster occurrence in addition to risk management techniques, which are in principle applied to management before disaster occurrence. The Seminar provided an ideal opportunity to disseminate and share the knowledge and techniques of risk management for roads. The proceedings of the seminar are available from the PIARC web site (http://www.piarc.org/en/).

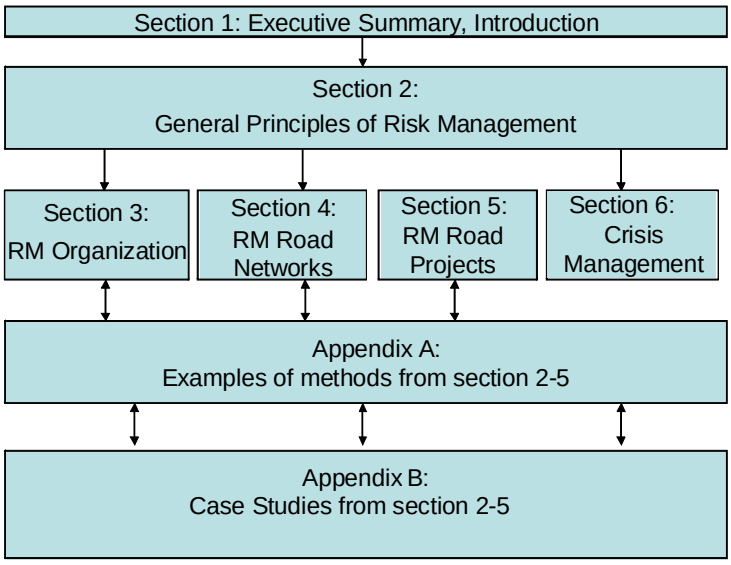
3. WORKING GROUPS' ACTIVITIES

3.1. Introduce Risk Management Techniques in the Road Sector

INTRODUCTION

This guidance "A Guide to Risk Management in a road organization" will be prepared by WG1 of the PIARC Technical Committee TC C.3, Introduce Risk Management Techniques in the Road Sector, which will address the following aspects:

- General principles of risk management
- Organizational risk management
- Risk management for road network
- Risk management for road projects
- Crisis management
- Library of examples of methods and case studies



GENERAL PRINCIPLES OF RISK MANAGEMENT

The management of risks is not new to road administration. Basic principles, instruments and tools exist for a long time. The novelty lies in the systematic and organization-wide standardized handling of these issues as the basis for the assessment of risks, as well as the basis for taking the decision of implementing additional measures. In recent years, legal developments have also taken place in many countries, requiring risk assessment. A comprehensive and integral risk management is based on the entire risk cycle. This section describes the general principles of risk management.

ORGANIZATIONAL RISK MANAGEMENT

Risk management is an activity to properly manage the various risks related to the enterprise or entity business, in order to continue to maintain and increase the corporate value or the accountability. Internal control is a managing system and process built in house in order to carry out its business properly and efficiently. Internal control is a kind of a prerequisite for the establishment and shaping the whole company system; moreover, internal control process is also indispensable for sustainable development by reducing the risks to the company or entity to achieve their objectives.

Internal control and risk management, with having different backgrounds and developed through different routes, have almost the same objectives and goals in the view of corresponding to various risks surrounding the entity in terms of maintaining and improving their values.

This section describes the organizational risk management with emphasis on internal control for road authority.

RISK MANAGEMENT FOR ROAD NETWORK

A substantial supply of quality road network is the robustness, which can be defined as the transport system's ability to withstand and manage major disruptions such as natural disasters and major accidents.

Road authority's aim is to provide a normal (or minimum acceptable) function for a road with sufficient safety margin with regard to the consequences of damage to the facility. It is also assumed that the expected costs over time for the community and the road authority should be held with a sufficient safety margin with regard to the consequences of damage to the facility.

Risk and risk level is governed by the probability of the adverse event and the consequences of the event. Therefore, both dimensions are assessed. The events at issue in the case of road facilities and that we have better chances to predict usually have very long return periods. This means that there are consequences that are primarily normal control level of risk.

Drums and other structures are designed for dewatering normally based on return periods. The ongoing climate change seems to lead to their return periods tend to change - which would then also mean that the risk level increases or decreases depending on where in the world we lever. Climate change can also affect the need for winter maintenance activities in the relevant parts of the world. More unstable weather conditions can e.g. cause more de-icing activities.

The events can be characterized by consequences with different categories such as:
- Personal injury
- Property Damage
- Environmental damage
- Other socio-economic damage
- Intangible injury

Serious injuries are rare due to physical damage to the road network. But we cannot ignore the risk e.g. of vehicles in the rain and darkness running down into the hole that can be formed when the drums or road embankments collapse. Property and socio-economic damages dominate, however. Environmental damage is usually small and the cost of restoring them is generally limited. The economic damage depends on the rest of the suspension length, traffic flow and how much traffic is forced to detour. If no or very poor diversion opportunities available to the socio-economic damages can be large even at low traffic volumes and relatively short-term exclusions. Regarding intangible damage to the road authority is deemed society's tolerance to decline as the new injury occurs.

The road network system contains serious physical dangers along the road stretches. In order to manage the various kinds of risks, a comprehensive risk analysis for the road transport system with emphasis on the serious physical dangers is necessary. Purpose of this section is to provide examples of risk management as applied to the road network. Although a number of different types of risk are considered, the basic approach is the same. Therefore, the purpose of this section is to provide examples that be applied in a number of contexts.

RISK MANAGEMENT FOR ROAD PROJECTS

The goal of the project is normally analyzed out of the sensibility not to reach time, cost and function. Furthermore, for projects in inhabited areas there is a risk of damage to a range of third party persons and property. Finally, there is a risk that the problems which the project causes to the public will cause public protests and political reactions affecting the course of the project. To be successful, 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, response strategies and specific actions, symptoms-warning, fallback plans and contingency reserves of time and cost to provide for risk owners risk tolerance. In this section, elements of risk management projects such as risk monitoring, risk assessment, controlling and choosing alternative strategies, executing a contingency or fallback plan, taking corrective action and modifying the project management plan are introduced.

CRISIS MANAGEMENT

Crisis management has not been a prioritized task for TC C.3 WG1. But to make this Risk Management framework complete it is essential to include crisis management. This chapter is targeted at providing examples of best practice in the management of emergencies after the event has occurred. Of course one of the most essential parts of emergency management is to identify the hazards, establish the risks and prepare contingency plans to deal with the consequences of an adverse event.

Most highway authorities have contingency plans to manage the effect of these events. An important element of all emergency planning is the establishment of organizations and structures to prepare for adverse events. In this section, both well prepared planning and organization for crisis management are addressed.

LIBRARY OF EXAMPLES OF METHODS AND CASE STUDIES

The group has continued to build on results from previous work in PIARC for Risk Management. The framework for risk management has been updated, but special emphasis has been placed on finding practical examples and case studies for the various areas of risk management practices. This guidance prepared diverse linked examples and case studies to PIARC web-site at the end.

3.2. Risks Associated with Natural Disasters, Climate Change, Man-made Disasters and Security Threats

INTRODUCTION

This section is prepared by WG2 of the PIARC Technical Committee TC C.3, Managing Risk Associated with Natural Disasters, Climate Change and Man-made Disasters, and Security Threats, which will address the following aspects:

- Methodologies to evaluate risks associated with all hazards;
- Managing risks associated with natural disasters
- Managing climate change risks and the adaptation of transportation infrastructure; and
- Risk Management Toolbox

METHODOLOGIES TO EVALUATE RISKS ASSOCIATED WITH ALL HAZARDS

This section presents a methodological approach developed in the United States on "Costing Asset Protection: An All Hazards Guide for Transportation Agencies (CAPTA)," which was funded by the National Cooperative Highway Research Program (NCHRP). CAPTA provides a means to evaluate a wide range of assets and transportation modes based on generic asset attributes. CAPTA methodology assesses threats and hazards and their potential consequences in a common framework. The major question that transportation owners and operators want answered is "What consequences concern me most in my transportation system?" A step-by-step action plan of the tool for users to implement the CAPTA methodology will be included.

MANAGING RISKS ASSOCIATED WITH NATURAL DISASTERS

Presented are practical techniques for managing risks associated with heavy rainfalls and earthquakes, which are typical natural disasters in many countries and regions. Those techniques have been developed in Japan and may be applicable to other countries. Road inspection for heavy rainfall has been repeatedly conducted since 1968. Inspected are nine elements including rockfall/slope failure, rock failure, landslide, debris flow, road embankments, scouring of bridge foundation and retaining walls. The inspection results were categorized into three ranks, and countermeasures have been systematically taken. While those efforts are steadily continued, there still remain a large number of unprotected road slopes for heavy rainfall. In order to cope with those slopes, roads are intentionally blocked for traffic to ensure their safety when the rainfall exceeds a certain threshold level. This threshold level is established for an individual road section, based on the past history of disasters, and so forth.

Seismic inspection of road facilities has been also performed since 1971. This inspection is intended for eight kinds of road facilities such as bridges, pedestrian bridges, road embankments, retaining walls and cut-and-cover tunnels. The results of inspection were put into databases and have been widely applied for evaluating seismic performance of road facilities. Seismic retrofit of road bridges has been pursued as part of the efforts to improve seismic performance of road facilities. Especially seismic retrofit of bridges on emergency transportation routes and those over Shinkansen, i.e., bullet train tracks and expressways were intensively promoted in recent years. This aimed to prevent serious damage such as collapse of bridges, ensure the function of emergency transportation routes, and prevent secondary disaster, for strong ground motions.

MANAGING CLIMATE CHANGE RISKS AND ADAPTATION OF TRANSPORTATION INFRASTRUCTURE

The need for the adaptation of infrastructure to climate change has gained momentum in recent months as transportation stakeholders acknowledge that despite the best mitigation practices, climate change is inevitable. For example, throughout the United States, governors have been creating task forces and collaborating with neighbouring states to study the issue of climate change adaptability. More recently, the federal government has been taking a national leadership role in studying the US's ability to adapt to climate change. The struggles within the US to collectively address climate change adaptation mirrors the efforts of the international community.

As the result of a major research effort, the USDOT identified three universal climate change issues that will affect transportation networks on all six habitable continents: (1) Temperature, (2) Precipitation, and (3) Sea-Level Rise/Increased Storm Surges. This chapter of the report will highlight those three issues, including identifying the climate change events and potential risks to the transportation network within each of the issues.

A snapshot of current and developing efforts to prepare communities for the eventual deployment of the next era of transportation infrastructure technology, standards and practices will be presented in this chapter. Several case examples will be presented in the Appendices.

RISK MANAGEMENT TOOLBOX

In 2007, the PIARC Technical Committee on Risk Management for Roads (TC 3.2) developed the first version of the Road Risk Management Technical Toolbox. The toolbox is a database of policy, techniques and operational (maintenance) technologies/tools with an inspection facility for road management, consisting of 124 inventory sheets.

The inventory sheets introduce the risk management technology, used mainly in Japan and New Zealand. The inventory sheets aim to assist budgeting and road management with easy application of risk management technologies/tools. The inventory sheets are divided into natural event management and man-made event management. All sheets are classified according to the different stages of the project (from planning to operations). In each case, the sheet makes a brief presentation of the proposed recommended methodology and of the technologies available. Current TC C.3 members will add inventory sheets on climate change adaptation strategies to the toolbox.

APPROVAL PENDING:
The current PIARC TC C.3 has been submitted a proposal to PIARC to transform the current version of the toolbox (in CD-ROM) into a user-friendly web-application. The web-application would connect to a searchable risk management database and allow registered PIARC members to upload road risk management files. The web-application would also allow TC C.3 to continue building a vibrant and engaged risk management community. If the proposal is acceptable to PIARC, then this chapter will include an interactive web-application technical toolbox for risk management.

3.3. Social Acceptance of Risks and Their Perception

Technicians normally assess the risk as the product of consequences of unfortunate events and relevant frequency. This kind of approach can cover both natural and manmade events.

This technical approach is typical of authorities and operators involved in the risk management process. In the specific case of roads, we refer to Authorities and Operators that are involved in the construction of or in charge of the operation of public roads.

Authorities and Operators often need to estimate the risks, in order to assume the most suitable set of measures (technical, technological, investments or organizational measures) aiming at preventing risks, keeping them under "acceptable" or "legal" thresholds.

Sometimes, the aforementioned process of assessment is strictly adopted as follows: analysis of phenomena / assessment of the risk / comparing risk with acceptable thresholds / defining mitigation or preventive measures.

In other cases, the procedures adopted for achieving the target level of risk through the prevention of root causes and mitigation of the consequences are not explicit: adopted measures may be coming from other kind of approaches, may be coming from past experience, or may be coming from the analysis of physical processes. In the last cases, the risk assessment process is in some way “hidden” inside the criteria and procedures, with the same goal.

Whatever the process can be, the main question that underpins the overall matter is: "when can a certain risk be considered as acceptable?". Clearly, this question is never a "technical" one: in most of the cases the answer to this question underpins choices that have a direct impact on society. Reaching for an answer to this kind of question requires comparing the possible outcome of hazards with social drawbacks of a different nature. The most obvious drawback is the economic cost of preventive measures. Generally speaking, there is no "safety for free". In fact, safety is (also) the result of preventive investments and, in the case of roads, it is the result of the public investment in infrastructures, education and training programs, equipment and facilities for safety.

Cost is not the only possible drawback, others can raise, for example, the impact on the environment. A case in point could be authorities that have to decide whether to build a second tube for a long mountain tunnel. On one side, we have high costs and impacts on a fragile environment. On the other side, we have an increased safety and a more efficient mobility. In turn, the question "when a certain risk can be considered as acceptable?" becomes "do we accept the current level of safety, knowing costs and impacts of the new construction?".

Then, there is the question "what the acceptability of a risk is?". Existing literature demonstrates that user’s risk perception may differ significantly from the expert assessment. The technical report of WG C3.3 elaborated further on this additional question.

Mary Douglas said "acceptability of a risk" implies a "social" acceptability: it is the culture that takes the lead when it comes to consider some risks as being acceptable and others to be feared and therefore refused. It is impossible to discuss on the perception of risk without taking into account the overall reference context, moral, social and political.

Thereby, the committee studied the issue of risk acceptance and perception trying to define a best practice approach for road stakeholders to handle these differences. Several actions such as information or education of users, revising of the design codes, approach to safety factors, traffic regulations or preparedness education strategy could be useful to best take charge of these phenomena according to the risk perception of people.

Understanding of risk perception is instrumental in understanding and anticipating public response, understanding dimensions of public concern, improving communication of risks between different categories of people (lay, experts, risk managers), and developing better methods for eliciting opinions about risk (societal decision making).

1. The result of the research in the field of risk perception made self-evident that the user's perception of risks is fairly different from the assessment of experts in many fields of human action, including the operation of roads; we can assess "normal" or "physiological" this fact if we consider that the mathematical and statistical approaches normally adopted by experts have nothing to do with the processes that underpin the social perception of risks.

2. Assessments aiming to define risk are part of the scientific approach relevant to the operation of roads. For some road related risks, it is easy (or at least possible) to have a reasonably accurate analysis and assessment of the risk, using probabilistic methods. For risks that are of rare occurrence, a strict statistical modelling of phenomena appears to be more difficult, but in all cases we can have a general assessment even if the events under analysis are described by a very low probability.

3. Culture leads the perception of risks. It influences the definition of risks considered acceptable and those feared and consequently refused by society. Different cultures could lead to different personal and social approaches to key risk influencing factors such as: national provisions, behaviour of users, level of enforcement of inappropriate attitudes, etc. In the fields of health, environment and technological progress, the attitude to resort to simplistic cause-effect relationship, often without an analysis of the overall context of the problems, in spite of the complexity and the huge number of factors in play appears more and more diffused. This is normally the case in the aftermath of major accidents or events with a high impact on population and the media.

4. Social behaviour and the media are the drivers of risk amplification, where the adverse impacts of a major event could extend its consequences far beyond the direct damages inflicted to victims and property and may result in massive collateral impacts such as litigation against a company or loss of sales, increased regulation of a road sector, and so on.

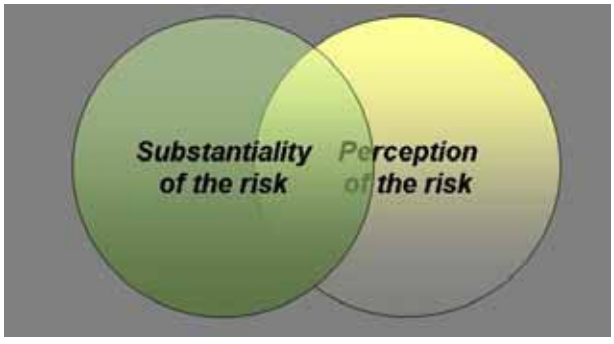


Figure 3.1 Difference from perception to the statistical relevance of a risk

The perception of risk has two major areas where its consequences were identified as fields of interest for the operation of roads:

a. **The field of major events:** Road Authorities and Operators need to make choices and investments evaluating hazards with a reasonably high probability of occurrence and other risks. In fact, in order to be cost-effective from the perspectives of safety, the environment and public interest, road stakeholders need to disregard cases of "minor" hazards (or to postpone the course of action), when the preventive measures are expensive and the frequency of the expected adverse events is reasonably low (and consequently the practical return of the preventive investments to the safety or the environment is low). The perception of risk and the social amplification of major events can have a significant impact on the assessment process, bringing unpredictable results in assessment, provisions or remedial plans.

b. **The field of human behaviour:** Understanding of the processes involved and appropriate risk perception by users is instrumental in the proper overall functioning of the road system and for the users to achieve a coherent approach. This is certainly true for the risk perception of professional operators, but when analyzed at the level of ordinary drivers it has an even greater impact in the field of road safety. The misperception or underestimation of risks can be considered as a key factor, affecting a good approach to driving.

4. CASE STUDIES OF RISK MANAGEMENT IN VARIOUS COUNTRIES

There are a lot of papers regarding risk management for roads in the meetings, seminars and journals as shown in the following Table 4.1.

Table 4.1 List of Papers Regarding Risk Management for Roads

Title	Authors	Reference
Managing the operational risk of roads - Social acceptance of risks and their perception	Arditi Roberto, Belda Esplugues Enrique, Cecchini Bianca Maria and Fernandez Alonso Federico	Routes/Roads No.344
How does social acceptance of risks and their perception influence Risk management on road operations?	Ioannis Benekos and Panagis Toniolos	Routes/Roads No.346

PIARC/TC C.3 Managing Operational Risk in Road Operations Presentation List	
Title	**Country**
2nd International Committee Meeting in Madrid (November, 2008)	
Application of Risk Analysis for Road Construction and Operation in Japan	Japan
Safety Management for Highways Projects: An Alternative Approach	UK
Explicit Safety Evaluation Example	Canada
TC C.3 Managing operational Risk in National and International Road Operation	Italy
Information Publishing System	Spain
Traffic Management Centre In Madrid	Spain
Role and responsibility of DGT	Spain
3rd International Committee Meeting in Vancouver (May, 2009)	
Advances in Proactive Road Safety Planning	Canada
Climate Change Effects on Transportation infrastructure	Mexico
TC C.3 Managing operational Risk in National and International Road Operation	Italy
Public Opinion Survey for Earthquake Resistant Design of Road Bridges	Japan
Risk Management Practices in the U.S.	USA
4th International Committee Meeting in Iasi (November, 2009)	
Road system and related operational risks in Romania	Romania
5th International Committee Meeting in Rome (May, 2010)	
Risk management of airports and surrounding road network in Quebec	Quebec, Canada
Risk management practice in Flanders	Belgium
Risk management criteria adopted by Italian Civil Protection	Italy
Operation of Roads and the impact of climate change	USA
Evolution of seismic risks: the case of L'Aquila	Italy
Management of operational risk for roads	Sweden
Risks and road safety in Italy – current frame	Italy
Risk perception and risk homeostasis: a recommendation for safer roads	Italy
Management of road related risks and human behaviour	Italy
Actions adopted by the Italian Administrative Authority for the safety of road tunnels	Italy
Operational risk of roads in China - Criteria of handling of the risk and emergency management	China
Current trends of road safety and actions undertaken by DGT for a correct perception of road operation risks	Spain
Experience in mobile laser scanning by means of LYNX system in L'Aquila City after the earthquake	Italy
6th International Committee Meeting in Beijing (November, 2010)	
Emergency Management in China	China
1st International Seminar in Iasi (November, 2009)	
Safety Management for Highways Projects: An Alternative Approach	UK
Road Safety Risk Management in Australia-past, present and future	Australia

Actual status and implementation of the risk management on roads in Romania	Romania
PIARC methodology for identification and evaluation of the risk on the road network - Proposal for assimilation and implementation in our country	Romania
Proactive Road Risk Management Techniques - An Overview	Canada
Case Study of Road Disaster Risk Management	Japan
The system for the management of the emergency situations on public road network of Romania	Romania
Risk based estimate of transportation infrastructures	USA
Limitation of risk for traffic accidents by correlating horizontal and vertical alignments, at the design of the road routes	Romania
Earth work consolidation with drilled pilots and lowering of the groundwater level by using siphon drains on the National Road NR 15	Romania
Increasing the probability of detection and evaluation of the buried objects, archaeological sites and voids in soil by data fusion GPR-EMI	Romania
Risk management for Roads against Climate Change and Natural Disasters in Japan	Japan
Mexico Climate Change, Tabasco Case	Mexico
Risk Management for Roads in a Changing Climate: A common European Approach	France
Climate change interference and risks involved in highway management	Romania
Some considerations on the repairing and correction of the landslides on the public road network	Romania
Landslide risk management in rehabilitation works for transportation infrastructure	Romania
Geological and geotechnical characteristics of rocks from the alluvial plan of river Bahlui and their influence on safety of transport infrastructures	Romania
Interactions, impacts and influences of social acceptance of risks and their perception in managing operational risk on road operations: an overview and a proposed categorization of available case studies	Greece
Impact of Different Cultures on the Perception of Risk: The Malaysian Perspective	Malaysia
Brief Introduction of Japan's Vulnerability to Natural Disaster from the risk perception perspectives	Japan
Improving the road user information as a key factor in the management of the mobility in risk situation	Spain
2nd International Seminar in Beijing (November, 2010)	
Concept for Risk Management in a Road Management Organization	Sweden
Risk Concept for Natural Hazards on National Roads	China
Risk Management Practice in Flanders, Belgium	Belgium
Risk Identification and Control Method & Technology for Bridge and Tunnel Construction	China
Development of a National Risk Assessment Model for Road Safety	Australia
Advance of Road Safety Audit and Its Application in China	China
Managing Risks Associated with Climate Change - Mexico Case	Mexico
Road Weather Information Systems and Service in China	China
Bridge Collapse in Brasby, Finland	Finland
Technologies to Ensure Road Safety under Adverse Weather Conditions	China
Risk Management for Roads in a Changing Climate: A Common European Approach	France
Best Practices and Lessons Learned in Emergency Transportation Operations and Planning	USA
Contingency Planning for Highway Emergencies in China	China
Disaster Prevention Management and Prompt Restoration of the Tomei Expressway after the Earthquake by NEXCO-Central	Japan
Road disaster management by MLIT, Japan	Japan
Risk Management Application in Xiang'an Tunnel Construction	China
Risk Management Application in Hangzhou Bay Bridge Operation	China
Management of structures in Metropolitan Expressway	Japan
Social Perception of Risks in the Frame of Road Operation	Italy
Social Acceptance of Risks in Road Related Activities in China	China
Brief Introduction of Japan's Vulnerability to Natural Disaster from the Risk Perception Perspectives	Japan
Public Opinion Survey on Their Acceptable Level of Risks in terms of Earthquake Resistant Design of Bridges in Japan	Japan

5. DRAFT CONCLUSIONS

The activities of TC C.3 including meetings, seminars, international survey, studies, and technical toolbox are summarized as follows:

1) Since the commencement, TC C.3 has been making considerable efforts to achieve our objectives, by organizing six TC C.3 meetings in various countries and two international seminars in Iasi, Romania and Beijing, China. Two more meetings are planned in Japan and Mexico.

2) TC C.3 conducted an international survey to understand the current status of risk management techniques and practices in the PIARC member countries.

3) Significant number of best practices of risk management for natural hazards, climate change and man-made disasters and studies on social acceptance of risks and their perception have been collected and examined to improve risk management techniques.

4) The technical toolbox, which was first developed by the previous Technical Committee TC 3.2, has been further improved.