

PIARC (World Road Association) Strategic Plan - 2024-2027

TECHNICAL COMMITTEE 1.4 – PLANNING THE RESILIENCE OF ROAD NETWORKS - CLIMATE CHANGE AND OTHER HAZARDS

Overview

A road organisation is responsible for ensuring that the infrastructure provides service, and monitors the performance of the service being provided and restores the infrastructure damaged during extreme events. A road organisation is also responsible for maintaining the expected levels of service (LoS) of the infrastructure assets with the most effective technical and administrative interventions. The growing challenge of climatic as well as non-climatic natural hazards demands evolution of road organisations with appropriate resilience frameworks, both institutional and situational, to achieve the LoS expectation with acceptable deviations.

PIARC Technical Committee (TC) 1.4 “Planning the Resilience of Road Networks - Climate change and other hazards” in the 2024-2027 cycle will focus on Strategic, tactical, and applied planning aspects of enhancing resilience, such as methodologies and approaches for resilient network planning and road infrastructure designs, which reduce risk, are better prepared, more robust, and are able to respond and recover other hazard events. In this context, other hazards include extreme weather, natural threats (geotechnical), and pandemics related impacts. Chemical threats, cyber threats and terrorism are outside the scope of this Committee. This entails a global approach towards ensuring that infrastructure is less vulnerable and is able to adapt, transform and adopt lessons learned to increase the resilience of road infrastructure assets (pavements, bridges, drainage, slopes, etc).

Two topics for analysis are listed below. These topics will provide comprehensive guidance towards improving the resilience of road transportation assets, investments in future roads, and enhancing institutional resilience for improved road networks.

1.4.1 Development of a resilience framework for road networks – climate change and other hazards

1.4.2 Best practice in understanding organisational resilience for road networks

1.4.1 Development of a resilience framework for road networks – climate change and other hazards

Purpose: The purpose of the work to be developed by Technical Committee (TC) 1.4 is to extend the work undertaken in previous cycles covering resilience approaches for climate change and other hazards, and an updated version of the PIARC Climate Change Adaptation Framework for Road Infrastructure (2000-2023 cycle). The work of this cycle will involve development of a resilience framework (covering climate change and other hazards) based on the work of TC1.4 in the 2020–2023 cycle and will include the identification of medium to long term vulnerability and risk assessment methods that take into account both climatic and non-climatic risks. The work also includes identification and assessment of critical infrastructure, through examples such as case studies for the identification of critical assets as tools for adaptation to climate change and to increase the resilience of road networks. This Framework will therefore extend the Framework (2023) from a climate change to a framework covering changing hazard risks, climate hazards, natural hazards (geotechnical) and pandemics.

Preliminary research questions: The aim of this topic is to explore the effectiveness of a PIARC resilience framework for road networks, covering climate change and other hazards. The Framework will build upon the reports from the previous cycles. It will include a resilience framework, where other hazards refer to climate change, extreme weather and natural threats (geotechnical) and pandemics. It is noted that malevolent or man-made threats such as, cyber-security, cyber-physical, chemical impacts and terrorism events are outside the scope of this Committee.

The pertinent preliminary research questions are:

- How is the existence of different resilience frameworks (addressing climate and other hazards), impacting the optimisation of road network resilience performance? What are the effects, and opportunities for improvement?
- How to address the structural gaps, including uncertainties associated with pandemic related impacts, for effective integration of different road resilience frameworks?
- How to validate the new Resilience Framework for practitioner level application, confirming implementation outcomes (to be investigated) of the Climate Change Adaptation Framework 2023?
- How to address stakeholders' concerns relating resourcing, planning and financing aspects of implementing the proposed resilience framework?

Importance to roads agencies: This work is important to road organisations because it will provide a comprehensive process to guide improvements to the resilience of road transportation assets by addressing both climatic and non-climatic hazards as a holistic approach. It will help improve service levels of road organisations in the event of a hazard emergency with higher effectiveness and public confidence. The work will be flexible enough to enable application at both the national and local levels including LMICs. It is also relevant to assist in decision-making processes for road organisations with respect to climate change adaptation. It will provide case studies on the best practice methods on inclusion of non-climate hazards and changing probabilities in a vulnerability and risk assessment with a long-term horizon of assessment.

Audience: This work is intended to be used by road organisations, practitioners, consultants and academics.

Deliverables: article in Routes/Roads, webinar, seminar, workshop or conference, guideline (update and upgrade of the current International Climate Change Adaptation Framework for Road Infrastructure).

Background to TC's work on this topic: The International Climate Change Adaptation Framework for Road Infrastructure was initiated during the Strategic Plan Cycle 2012-2015 of the World Road Association. At its meeting in Bali, Indonesia, TC1.3 "Climate Change and Sustainability" developed a proposal for a 'special project' with the aim to create an international framework for climate change adaptation. In May 2014, the World Road Association launched a call for proposals for PIARC special projects. The idea of developing a framework to address climate change adaptation, which would be of practical use for road assets owners and managers, was supported. Accordingly, the International Climate Change Adaptation Framework for Roads was published and disseminated during the World Congress in Seoul, November 2015.

The PIARC International climate change adaptation framework for road infrastructure aims to guide road organisations through the process of increasing the resilience of their networks and assets and is designed to be applicable at any scale such as national, regional, local or asset specific level. It was designed to be of practical use for road owners and managers in high and low-middle income countries. The Framework is comprised of four main elements or stages, supported by a series of international case studies.

In the 2016-2019 cycle, tasks related to adaptation to climate change were assigned to Technical Committee E.1 Adaptation Strategies/Resilience. Working Group 2 had the task to formulate proposals for the refinement of the International Climate Change Adaptation Framework for Road Infrastructure, based on the case studies analysed by Working Group 1 and on findings from direct implementation of the Framework. The final report developed by TC E.1 WG2 summarises the results of the work on the refinement of the Framework.

Further to this work, in the 2020-2023 cycle, Working Group 1 investigated holistic approaches to climate change and other hazards resilience. Additionally, Working Group 2 aimed to provide an Update of the PIARC Climate Change Adaptation Framework. This updated Framework, taking on board the suggested refinements from the previous cycle, as well as the inclusion of new case studies and approaches and proposing a framework with a new structure and revised contents. The implementation of this framework needs to be investigated as part of the work for the development of the new Climate Change and Other Hazards framework to ensure its effective inclusion for road organisation's applicability.

In this 2024–2027 cycle, the outputs from WG1 and WG2 in the previous cycle will be used to develop an Resilience Framework – climate change and other hazards.

Low and lower-middle income countries: This topic will identify the best practice (through case studies and critical discussion) of climate change adaptation and other hazard resilience activities for all countries including the low- and middle-income countries (LMICs) and will play a fundamental role in providing access to information about resilience measures and its dissemination among LMICs. This includes the identification of different data available to assess vulnerabilities and the different types of road assets in different countries and illustrating the needs of LMICs and other countries. TC1.4 will promote the representation of LMICs and will accommodate a platform for mutual knowledge exchange of practices among the member countries.

Gender inclusion & diversity: The access needs and travel patterns are often different for various vulnerable groups like woman, children and marginal communities. Both climatic and non-climatic hazards may have impact on their travel choices from time, cost, safety, security, cultural and other perspectives based on the context. The collective share of these groups is a greater part of the total travel demand, and hence consideration of the distribution and nature of their needs is very important for developing a socio-economically effective infrastructure resilience framework.

The formation of the working groups under Technical Committee 1.4 will, therefore, consider gender and diversity aspects, to the best possible, for getting appropriate inputs and feedbacks in formulating the frameworks.

Potential duration: It is expected that the research period will be 4 years.

1.4.2: Best practice in understanding organisational resilience for road networks

Purpose: A road network is a complex and dynamic system composed of many elements including the built infrastructure (roads, bridges, buildings and other assets). It is also necessary to take into account a set of components such as governance structures, operation, maintenance processes, national and international (cross border) regulatory frameworks, available technical, human or natural resources, as well as all the interdependencies of these elements with each other and with the network's external environment.

In this context, organisational resilience is essential to organise, resource, promote and maintain a sustainable activity, serving users and the necessary movement of goods, services and people. The purpose of the work to be developed by TC1.4 is to assess how resilience is understood, implemented, measured and evaluated in road organisations. This involves identification of institutional attributes that can make an organisation adaptive enough to respond to changes over time to address the climatic and non-climatic threats. This may include processes supportive to resilience in road management decision-making, existence of specific work units facilitating network resilience improvement in a road agency, flexibility of internal/external stakeholders engagement process to accommodate new ideas or best practices elsewhere with appropriate validation and so on. Once these organisational aspects have been identified, the work will identify common attributes and processes and different approaches used, such as: taking into account services provided by network providers and links with users (human factor and levels of service), consideration to functionalities of the network and resilience of road organisations as complex systems. This also includes identifying the relationships of road resilience within complex systems, including resilience at the network-wide level, arterial and asset levels.

The work will involve development of a survey to road organisations to better understand what “resilience” means for them, and how resilience is measured and implemented. It will then identify common approaches and best practices depending on the type of the road network.

Preliminary research questions: This topic addresses the “Strategic, tactical and applied planning aspects of enhancing resilience”, such as methodologies and approaches for resilient network planning and road infrastructure designs, which reduce risk, are better prepared, more robust, and able to respond and recover from climate change risks. This entails a global approach towards ensuring that the infrastructure and the services it provides are less at risk and are able to adapt, transform and adopt lessons learned to increase the resilience of the road networks (pavements, bridges, drainage, slopes, etc).

The research works is to assess how resilience is understood, evaluated and considered by the road organisations, and to examine a range of different approaches used, such as: services provided and links with users (human factor and levels of service), functionality of the network for changing demand and risks, and resilience of the road organisations to address the needs as part of a complex system of governance. This also includes the identification of interoperable components within multifaceted systems, including resilience at the network-wide level, arterial and asset levels.

The preliminary research questions include:

- Why organisational resilience is important for a road agency to provide a resilient network? How the apparent absence impacts on the service?
- What are the main attributes for confirming organisational resilience of a road agency?
- How to dissect and interwin critical institutional and situational attributes for the development of a road organisation resilience framework with performing indicators?
- How to validate the developed road organisation resilience framework including answering to the stakeholders' concerns?

Importance to roads agencies: This work is important to road agencies/road industry because it will provide best practice in understanding of how to organize resilience of road transportation assets in the different organisational levels of the road authorities. It is relevant to assist in decision-making processes for road owners or managers with respect to providing an understanding of; What parameters/variables to use? What are the historical thresholds and what should be the future thresholds? How to use climate scenarios in the design and maintenance programs of infrastructure? What kind of indicators can be used to monitor the selected adaptation trajectories? This work will also investigate the economic issues relating to the cost of disruptions (possibly compared to the cost of inaction), the cost effectiveness of the measures taken, the residual risk costs as well as the return on investment of adaptation solutions.

These are important aspects of assessing resilience in road authorities.

Audience: This work is intended to be used by road organisations, practitioners, consultants and academics.

Deliverables: Technical report, case studies, survey, article in Routes/Roads magazine, webinar, seminar, workshop or conference.

Background to TC's work on this topic: In the PIARC cycle of 2020-2023, the TC1.4 Working Group 1 delivered a report titled "Uniform and holistic methodological approaches to climate change and other hazards". This presented the concept of holistic approach of resilience where wider impacts beyond assets across the whole network are considered for climate change as well as other hazards. Within this issue, there was reflection to resilient approaches such as risk management approaches, decision-making and uncertainties/deep uncertainties, as well as economic, social and environmental aspects of resilience management. This included consideration to the evaluation of resilience of road organisations for delivering resilient networks. Further work will be undertaken to explore this concept in this topic.

Low and lower-middle income countries: This topic will assess and identify the best practice (thorough case studies and critical discussion) of organisational resilience structures, resources and practices in all countries including low- and middle-income countries (LMICs) and will play a fundamental role in providing access to information about resilience measures and its dissemination among LMICs. TC1.4 will promote the representation of LMICs and will accommodate a platform for mutual knowledge exchange of practices between countries.

Gender inclusion & diversity: The access needs and travel patterns are often different for various vulnerable groups like woman, children and marginal communities. Both climatic and non-climatic hazards may have impact on their travel choices from time, cost, safety, security, cultural and other perspectives based on the context. The collective share of these groups is a greater part of the total travel demand, and hence consideration of the distribution and nature of their needs is very important for developing a socio-economically effective infrastructure resilience framework.

The formation of the working groups under TC1.4 will, therefore, consider gender and diversity aspects, to the best possible, for getting appropriate inputs and feedbacks in formulating the reports.

Potential duration: It is expected that the research period will be 4 years.