STRATEGIC PLAN 2020-2023

PIARC – THE WORLD ROAD ASSOCIATION

UPDATE OCTOBER 2020

STATEMENTS

PIARC, the World Road Association, is a nonprofit organisation established in 1909 to improve international co-operation and to foster progress in the field of roads and road transport

PIARC Strategic Plan 2020– 2023 was drafted by the Strategic Planning Commission and approved by the Council of the World Road Association.

In accordance with the implementation of the Strategic Plan, the second update has been drafted by the Strategic Planning Commission and approved by the Executive Committee in October 2020. It consists of including the PIARC Covid-19 Response Team and making some adjustments in the Terms of Reference of two Committees. These are based on input received from internal and external stakeholders and on PIARC's necessary and timely addressing of the impact of Covid-19 pandemic on road infrastructure and road transport. In addition, references have been included for Special Projects that will be developed during the cycle.

More information is available about PIARC from its Website: http://www.piarc.org

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STRATEGIC PLAN 2020-2023

PIARC – THE WORLD ROAD ASSOCIATION

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FOREWORD

PIARC (the World Road Association) is the world leader in technical analysis and exchange in the field of road and road transport. In addition, it defines, develops and disseminates international best practices. To achieve this mission, the Association develops a Strategic Plan every four years to structure, develop, monitor and evaluate its activities over the four-year work cycle.

This seventh Strategic Plan of the Association, which covers the period 2020-2023, is a very important document. As with previous plans, it sets out not only the Association's mission, vision and objectives, but also the most relevant current and future issues. It also proposes the working structure that will allow the Association to process them and produce information and documents that will help it to provide its services to the road communities of its member countries.

This new Plan was prepared under the direction of the Strategic Plan Commission and is the result of extensive consultations. First Delegates from all member countries, Chairs and Secretaries of Technical Committees and Task Forces, Strategic Theme Coordinators and all National Committees were invited to be involved in the process. In addition, interviews were held with representatives of other road and transport related organizations to gather their ideas and views. A special effort was made to consult representatives of low- and middle-income countries so that their needs and perspectives could be taken into account in the final version of the Plan. Some choices have been difficult, as it has not always been possible to meet all the requests of our members within the limited budgetary possibilities of the Association, which must remain resilient.

To ensure the continuity of the Association's core activities, the 2020-2023 Strategic Plan adoptes a structure similar to the previous Plan. It includes four Strategic Themes that will be divided into Technical Committees and Task Forces. In each case, the Plan outlines their roles, topics to be covered and expected results.

Previous structural developments are maintained: Task Forces, which have more flexibility to deal with emerging topics in a short period of time; Special Projects, which are outsourced to provide useful information to member countries in a short period of time; Regional Task Forces, which focus on specific regions, particularly those with developing countries; and enhanced communication and dissemination of the Association's activities and products, both to members and to other professional groups with whom we are developing partnership relations.

This 2020-2023 Strategic Plan also includes several developments:

- In order to better adapt our work to the increasingly rapid evolution of road-related topics, an annual update of the Plan will be conducted by the Executive Committee.
- The work will also be able to reflect the particular expertise that we will have in the technical committees: it is indeed logical to take into account more and more the opinions of these experts, and to avoid the duplication of already existing results.
- The Association will continue to apply rigorous quality processes, and to reflect the diversity of situations around the world, while identifying and treating subjects with greater flexibility, so that it can provide the most appropriate insights within short deadlines.
- More diversified themes will be presented at the International Winter Road Congress in order to present our interim results without having to wait for four years until the next World Congress.

The aim here is to ensure that the Association's products and services continue to serve, as closely and efficiently as possible, the expectations of our members and all stakeholders in the road sector, and therefore form part of a real societal added value approach.

FOREWORD

I am convinced that this document will be of great value in guiding the activities of the World Road Association during the 2020-2023 work cycle, and that it will contribute to strengthening its position as an international leader in the exchange of knowledge and information on roads and transport.

Finally, the intensity of the efforts that have been made to prepare this Strategic Plan illustrates the vitality of our Association and in particular the interest, commitment and professionalism of all those who participated in it. I would like to express my deep gratitude to them.

Claude VAN ROOTEN

President of the World Road Association

CONTENT

EXECUTIVE SUMMARY

The World Road Association (PIARC) is a non-profit organization with more than 100-year history that aims to promote international cooperation and the exchange of knowledge on issues related to roads and road transport. Being more than 120 member countries, the World Road Association brings together governments from all over the globe, as well as regional authorities, collective members, and individual members. Its members represent both all levels of economic development and every region in the world.

The Association mobilizes its members' expertise to develop and share knowledge to contribute to sustainable accessibility for people and goods by improving the state of roads and road transport worldwide, a mission that is grounded in the needs of member countries and supportive of larger trends in global society. It fulfils this mission through activities gathered in a 4-year Strategic Plan.

This plan, which covers the period 2020-2023, is the result of a highly participative process based on a broad stakeholder consultation including First Delegates, National Committees, Technical Bodies (Technical Committees, Task Groups and Regional Working Groups) as well as external stakeholders. As a novelty in this cycle, the new Technical Bodies that will develop the plan of activities have also been involved in its elaboration, in order to have, on one hand, their experience, and, on the other hand, they gain early knowledge of the plan so that its development is more effective.

A great amount of responses was received, which clearly shows the high interest of all these stakeholders in the activities of the World Road Association and their expectation for the Association to keep on improving and providing an effective knowledge transfer.

With the aim of responding to the expectations of our members and all stakeholders in the road sector, the Strategic Plan establishes the principles that will guide the Association throughout the 2020- 2023 cycle. This Plan describes the strategic elements steering the work of the Association, vision, mission and organizational principles, and the substantive agenda that technical bodies will follow to bring those strategic elements to the practice, through the Plan of Activities.

The Plan of Activities for the 4-year cycle, covers Strategic Themes developed through Technical Committees and Task Forces, with related Regional Working Groups and is completed with Cross-cutting Committees, Response Teams and Special Projects. Thus, most of the working structure that has proved useful in recent cycles is maintained, but increased to meet new needs for PIARC's response to specific issues. It also introduces amended or novel ways of working to enable the Association to provide results more frequently and in a wider variety of formats, this is both, to increase flexibility for attending PIARC members' needs in a quick changing world and to give more visibility to PIARC, making the Association more relevant.

The Plan of Activities of the Strategic Plan 2020-2023 is organized through four Strategic Themes: Road Administration; Mobility; Safety and Sustainability; and Resilient Infrastructure. These ones represent a continuation of several lines of traditional work within the Association, focusing on environment-related issues, road safety and resilience of road networks, based on the key concern within the membership.

Through Technical Committees, and encouraging greater collaboration among them to achieve a more integral and interconnected knowledge, the Association will explore a range of issues within these themes. In addition, within the Strategic Plan there are also several Task Forces, with shorter delivery times and smaller mandates to foster the exploration of critical issues, Response Teams that provides timely and accuracy addressing of specific issues and Cross-cutting Committees that serves as support for general knowledge. Regional Task Groups and Special Projects will complement the structure, and enable the Association to engage external partners to develop meaningful products.

The Strategic Plan is expected to be a work cycle that enables the road sector, and the worldwide, to benefit from access to best practice, collaboration of experts to develop and share new knowledge in key areas, and confirmation of the World Road Association's value as the leading forum for advancing sustainable road infrastructure and transport globally.

INTRODUCTION TO THE WORLD ROAD ASSOCIATION

The World Road Association is a non-profit organization established in 1909 as the Permanent International Association of Road Congresses (PIARC). The Association's broad aim over its more than 100-year history has been to promote international cooperation and the exchange of knowledge on issues relating to roads and road transport.

With more than 120 member countries, the World Road Association brings together governments from all over the globe. Its members represent all levels of economic development and every region in the world. In addition to national governments, the Association includes regional authorities, collective members, and individual members. For details about the organizational structure, see Appendix 1.

By building on the diversity of its representatives, the Association musters knowledge and expertise to contribute to sustainable accessibility for people and goods by improving the state of roads and road transport worldwide.

PIARC VISION

Taking into account its broad membership and geographic diversity, the vision of the World Road Association is to become "the world leader in the exchange of knowledge on roads and road transport policy and practices within the context of integrated and sustainable transport."

PIARC MISSION

Closely related to this vision is an organizational mission that speaks to how the Association will position itself to accomplish its long-term goal of global leadership in the sharing of expertise and information related to road and road transport. The mission of the World Road Association is to serve all its members by:

- being a leading international forum for analysis and discussion of the full spectrum of transport issues related to roads and related transport;
- identifying, developing, and disseminating best practice and giving better access to international information;
- fully considering within its activities the needs of low and middle-income countries; and
- designing, producing, and promoting efficient tools for decision making on matters related to roads and related transport.

This vision, along with the processes described in the mission, is consistent with the Association's long history of facilitating the development and sharing of road-related knowledge. At the same time, the approaches that the Association must take to realize its vision have to evolve as the needs and number of members have grown, and as conditions outside the road sector have changed.

ABOUT THE STRATEGIC PLAN 2020-2023

The Strategic Plan establishes the principles that will guide the Association throughout the 2020-2023 cycle. The document is divided into two sections, which describe the strategic elements steering the work of the Association, and the substantive agenda that technical bodies will follow to bring those strategic elements to the practice.

Section 1 describes the Association's strategic principles, based on key aspects and organizational principles. This foundation will serve as a blueprint throughout the work period; it will be revised at the end of the cycle to ensure that the Association is aligned with both the strategic challenges faced by its members and the overall topics of interest within the road and road transport sectors.

Section 2 explains the Plan of Activities, based on Strategic Themes and Terms of Reference for technical bodies. The Association is concerned with ensuring that the Plan of Activities is responsive to the fast-changing policy and technical questions that arise from the natural dynamism of the transport field. This section will be annually reviewed during the cycle.

SECTION 1. THE WORLD ROAD ASSOCIATION'S STRATEGIC DIRECTION

This Section presents the World Road Association's internal and external operating context and outlines its strategic foundation. The content reflects the input provided by members and external organizations and will be revised at the end of the work cycle.

OPERATING CONTEXT IN ROADS AND ROAD TRANSPORT

Roads are the **dominant national asset** for transport and constitute a lever for national economies to fuel economic growth and reap social benefits. Because of their relevance for sustainable development, and because of **growing pressure on financing capacities**, transport administrations worldwide, and importantly, the Association's membership, are faced with the complex task of implementing policies and methods to best finance, develop, operate, and maintain road and road transport systems.

The World Road Association is sensitive to this complexity and considers both the internal and external conditions that impact its strategy and operating methods. The Association's external operating context relates to large global shifts impacting roads and transport sector in which members strive to effect change. The Association's internal operating context, on the other hand, refers to needs for value-added networking, solutions and knowledge products of its membership.

External Operating Context

Society is changing: – challenges for the road transport sector

The roads and road transport fields are constantly evolving in response to large social, economic, and environmental shifts. Decision makers, professionals, and organizations in charge of road planning and administration must keep up with the complexities brought by ever-changing demographics, fast-paced urbanization, technological innovation and changing environmental conditions. Administrations and providers face a growing need to contribute to sustainable development, such as resource efficiency, advanced construction techniques, and materials, coupled with the use of data and innovation to promote automatization and digitalization, connected infrastructure and transport systems, safety and security conditions. These pressures are reflected in the way the Association addresses solutions that meet various needs in a range of areas including mobility, accessibility, safety, diversity, financing, governance, asset management and infrastructure, climate conditions and extreme weather events. At the center of all activities are the users. It is the transport needs of citizen and of the business community that must be met.

Financing and managing risks for creating, renovating, and maintaining road assets are priorities in transportation. The needs for investment in infrastructure development and maintenance, including transport assets, are widening and **public-sector budgets might not suffice to meet future funding requirements**. Administrations worldwide are concerned with identifying methods to finance road systems by tapping both public-and private-sector resources. In addition to encouraging investment, policymakers continue to focus on efficiency-enhancing approaches, such as improving the planning, management, and evaluation of projects and policies; other areas of intervention include fostering sustainable materials and solutions and implementing whole-life approaches to build and maintain road assets.

Economic progress and **fast-paced urbanization** trends further motivate the establishment of integrated and cost-effective transport systems for the mobility of persons and goods. Road systems require solutions that promote energy efficiency, multimodality, sustainability, reductions in road congestion, and safety in transport. Additional areas that are given attention to facilitate mobility refers to planning for responsible land use, promoting healthy environments, fostering local economic capacities, and enhancing road safety.

Strategies and policies that advance **safety and security in road systems** are given priority in the design, construction, and management of road infrastructure, and in the establishment of interventions to influence user behaviors and awareness. Following the trend set by of the United Nation's *Decade of Action for Road Safety,* road administrations and transport-related organizations around the globe have adopted a firm commitment to uphold road safety as both a local and a collective goal for progress. Effective measures to improve road safety have the potential to be further developed, for example, artificial intelligence-based tools and methods and infrastructure solutions that compensate for human errors and reduce risk and consequences of accidents. Security is also of strategic relevance with road administrations increasingly seeking new technologies and cost-efficient alternatives to address threat scenarios, assess and protect against vulnerability, and manage crises, among others. Security strategies for infrastructure protection from trespass and terrorist threats, security standards using risk and performance indicators as well as cyber-security along the overall life of infrastructure are important issues.

Technological advances and data-driven solutions hold significant potential to boost cost-reductions, improvements in mobility, reduction of CO_2 emission and safety conditions for road transport. Electric, automated, and connected transport systems and blockchain technology are just a few examples of developments under analysis and implementation. Technological innovations can allow infrastructures to be used more effectively and operated and maintained more efficiently. Interaction with innovative vehicle concepts is of importance. Technologic models that allow for the **digitalization of road infrastructure** and the exploitation of road data, are expected to gain strategic relevance to plan road systems, manage demand, enhance logistics, set pricing policies, and enhance user's experiences and benefits. Evaluating the impact of regulation and deregulation, is essential for understanding the use of these technologies in response to the growing demands within the transport and logistics industries.

In confluence with technological evolution, the natural dynamism of the road and road transport sectors calls for solutions developed in close engagement with the **social and environmental context**. Road administrations worldwide place a large value on initiatives that deliver social benefits, ponder the environmental footprint and are financially feasible.

Changing climate conditions and extreme weather events challenge administrators, communities and businesses to meet the impacts on road assets and the associated social and economic conditions. Road and transport industries and public administrations are increasingly interested in measures like furthering renewable energies, minimizing or preventing pollution, protecting natural areas and wildlife habitats, promoting resiliency in road asset, and addressing service disruptions and repairs.

The need to **reduce emissions of greenhouse gases** remains a dominant issue in the debate on how the transport system is to be developed. Even though traffic is the major source of emissions, the impact from building, maintenance and operations of the road infrastructure must be reduced in this regard. Designing infrastructure aiming at minimizing carbon emissions over its life time is essential. Technologies for sustainable energy harvesting and recovery, for example heat removal and solar road, and electric charging infrastructure are new solutions that can be further developed and implemented.

Infrastructure managers are facing many challenges as well as opportunities striving for sustainability. New approaches and technical solutions can be developed and implemented, for example **advanced construction methods and techniques**, reuse of materials, technologies and materials to improve air quality, noise and vibration, methods enabling condition-based maintenance and new and innovative inspection and testing technologies.

Developing holistic solutions to transport-related issues involves a cross-assessment and coordinated response among different sectors in the public and private spheres, and at the domestic, regional, and global levels. Addressing the complexity and magnitude of these issues,

therefore, demands initiatives that foster effective management, change management, innovation, good governance, and strengthened institutional capacities (e.g. human, networks, knowledge, systems, culture, and financial resources) to support operations. Road administrations are increasingly looking to enhance their internal processes, controls and capabilities to establish transparent processes, meet performance targets, and bring new methods to the practice.

Internal Operating Context

The World Road Association must consider the needs of a **diverse body of members**. Although road authorities represent the Association's primary membership, the preceding work cycles have seen growing participation on the part of National Committees, organizations, and professionals from the public-and private-sectors. This rich membership profile represents an unprecedented opportunity to build on the diversity of knowledge, skills, and experiences to foster collaborative work.

The World Road Association must ensure proper **adequacy between ambitions and resources**. Road-related project ideas have to be prioritized in order to offer relevant and time-adequate answers. As for any organization, projects have to be screened and ranked in terms of use for members and value for money. The Association shall also explore additional avenues, such as looking for additional sources of revenues, when appropriate, and looking for win-win partnerships that help us reach our objectives.

PIARC'S RESPONSE

The World Road Association is receptive to these internal and external challenges, and the diversity of ways in which they impact its global membership. The 2020-2023 cycle poses an ambitious substantive agenda that delves into these and other related topics, and both nourishes and expands the technical conversation among member countries.

The Strategic Direction and Plan of Activities presented in the following section articulate the Association's internal management, with a representative and responsive technical program, and a firm commitment to bolster the reach of its technical contributions within the global audience, and to contribute to the awareness on the importance of roads within the social, ecological and economic environment.

The Strategic Plan envisions advancing these principles by connecting with regional and international organizations. To deliver value to its membership and society, the World Road Association confirms and furthers its policy of partnerships with other organizations, such as regional road organizations, mode-specific transport organizations, international knowledge-sharing organizations, United Nations agencies, donors, and others that share equities with the Association.

Strategic Direction

The Strategic Direction establishes the concepts that steer the work of the World Road Association throughout the four-year cycle.

The vision and mission statements describe the Association's envisioned role and approach as a global leader in the sharing of expertise and knowledge in the road and road transport fields. Vision and mission statements are made operational through the Association's Strategic Direction by key aspects and organizational principles.

Key aspects

The Association's strategy emphasizes three key aspects.

- **Quality and value-added outputs** : refers to the Association's intents to reflect a wide range of international experiences in its outputs, and to continue implementing

adequate review processes, and to the selection and pursuit of topics and working formats that provide unquestioned value to the Association's constituency;

- **Flexibility**: refers to the Association's ability to identify the best product forms, to adjust topics that it addresses to the needs of its members
- **Outreach**: refers to a continued emphasis on communications, embedding it as an important issue at all levels of the organization, to better ensure that the information the Association produces serves its purpose with desired audiences, as well as partnerships with relevant organizations that can help roads serve the needs of the transport community and of society.

The specific approaches for the 2020-2023 work cycle are described below.

Quality and value-added outputs

PIARC members have confirmed that ensuring good quality of the association's outputs is essential. Those are values for which PIARC is recognized and respected.

This refers to the Association's intents to reflect a wide range of international experiences in its outputs, and to continue implementing adequate review processes.

Working in silos will also be avoided through a wide range of viewpoints and perspectives.

The World Road Association has also identified a need to address diverse audiences with varying levels of seniority and information requirements. The Association is diversifying in the creation of value-added knowledge outputs to promote a wide range of solutions and information exchanges, including a mix of in-depth products and reports as well as easy-to-read fact sheets and recommendations.

Flexibility

At its most senior levels, and as part of the solicitation of inputs for developing the Strategic Plan, the World Road Association has identified a need to update its Strategic Plan throughout the work cycle, to keep up with the dynamism of the roads and road transport sectors. Increasing the flexibility and usefulness of the technical outputs represents the consolidation of strategies and working methods that the Association has been implementing throughout the last decade.

The Association has consciously set the structure and operation of its technical bodies to better enable the generation of more frequent content. Employment of the Task Force construct, which complete of discrete assignments within two years, is one example of how the structure is designed to promote timely information. Continuation of Special Projects as a facility to pursue important topics outside the strict framework of technical bodies for reporting to the membership is another example.

The Association recognizes that producing extensive reports is not always the best answer to its members' needs. Thus, various possible outputs will be enabled, such as full reports, as always, but also short reports, literature review, briefing notes, roundtables etc.

This should lighten the overall workload of technical bodies, enabling their members to work less in silos, to engage in more free-form discussion and thus identify emerging issues at their level. As a consequence, this would confirm a vibrant and engaging work culture in the Association's technical bodies.

Along with priorities came an observation from past years that conditions change even during a single four-year cycle, and the Association has to be nimble enough to respond to key issues that might arise without prejudice to its technical working structure. The value of having some degree of flexibility in response has been recognized and incorporated into the strategic plan.

Closely linked with the idea of greater flexibility is a push to have the Association produce information on a more continual basis. While the value of the quadrennial World Road Congresses is well recognized as a means to showcase the full breadth of the Association's expertise, the concerns of its stakeholders at both the management and practitioner level are constant – as is the need for access to information to resolve concerns. Structuring work processes within the organization to foster the completion of reports and other resources more frequently has the benefit of ensuring that the Association can provide more current information in a timeframe that makes it more useable for its members.

Outreach

Knowledge sharing is at the core of the World Road Association's mission. Over the past 20 years, knowledge sharing has undergone a revolution. To remain relevant and viable, the Association must demonstrate value added to current members and pursue opportunities to widen and better engage the membership.

A unifying interest among members is a desire to access knowledge that can improve roads and road transport: knowledge that can be applied in their respective jurisdictions with the combined effect of improving the state of the practice worldwide while taking into account the greater mix of backgrounds and the need to address diverse audiences.

Within the Technical Committees themselves, there will be greater emphasis on communicating their work, in conjunction with the General Secretariat, to effectively move knowledge into channels appropriate to the Association's information sharing mission and visibility goals. Relevant media will be sought such as the website, Routes/Roads magazine, emails to members, various newsletters, information sharing at events, increased use of social media.

Many of the Association's constituents have expressed their interest in "training courses", which would also be a great way to engage with low and middle-income countries (LMICs). The Association will explore options in this regard, from organizing more webinars, answering invitations by development agencies to contributing to training courses that they organize.

Strategic activities for this cycle include a continued emphasis on cultivating alliances with related organizations. Cooperation with other organizations is important as the Association seeks to combine its unique capacities with those of complementary organizations to generate the best possible products for its membership. Cooperation may include knowledge sharing and exchange, joint projects with regional road organizations and with other international organizations with related goals. Cooperation with other organizations will benefit the broader road and road transport community through efficient use of resources, improved relevance on a geographical and thematic level, better visibility of the Association and its topics and products.

Organizational Principles

Organizational principles are the overarching areas of interest for the Association's governing and technical bodies: achieving effective management of internal processes, improving the responsiveness of the technical agenda, and enhancing the reach of its outputs.

Organizational Principle I. Achieving effective management of the Association's internal processes

Organizational Principle I focuses on the planning and coordination of the Association's internal processes and resources. This principle emphasizes effective management as a central quality to support procedures for the delivery of the Association's expected outcomes.

The management of governing and technical bodies shall promote clear decision-making, and to produce value-added and timely solutions for members. Efforts are directed towards stimulating and encouraging an active community of members and professionals taking part in technical work.

Organizational Principle II. Fostering representative and responsive work methods

Organizational Principle II targets the strategic planning and implementation processes that shape the Association's technical contributions throughout the cycle. As described above, the Strategic Plan shall allow the Association to promote a nimble, representative and responsive technical work program that meets the expectations of its membership as well as the strategic direction of the road and transport fields.

Representativeness refers to producing technical outputs that are mindful of the diversity of backgrounds, experiences, skills, and solutions required by the membership. Responsiveness refers to the selection and pursuit of topics and working formats that provide unquestioned value to the Association's constituency, throughout the work cycle, without prejudice to its technical working structure.

Throughout the work term, the Association will produce outputs on topic areas that are given continuity from preceding cycles and on novel areas that are brought forward as part of the dynamic policy environment in the field of road transport. A priority this cycle is also to deliver the technical program in close coordination with regional and international organizations that share interests with the Association.

Organizational Principle III. Enhancing the reach of the Association's technical products

Organizational Principle III addresses improvements of the Association's internal communication and increase its visibility and reach. Communication is emphasized as an important issue at all levels of the organization, to better ensure that the Association's knowledge products and information serve their purpose with desired audiences.

The focus shall be on effectively sharing information, transferring knowledge between member countries, and increasing access to publications and products. The World Road Congress and Winter Congress continue to function as core vehicles to showcase outputs. The Association will likewise continue using its website as a strategic tool and repository to continually disseminate technical products and knowledge, the Routes/Roads magazine, emails to members, newsletters, fact sheets, marketing materials, information sharing at events, seminars, conferences, and a variety of other ad hoc communications activities.

In continuity with efforts initiated in the preceding work cycle, the communications strategies will foster interactive multimedia tools, increased use of social media, an interactive version of the Routes/Roads magazine, and targeted dissemination plans for key information products.

Organizational Principle IV. Ensuring adequacy between ambition and resources

Organizational Principle IV focuses on prioritizing projects in order to offer relevant and time-adequate answers within the resource framework of the Association.

The Association shall also explore additional avenues, such as looking for additional sources of revenues, when appropriate, and looking for win-win partnerships that help us reach our own objectives.

SECTION 2. WORK PLAN

MAIN STRUCTURE

The Plan of Activities of the Strategic Plan 2020-2023 is made up of Strategic Themes developed through Technical Committees and Task Forces, with related Regional Working Groups and is completed with Cross-cutting Committees, Response Teams and Special Projects. Thus, most of the working structure that has proved useful in recent cycles is maintained, but increased to meet new needs for PIARC's response to specific issues.

This structure has been crafted through a highly participative process based on a broad stakeholder consultation including First Delegates, National Committees, Technical Bodies (Technical Committees, Task Groups and Regional Working Groups) as well as external stakeholders. The novelty of this cycle has been to involve, from an earlier date, the new Technical Bodies in charge of developing the Strategic Plan, as well as to increase flexibility through updates to the Plan in its structure and content.

A great response has been obtained, on one hand due to the number of responses and on the other hand thanks to the quality of the information provided. This clearly shows the high interest of all these stakeholders in the activities of the World Road Association and their expectation for the Association keep on improving and providing an effective knowledge transfer.

Some challenges for crafting the Plan of Activities have been:

- Incorporate and balance the needs of LMICs as well as those of HLICs, since the Association has a large number of members with different needs and the challenge of meet the needs of all of them must be faced.
- Incorporate and balance emerging issues and those that are traditional in the road sector but in which improvements and going forward is always required.
- Incorporate issues, such as innovation, climate change, safety and resilience of road infrastructure as cross-cutting issues.

The Plan of Activities meets the goals pursued for the 2020-2023 Strategic Plan, which are:

- Increase flexibility to attend PIARC members' needs in a quick changing world. The impact of the Covid-19 pandemic, or a similar crisis, is a clear example of an emerging issue that has been incorporated into the Strategic Plan by updating it.
- Produce more useful and frequent outcomes to give more visibility to PIARC, and to make it more relevant.
- Improve quality of outcomes, so that PIARC continues to be recognized for producing valuable road related products for decision makers and users.
- Ensure a diversified and value-added production of outcomes to improve the Association's portfolio and extend its scope to a wider audience.
- Encourage greater collaboration among Technical Bodies to achieve a more integral and interconnected knowledge.

As well as the operational goals for the Association, such as:

- Preserve the prominence of the World Road Congress and therefore the 4-years cycle.
- Enhance the scope of the International Winter Road Congress by adding the theme of road resilience.
- Increase the technical members' involvement and overcome gender and diversity issues.
- Increase efficiency of processes and procedures.
- Ensure an effective transfer of Knowledge and processes between cycles, building on what has already been achieved and avoiding reoccurrence.
- Broadening the dissemination of PIARC activities.

Taking into consideration these goals, the Plan of Activities is organized through four Strategic Themes:

- ST1. Road Administration.
- ST2. Mobility.
- ST3. Safety and Sustainability.
- ST4. Resilient Infrastructure.

Within these themes are 17 Technical Committees and 6 Task Forces plus the Cross-cutting Committees on Terminology and Roads Statistics Committees and the PIARC Covid-19 Response Team.

Strategic Theme 1 Road Administration	Strategic Theme 2 Mobility	Strategic Theme 3 Safety and Sustainability	Strategic Theme 4 Resilient Infrastructure
TECHNICAL COMMITTEES			
TC 1.1 Performance of Transport Administrations	TC 2.1 Mobility in Urban Areas	TC 3.1 Road Safety	TC 4.1 Pavements
TC 1.2 Planning Road Infrastructure and Transport to Economic and Social Development	TC 2.2 Accessibility and Mobility in Rural Areas	TC 3.2 Winter Service	TC 4.2 Bridges
TC 1.3 Finance and Procurement	TC 2.3 Freight	TC 3.3 Asset Management	TC 4.3 Earthworks
TC 1.4 Climate change and resilience of Road Network	TC 2.4 Road Network Operation/ITS	TC 3.4 Environmental Sustainability in Road Infrastructure and Transport	TC 4.4 Tunnels
TC 1.5 Disaster management			
CROSS-CUTTING COMMITEES			
Terminology Committee			
Road Statistics Committee			
RESPONSE TEAMS			
PIARC Covid-19 Response Team			
TASK FORCES			
TF 1.1 Well-Prepared Projects	TF 2.1 New mobility and its impact on road infrastructure and Transport	TF 3.1 Road Infrastructure and Transport Security	TF 4.1 Road Design Standards
TF 1.2 HDM-4	TF 2.2 Electric Road Systems		

In addition to this, the Task Force B.2 “Automated vehicles – challenges and opportunities for road operators and authorities”, that was launch at the end of the last cycle, has been functioning during the beginning of 2020.

TF 1.1 Well-Prepared Projects and TF 3.1 Road Infrastructure and Transport Security were launched at the beginning of the cycle. By the end of 2020, two additional task forces, TF 2.2 Electric Road Systems and TF 4.1 Road Design Standards, are expected to be launched. The rest will be launched during the cycle, in order to be distributed throughout it, according with the goal of flexibility and the principle of reasonable use of resources. All this without prejudice to the new Tasks Forces that could arise during that period, according to the updates of the Strategic Plan.

Regional Working Groups are defined within the framework of relationships between the Association and Regional Organizations.

DEFINITION OF ACTIVITIES

The Terms of Reference of Technical Bodies define the activities to be carried out, setting different intermediate deadlines and different types of outcomes that allow the development of proposed topics throughout the 4-year work cycle. Besides, it will be able to be reviewed according with the update of the Plan and even adapted to the circumstances at any time. Second Update, from October 2020, is included in this document.

This Second Update of the Strategic Plan, which also includes the incorporation of two new Special Projects to be developed during 2021, has taken into account the impact of such a disruptive element as the crisis caused by the COVID-19 pandemic. This pandemic is a global health and social emergency that requires effective, supportive and immediate action. In this sense, road transport, being an essential service to maintain the movement of workers, goods, supplies and key services, has to remain operational. Moreover, COVID-19 and its effects are expected to last for some time and have medium and long-term consequences for administrations and agencies in the road and road transport sector.

The impact of a crisis such as Covid-19 pandemic is addressed in all Technical Committees and Task Forces dealing with issues that may be affected. The current definition of the Terms of Reference for the Technical Committees and Task Forces, with the exception of Technical Committee 2.3 Freight, allows the impact of Covid-19 to be addressed without adaptation. These are:

TC 1.1 Performance of Transport Administration
TC 1.2 Planning Road Infrastructure and Transport to Economic and Social Development
TC 1.3 Finance and Procurement
TC 1.4 Climate Change and Resilience of Road Network
TC 1.5 Disaster Management
TC 2.1 Mobility in Urban Areas
TC 2.2 Accesibility and Mobility in Rural Areas
TC 2.4 Road Network Operation/ITS
TC 3.1 Road Safety
TC 3.2 Winter Service
TC 3.3 Asset Management
TF 3.1 Road Infrastructure and Transport Security
TC 4.4 Tunnels

In addition this important issue will be addressed in a holistic and comprehensive manner, through a Response Team, the PIARC Covid-19 Response Team (CRT). The CRT organizes a rapid sharing knowledge of the impacts of and responses to the pandemic and the economic and social crisis it has caused, proposes and implements specific short-term actions, tracks the course of the

pandemic and studies medium and long-term implications of the pandemic among PIARC members and even external stakeholders.

The CRT will work in coordination with the Technical Committes and Task Forces. Specific actions will be carried out by the CRT to address the issue of freight transport with the impact of Covid-19, in collaboration with the TC. 2.3 Freight transport.

In this way, the impact of COVID-19 will be addressed both individually by topics while having a general overview.

The topics to develop by each Technical Committee, Task Force, Cross-cutting Committee, Response Team and Special Project defined so far, are summarized hereinafter, and a full description of the Terms of Reference is included afterward.

In addition, there is the valuable contribution of each Technical Committee,Task Force, Cross-cutting Committee and Response Team in the preparation and development of the World Road Congress and some of them of the World Winter Service and Road Resilience Congress , as well as organizing Seminars in LMICs and other activities such as Conferences and Workshops in HICs, articles for the Routes/Roads Magazine,... to be decided by the technical bodies itself for a greater dissemination of its results.

Strategic Theme 1 – Road Administration

The external operating context related to road infrastructure and road transport is constantly evolving in response to large social, economic, and environmental shifts. This affects the financing and risk managing for the construction, rehabilitation, and maintenance of road assets that are priorities in transportation, since some times the public-sector budgets are not enough to meet future funding requirements. In addition, safety and security in road systems, technological advances, data-driven and digitalization of road infrastructure, as well as resilience to climate change and extreme weather events are challenged issues that all Road Administrations are facing.

This external context meets with the Strategic Theme 1 to study "Road Administration" developing five Technical Committees and two Task Forces.

The main objective is to analyze how Road Administrations are addressing these issues for a better performance, an accurate planning of road infrastructure and transport to enhance economic and social development, obtaining the necessary funding for construction and maintenance of road networks, increasing resilience to climate change and the disaster management.

This objective takes into account the impact of the Covid-19 pandemic, since the issues addressed will be affected by this pandemic and therefore, it is something to take into account within this Strategic Theme.

TC 1.1 Performance of Transport Administrations

This TC focuses on identifying best practices for establishing a framework for measuring the efficiency and effectiveness of Transport Administrations, including the establishment of assessment indicators/evaluation indexes (benchmarking) that can be used to recognize opportunities for improving the overall performance of transport administrations, with a particular focus on overall customer experience and communication of performance information. All this, taking into account the impact of the sharing economy and other disruptive technologies on the performance of Transport Administrations.

In addition, TC analyzes effective approaches for defining and promoting diversity in opportunity across the roads and transportation sectors, as well as how to attract new employees into the transport industry/profession, specially, young professionals.

TC 1.2 Planning Road Infrastructure and Transport to Economic and Social Development

One of the aims of this TC is to analyze the role of innovation in road planning. Other objectives are to analyze the area of transport studies and traffic models applied to freight transport, bimodal and multimodal, including the metropolitan context; and to review new approaches to the study of mobility of people and freight, based on the Internet, big data and other innovative sources of information.

Within the concept of sustainability in transport network planning - also related to accessibility and equity-, one aspect that is analyzed is public health, probably included in the objective of "identifying, investigating and documenting the social value of transport". For this activity, the TC advances both in the analysis of impact analysis techniques and in the identification of best practices in ex-post project evaluation. With all this, it will deepen in the relationship between transport investments and economic growth.

TC 1.3 Finance and Procurement

Obtaining sufficient funding for road infrastructure construction and maintenance remain a key challenge for roads authorities globally. In addition, likely there will be an impact of new propulsion techniques on funding that should be considered. One of the aim of this TC is to analyze traditional funding and financing options and explore for developing innovative and hybrid solutions, addressing especially the needs and circumstances of LMIC’s.

Other TC's aim is to develop fundamental criteria that will govern procurement practices internationally through the evaluation of current processes and techniques. These overarching principles would form the basis of procurement guidelines for agencies.

TC 1.4 Climate change and resilience of Road

Road owners and operators are required to manage a very broad spectrum of threats in the future. The aims of this TC are to identify hazards and environmental threats within the context of road infrastructure resilience, in consultation with other relevant TC's, and to asses several approaches to increase resilience –taking into account the economic, environmental and social aspects of resilience management-

TC will update the PIARC Climate Change Adaptation Framework with the integration of best-practice case studies within an approach to resilience from climate change.

TC 1.5 Disaster management

Developing a reliable information collection and sharing system is the first step of proactive disaster management toward engaging with internal and external stakeholders and understanding their information needs and expectations. The aims of TC are to study disaster management techniques using Big Data and Social Network Data as well as to analyze the financial aspect of disaster management in preparedness, mitigation response, and recovery phase, and to update the Disaster Management Manual.

TF 1.1 Well-Prepared projects

A good preparation of infrastructure projects is of utmost importance to secure their proper financing, wide acceptance and seamless implementation.

The aims of this TF are to review literature and existing project preparation software and analyze good practices of project management for improving and optimizing public and private investment, as well as to define strategies to accelerate project delivery and reduce project lifecycle costs. It will also facilitate to identify how well-prepared projects contribute to a culture of transparency and accountability.

TF 1.2 HDM-4

This task force will be launched later during the cycle.

Strategic Theme 1. Road Administration	
Technical Committee 1.1 - Performance of Transport Administrations	
1.1.1	Understanding how Road and Transport Administrations are measuring the efficiency and effectiveness of Customer Experience and Public Value Creation
1.1.2	The Role of Transport Agencies in Shaping Disruptive Technology and Service Models
1.1.3	Organization of Staff and Human Resources
Technical Committee 1.2 – Planning Road Infrastructure and Transport to Economic and Social Development	
1.2.1	Transport modeling and forecasting for preparing econometric analyses
1.2.2	Implementation of sustainable mobility plans
1.2.3	Economic and social contribution of road transport system
Technical Committee 1.3 – Finance and Procurement	
1.3.1	Best practices in funding and financing of road infrastructure
1.3.2	Impact of new propulsion techniques on funding
1.3.3	Harmonization of procurement
Technical Committee 1.4 – Climate Change and Resilience of Road Network	
1.4.1	Uniform and holistic methodological approaches to Climate Change and other hazards resilience
1.4.2	Update of the PIARC International Climate Change Adaptation Framework for Road Infrastructure
Technical Committee 1.5 – Disaster Management	
1.5.1	Information and communication in disaster management
1.5.2	Financial aspects of disaster management
1.5.3	Update the Disaster Management Manual
Task Force 1.1 – Well-Prepared Projects	
1.1.1	Well-prepared projects
Task Force 1.2 – HDM-4	
	To be defined during the cycle

Strategic Theme 2 – Mobility

Roads and transportation services delivered by roads are, besides other transportation services a key element of mobility policies. Mobility policies take now into account multimodality to optimize the use of transportation assets, but mobility policies are not an end by themselves. They contribute to broader goals for communities (cities, rural communities, regions and countries) such as providing a good quality of life, welfare, social equity, or a better environment. Indeed, broader goals for communities depends on the level of development of countries, cultures, types of communities (rural or cities), or size of those communities (local or regional).

Mobility policies are facing increasing challenges such as: Climate Change and the need of decarbonizing our transport services, road construction, road maintenance, but also the need to provide more resilient services; lack of public space, congestion and health impacts in urban areas; lack of roads and transportation services and, as a result social exclusion in rural areas; overloaded trucks, poor vehicle conditions, driver fatigue and speeding in road freight transport, and related safety problems especially in LMIC's.; new mobility services which are disrupting the existing transportation ecosystems; how to implement the potential of digitalization, or data driven solutions which offer new possibilities of optimization of road operations and services; and lack of public funds.to maintain and modernize our assets, or to finance new infrastructures

Broader goals for communities are changing because people behaviors are evolving (circular economy, share economy, etc.). Furthermore, they will probably change after the Covid-19 pandemic. Many questions are open, but we can imagine some long term effects such as boundaries between home and work, or between home and purchase might change thanks to the new technologies (remote working, etc.). The severe economic crisis will make the lack of public funds more acute. The pandemic may also affect international trade and thus goods transport systems.

The goal of this Strategic Theme is to provide good knowledge and some sustainable answers to all communities in the fields of people mobility and goods transportation, taking into account what follows: challenges for mobility policies mentioned above, the opportunity of new technologies, and the increasing need to have a good alignment between mobility policies and the broader goals of communities, in a context where those goals are changing.

This external context meets with the Strategic Theme 2 to study "Mobility" developing four Technical Committees and two Task Forces.

TC 2.1 Mobility in Urban Areas

Cities deliver a lot of services (jobs, education, culture, hospitals, …) not only for citizens, but also for rural communities around the cities. This TC focuses on inhabitant's mobility needs in the commuting areas in order to make sure that all transportation needs in relation with the services delivered by cities will be taken into consideration. It will take into account the complexity of urban areas (integration with land planning, multimodality, public support, new mobility modes).

TC 2.2 Accessibility and Mobility in Rural Areas

Rural areas provide goods, industries, and workforce for all communities, and roads are the most important way to exchange goods and services. This TC focuses on accessibility in rural areas and on mobility needs in coordination with T.C 2.1. Road networks in rural areas are very extensive compared to the low density of population, and as a result it is difficult to finance the construction and the maintenance of those networks and the safety conditions are generally poor. Therefore, this TC also focuses on improving road safety and technical solutions for paved and unpaved roads in rural areas.

TC 2.3 Freight

This TC focuses on vehicles overloading and its related consequences. Road freight transport is heavily depending on fossil fuel and this TC will also investigate the strategies and measures to reduce greenhouse gas emissions of road freight transport. It will take into account the potential of new technologies onto logistics and transport services of goods.

TC 2.4 Road Network Operation / ITS

Road network capacity is not fully utilized, as traffic demand is concentrated on only small sections of the road network. This TC focuses on how new mobility, new technologies and digitalization are incorporated to Road Network Operation. This T.C investigates the concept Mobility as a Service (MaaS). It will also update the RNO / ITS Manual.

Besides, almost all TC are dealing with common topics such as mobility of people between urban and rural areas, or data-driven solutions.

TF 2.1 New Mobility and its impact on Road Infrastructure and Transport

This task force will be launched later during the cycle.

TF 2.2 Electric Road Systems

There is a need for decarbonizing the road transport all over the world both for freight and passengers. ERS is one possible solution for diminishing the carbon footprint. This TF plays a leading role in exchanging knowledge and experience in ERS globally, addressing as well road operation, road safety, road maintenance and cyber security aspects.

Strategic Theme 2. Mobility	
Technical Committee 2.1 – Mobility in Urban Areas	
2.1.1	Accessibility and mobility facing land use in urban and peri-urban development
2.1.2	Integrated transportation systems, multimodality
2.1.3	Evaluating impacts of new mobility in urban and peri-urban areas
Technical Committee 2.2 – Accessibility and Mobility in Rural Areas	
2.2.1	Accessibility and mobility in rural areas
2.2.2	Improving road safety in rural areas
2.2.3	Technical solutions for paved and unpaved roads
Technical Committee 2.3 – Freight	
2.3.1	Best practices, monitoring and regulation to reduce overloading and associated infrastructuredamage on road networks
2.3.2	Greening of freight transport
2.3.3	Application of emerging technologies on freight transport and logistics
Technical Committee 2.4 – Road Network Operation/ITS	
2.4.1	Opportunities of new mobility forms for road network operation
2.4.2	Optimizing road network operation decision-making through new technologies and digitalization
2.4.3	Sharing RNO & ITS knowledge through PIARC dedicated online resource
Task Force 2.1 – New Mobility and its impact on road Infrastructure and Transport	
2.1.1	*To be defined during the cycle*
Task Force 2.2 – Electric Road Systems (ERS)	
2.2.1	Electric Road Systems (ERS)

Strategic Theme 3 – Safety and Sustainability

Nowadays, there is a growing awareness worldwide that the strategy and policies, which are formulated by road administrators and transport-related organizations, enhance safety and security in road systems during the design, construction, and operation of road infrastructure. This environment steers them to producing practical solutions to improve road safety with further developed technologies and to raise awareness of cybersecurity for strengthening road and transportation security.

Pursuing the efficient road operation especially in winter service, optimizing the maintenance cost of road assets, and contributing to the sustainable environment are also essential for road administrators and transport-related organizations to manage road infrastructure successfully.

This external context meets with the Strategic Theme 3 to study "Safety and Sustainability," developing four Technical Committees and one Task Force.

Here, the issues of road safety, winter service, asset management, environmental sustainability, and security are featured, since they involve practical and pressing issues for road administrators to confront. The Strategic Theme 3 aims at comprehensively enhancing road management capacity in terms of operational, financial, and environmental perspectives, taking into account the impact of crisis such as the Covid-19 pandemic. At the heart of the Strategic Theme 3 is demonstrating the appropriate direction for these issues with the past achievements and the development/introduction of new technologies.

TC 3.1 Road Safety

Road Safety committee observes a fact that ninety percent of traffic deaths occur in LMICs, and then assesses and identifies the best practice of road safety activities for LMICs. This T.C also explores proven countermeasures that are effective in reducing the likelihood and severity of crashes at a given location. Remarkably, "Road Safety Manual" and "Road Safety Audit Guideline" are to be updated, pursuing efforts to disseminate and encourage the application of these manuals. T.C plays a fundamental role in providing access to well-chosen safety measures and its dissemination among LMICs.

TC 3.2 Winter Service

This TC focuses on road networks particularly vulnerable to the winter weather. Maintaining acceptable levels of winter service remains a challenging issue amid the struggle with snow and ice on roads. In-depth research on extensive use of new technologies provides a practical approach and application to winter service. Case studies and the major findings of winter maintenance from various countries are expected to form the basis of updating "Snow and Ice Data Book," and winter service in urban areas and the implication of connected and automated vehicles on winter service are investigated as well. It should be noted that T.C is actively engaged in preparing the technical program for the 2022 "World Winter Service and Road Resilience Congress" in Calgary, Canada.

TC 3.3 Asset Management

Asset Management committee develops, implements, and integrates an asset management framework based on ISO 55001 so that road organizations manage their performance, risks, and costs more effectively and efficiently. The results of the study will bring a guideline for implementing the asset management system. Notably, a web-based asset management manual will be updated through the survey among HMLICs. Extensive efforts are made to explore not only asset management but also the resilience of road networks and renewal and rejuvenation of aging infrastructure.

TC 3.4 Environmental Sustainability in Road Infrastructure and Transport

This TC identifies traffic operations to minimize the health impact of vehicle emissions, and improvement of pavement design, construction, and maintenance to reduce traffic noise. Also, understanding the road and road transport impact on wildlife habitats and their interconnections is essential for road construction to be implemented in the area affluent with natural environment. T.C carefully considers environmental sustainability, and diligently presents how road organizations commit to restraining air pollution and traffic noise, and the impact on wildlife habitats.

TF 3.1 Road Infrastructure and Transport Security

Road Infrastructure and Transport Security task force forges links with the relevant sectors to assemble knowledge of transportation security issues and their contribution to system resiliency. With the increasing use of cyber-physical systems in monitoring and management, more disciplines involved in the lifecycle of road assets need to have an understanding and appreciation of the security issues that arise. T.F will provide road infrastructure specialists with high-level guidance on embedding security and security-mindedness so that the number and severity of security incidents decrease throughout the lifecycles of the road assets.

Strategic Theme 3. Safety and Sustainability	
Technical Committee 3.1 – Road Safety	
3.1.1	Specific road safety issues for LMICs
3.1.2	Implementation of proven countermeasures
3.1.3	Update Road Safety Audit Guidelines
3.1.4	Implications of connected and automated vehicles
3.1.5	Update of the Road Safety Manual
Technical Committee 3.2 – Winter Service	
3.2.1	Integration of the new technologies in winter services
3.2.2	Winter maintenance in urban areas
3.2.3	Implications of connected and automated vehicles on winter services
3.2.4	Update of the Snow and Ice Data Book
3.2.5	Preparation of the 2022 World Winter Service and Road Resilience Congress (8th to 12th February 2022)
Technical Committee 3.3 – Asset Management	
3.3.1	Innovative approaches for asset management systems
3.3.2	Measures for improving resilience of road network
3.3.3	Renewal and rejuvenation of aging infrastructure
3.3.4	Update of the Asset Management Manual
Technical Committee 3.4 – Environmental Sustainability in Road Infrastructure and Transport	
3.4.1	Real-time evaluation of pollution and mitigation measures
3.4.2	Noise mitigation
3.4.3	Road and road transport impact in wildlife habitats and their interconnections
Task Force 3.1 – Road Infrastructure and Transport Security	
3.1.1	Embedding security into other infrastructure / transport-related topics

Strategic Theme 4 – Resilient Infrastructure

Roads are important, and in some cases even critical, infrastructures that make an important contribution to the social and economic well-being of the society. In this context, ensuring the availability, safety and reliability of road transport infrastructure is crucial. This should include, in addition to normal operation, in particular planning, preparation, response and rehabilitation in the event of unplanned and unforeseen natural or other events, and also includes the safe operation of road networks in the event of events that may have an indirect impact on availability and reliable operation, such as pandemics or black swan events.

Against this background, owners and operators of roads are required to proactively manage risks for the infrastructure itself and its users. This poses the challenge of assessing all existing threats and, if necessary, taking measures to ensure availability as far as possible under all conditions.

Based on the above mentioned challenges, the Strategic Theme 4 "Resilient Infrastructure" addresses topics such as: technologies and innovations, design and construction, safety, preservation, sustainability, resilience, as well as, standardization, developing four Technical Committees and one Task Force.

Due to their special and overarching importance, innovation and resilience have been identified as cross-cutting issues within the Strategic Plan 2020-2023.

Overall, in selecting the topics for the Strategic Theme 4 Resilient Infrastructure, importance was given to achieving a good balance between more traditional topics, such as construction materials and methods including sustainability aspects, infrastructure management, operation and user safety, and more innovative topics such as resilience, new technologies as well as challenges and opportunities arising from the rapidly advancing digital transformation.

TC 4.1 Pavements

This TC focuses not only on topics relating to innovative methods and procedures for maintenance, including the identification of solutions for maintaining the availability during the execution of maintenance measures as well as the future use of data-driven approaches for the monitoring of pavements, but also on aspects of sustainability (recycling and carbon footprint). Issues related to the improvement of the resilience of pavements are also addressed within a specific topic.

TC 4.2 Bridges

The subject of resilience also plays a major role in the field of Bridges. Here, the focus is on questions of adaptation to the consequences of climate change and on improving the resilience of bridges in the case of seismic events. In addition, TC will work on the further development of procedures and methods for bridge inspections and the implementation of these new technologies within bridge management systems. Lessons learnt from forensic engineering of bridge collapses will also be considered. Additionally, the use of innovative construction materials for the repair of ageing bridges will be addressed.

TC 4.3 Earthworks

In addition to questions concerning the improvement of the resilience of earth structures to natural hazards, this TC focuses in particular on the identification of technologies and innovations in their construction and maintenance. The knowledge gained within the framework of this work will then also be incorporated into the further development of the Earth Work Manual, which will be made available in an updated and expanded version.

TC 4.4 Tunnels

As with the TCs mentioned above, the subject of resilience will also be dealt with in a separate issue in this TC, where both the construction and maintenance as well as the future use of data-driven approaches for preventive and/or predictive maintenance are addressed. Operating and ensuring

the safety of users is a major challenge for owners and operators of road tunnels. Therefore, best practice approaches and successful solutions for the safe operation of heavily traffic urban tunnels as well as the impact of new propulsion technologies on tunnel operation and safety will be investigated. Further work of TC will address ITS applications for tunnels including the identification of the potential of big data and data analytics applications for the operation of road tunnels as well as the update and improvement of the DG-QRAM risk assessment software for the transport of dangerous goods in tunnels. The results of the work will then also be incorporated into the further development of the Road Tunnels Manual.

TF 4.1 Road Design Standards

In view of the importance of guidelines and standards in the field of road infrastructure, this TF focuses on collecting these standards from several countries and analyzing analogies and differences, taking into account the type of road. This TF will also analyze the current reliability of geometric models addressing the new mobility - new propulsion techniques and connected and autonomous driving - as well as will investigate the use of new tools such as Big Data to reconsider design parameters and models based on road user`s behavior.

Strategic Theme 4. Resilient Infrastructure	
Technical Committee 4.1 – Pavements	
4.1.1	Use of Recycled Materials in Pavements
4.1.2	Innovative pavement maintenance and repair strategies
4.1.3	Road monitoring and management based on Big Data and Data Analytics
4.1.4	Measures for improving resilience of pavements
4.1.5	Carbon footprint
4.1.6	9th Symposium on Pavements Surface Characteristics (SURF 2022)
Technical Committee 4.2 – Bridges	
4.2.1	Measures for increasing adaptability to Climate Change
4.2.2	Forensic engineering for structural failures
4.2.3	Advancement of inspection techniques / technologies and bridge management systems
4.2.4	New rehabilitation materials and technologies
4.2.5	Bridges damage-resilient in seismic areas
Technical Committee 4.3 – Earthworks	
4.3.1	Measures for increasing resilience of Earth Structures to natural hazards
4.3.2	Techniques and innovation in earthworks
4.3.3	Earthworks Manual
Technical Committee 4.4 – Tunnels	
4.4.1	Measures for increasing resilience of tunnels
4.4.2	Best practices in management (maintenance and traffic operation) particularly of urban and heavily trafficked tunnels traffic tunnels
4.4.3	Impact of new propulsion technologies on road tunnel operations and safety
4.4.4	Intelligent Transportation Systems in tunnels
4.4.5	Update of the Tunnels Manual
4.4.6	Preparation of the 2nd International Conference on Tunnels
4.4.7	Support for updating and improving of DG-QRAM
Task Force 4.1 - Road Design Standards	
4.4.1	Road Design Standards

STRATEGIC THEME 1 – ROAD ADMINISTRATION

TECHNICAL COMMITTEE 1.1 – PERFORMANCE OF TRANSPORT ADMINISTRATION

1.1.1. Understanding how Road and Transport Administrations are measuring the efficiency and effectiveness of Customer Experience and Public Value Creation

Strategies / Objectives
• Define and create an understanding of customer experience and public value creation as it applies to road and transport administrations building on the work carried out in cycle 2016-2019 by T.C.A.1 – Performance of Transport Administrations. • Identify existing frameworks within road and transport administrations that are aimed at delivering an improved experience for all our customers and stakeholders. • Identify current practices, methodologies and approaches to measurement aimed at delivering improved customer experience and insights that contribute to better operational and strategic outcomes. • Determine how community insights can assist with customer facing levels of service within the context of asset management. • Encourage coordination with other TCs and TFs, such as *T.C.3.3 – Asset Management.*

Implementation of Performance Management is at various degrees of adoption throughout the world. Some countries have been working on this issue for some time and continue to advance the implementation of Performance Management including the codification of infrastructure related performance measures in law. At the same time other countries are still lagging in the implementation of an even basic framework of organizational and performance management.

The *Technical Committee A.1 – Performance of Transport Administrations (SP 2016-2019)* and its predecessors have done quite a bit of work on the identification of good practices for performance frameworks and indicators for the road sector.

This cycle should look into updating and providing a more in-depth analysis of the work that was done in previous cycles, concentrating on identifying best practices for establishing a framework for measuring the efficiency and effectiveness of Transport Administrations, including the establishment of assessment indicators/evaluation indexes (benchmarking) that can be used to recognize opportunities for improving the overall performance of transport administrations, with a particular focus on overall customer experience and communication of performance information.

In this Cycle, two reports are expected to be completed. One on current practice and methodology of current practices on improved customer experience, and the other one, on good practice aimed at improved customer experience and public value creation.

Outputs	Expected Deadlines
• Report on current practice and methodology of current practices on improved customer experience	• December 2021
• Report on good practice aimed at improved customer experience and public value creation	• December 2022

1.1.2. The Role of Transport Agencies in Shaping Disruptive Technology and Service Models

Strategies / Objectives
• Define the role, responses, required and actual transformation of Transport agencies in the face of so-called disruptive technologies and associated ownership and service models. • Technologies and models within scope include, but are not confined to, automated and electric vehicles, smart highways, personalized journey management, transport brokerage, micro-mobility and autonomous aerial vehicles, as well as the data, communication and other enablers associated with them. • Put this analysis in the context of following up the work carried out by T.C.A.1 – Performance of Transport Administrations during 2016 – 2019 on change management and its identification of new technologies and business models as major change drivers on transport agencies in policy and organizational terms. • Encourage coordination with other TCs and TFs, such as with *T.C. 2.1 – Mobility in Urban Areas, T.C.2.4 – Road Network Operation/ITS, T.F.B.2 – Automated vehicles – challenges and opportunities for road operators and authorities, T.F. 2.1 – New mobility and its impact on Road Infrastructure and Transport, T.C.3.3 – Asset Management* and *T.F.3.1 – Road Infrastructure and Transport Security*. • Encourage coordination with NCHRP Project Number: 08-127 / B-12 Emerging Issues: Impact of New Disruptive Technologies on the Performance of DOTs.

The combination of the new sharing economy model and new disruptive and innovative technologies such as connected and autonomous vehicles (CAV), on-demand ride sharing services, Mobility as a Service (MaaS), etc., will continue to drastically alter the landscape of how people view mobility, how they travel, how freight moves, and what their overall travel behavior and expectations are. The power of new technologies to connect us to one another and the emergence of sharing platforms is forcing transport industries to re-evaluate their current business-models.

The new paradigm even has the potential to redefine what constitutes our transportation network. This will require organizations that are currently narrow-focused on the “traditional” road infrastructure to adapt to the new paradigm if they are to provide the required services to their customers.

Taking into consideration that the “Sharing Economy” and “Disruptive Technologies” are subtlety different things, the Strategic Plan could provide the option of looking at “The impact of the Sharing Economy and Other Disruptive Technologies on the Performance of Transport Administrations” either separately (Impact of Sharing Economy & Impact of Disruptive Technologies) or under one umbrella.

It is also important to separate the strategy and policy issues from the technological issues. The work of this cycle should focus on the strategy and policy issues associated with these topics and not the technology and technical aspects of each one (as for example in the case of CAV’s where a separate Technical Committee is looking at the technology issues).

T.C. A.1 drafted a report focused on Change Management and outside forces of change for a Transport Administration. Therefore, this Issue would be an ideal follow up to that work as emerging and disruptive technologies are part of the outside forces of change that Transport Administrations are facing. It means to investigate about the role and required transformation of Transport Administrations in the face of sharing economy, emerging technologies, and Transport as a Service (TaaS) - focusing on the here and now and immediate future in this rapidly evolving field.

In addition, earlier in 2018, T.C. A.1 worked with AASHTO’s Committee on Performance Based Management (CPBM) and TRB’s ABC30 Committee on Performance Management on the

submission of a research proposal to NCHRP on the Impact of Emerging Technologies to the Performance of Transport Administrations. While AASHTO and TRB will be taking the lead on that research proposal, T.C 1.1 could leverage the information coming out of the research to advance this topic.

In this Cycle, a full report is expected to be completed. Prior thereto, it would be interesting to schedule round table discussions as part of each T.C. 1.1 meeting with host country.

Outputs	Expected Deadlines
• Glossary and terminology of disruptive technologies, ownership and service models	• December 2020
• Case studies of emerging policy, regulatory and organisational approaches	• December 2021
• Recommendations on organizational responses to dynamic change in technology, ownership and service models	• June 2022
• Round table discussions as part of each *T.C 1.1* meeting with host country	• Up to June 2022
• Full report	• October 2022

1.1.3. Organization of Staff and Human Resources

Strategies / Objectives
• Identify, investigate and document organizational issues of Staff and effective approaches for defining and promoting diversity and equity in opportunity of Human Resources within Transport Administrations. • Effective approaches for recruiting and retaining new talent in Transport Administrations. • Identify, investigate and document participation within Transport Administrations. • Encourage coordination with other TCs and TFs, such as with *T.C. 1.2 – Planning Road Infrastructure and Transport to Economic and Social Development* and *T.F.3.1 – Road Infrastructure and Transport Security.*

Organizations across the World are increasingly concerned with matters of diversity, whether it be focused on gender, ethnicity, culture, disability, age, religion, political ideas or ideology, income or other factors perceived to represent disadvantage in achieving personal and community opportunities. The roads and transportation sector are no exception to this.

There are arguments for transport administrations to focus on, and reflect, all sections of society within their customer base, as well as mirroring this base within their own management structures and workforces. Approaches include positive discrimination, the setting of targets for recruitment or career progression, professional networks, publicity around role models or selective support for educational or training opportunities.

T.C. 1.1 should analyze effective approaches for defining and promoting diversity in opportunity across the roads and transportation sectors. Other important issue to investigate is how to attract new employees into the transport industry/profession, specially, young professionals.

It would be advisable to look at holding the Roundtable/Conference as part of the TRB Conference in January 2022 and organize a foresight session on this issues in the World Road Congress in 2023. In this Cycle, a full report is expected to be completed. Prior thereto, it would be interesting to schedule round table discussions as part of each T.C. 1.1 meeting with host country.

Outputs	Expected Deadlines
• Round table discussions as part of each TC 1.1 meeting with host country	• Up to December 2022
• Full report	• December 2022

TECHNICAL COMMITTEE 1.2 – PLANNING ROAD INFRASTRUCTURE AND TRANSPORT TO ECONOMIC AND SOCIAL DEVELOPMENT

1.2.1. Transport modeling and forecasting for preparing econometric analyses

Strategies / Objectives
• Application of technological innovation in road planning. • Analyze the accessibility and quality of the data for econometric analyses and transport modeling, in particular of the freight transport data. • Investigate innovative techniques of approach to the movements of people and goods based on big data. • Encourage coordination with other TCs and TFs, such as *T.C. 2.3 – Freight*, *T.C.2.4 – Road Network Operation/ITS* and *T.C.– Road Statistics.*

Transport modelling and traffic forecasting is the backbone of road planning and road investment decision. The sector is experiencing a fast evolution due to the recourse of innovation in many areas of research and application to the planning procedures of the Road Agencies or Administrations. The ToR identify tree different areas of development common to most of the Road Administrations worldwide:

- The role of innovation in a broad sense with respect to road planning
- The area of transport studies and traffic models applied to freight transport, bi-modal and multimodal transport, including the metropolitan context
- The new approaches to the study of the mobility of people and goods, based on internet, big data and other innovative sources of information

Technological innovation in transport planning and analyzing

The starting point of this activity will be the identification of the major trends that generate an impact on the Road Administrations, from different point of view: a possible tool for this activity will be the use of the PESTEL methodology, a validated methodology which showed to be useful in practice for some Road Administrations in Europe as well as by a Task Group of CEDR (Conference of European Road Directors). It is based on the description of a framework of five macro-dimensions or factors used in the strategic management: Political, Economic, Social, Technological, Environmental and Legal. The PESTEL framework will be used to identify the major trends impacting on individual and commercial mobility: for instance, the following emerging trend of the Social dimensions may be considered: urbanization, demography, new mobility needs and modes, attitude towards safety, participatory instruments to include the major stakeholders, increasing attention towards regulation.

The same scanning will be carried on for the 6 dimensions, by putting together the experience and the expectations of the different PIARC TC members, The aim of this preliminary activity will be to understand which are the challenges/needs expressed by the community vis-à-vis the competences and the attributions of the Road Administrations, i.e. the external factor that affect the planning activity of the Agency/Administration.

Even though not all the above described social trends are clear expression of technology or innovation, the aim of the TC is to identify opportunities and constraints related to a changing environment for the road construction and road management public entities.

In addition to the PESTEL preliminary analysis, a survey of some benchmarks among Road Administrations with respect to innovation (in the broad sense of emerging trends and new tools, techniques and opportunities) will be carried out. In many agencies an Innovation Plan has been published and some results of this activity are already available for analysis and comparison. The

results of this activities will be the state of the art of innovative tools for road plans, transport analyses and transport investment appraisal.

The legacy of the previous PIARC cycle is the set of studies related to ex-post evaluation of road project, carried out by the T.C. A.2 on this subject.

Transport studies and traffic models applied to freight transport, bi-modal and multimodal transport

Logistics is a key part of transport planning in any economy, regardless of its degree of development or volume of transferred goods.

Innovation is important for freight traffic for several reasons. First, the adoption of toll collection schemes for heavy vehicles and the policies of internalization of environmental effects of this type of traffic is common in many parts of the world, especially in Europe; these schemes are based on a high level of technology (based on different dialogues, vehicle-road, vehicle-vehicle and road-road). Second, the safety goals associated to road traffic implies a wide use of devices and tools to detect possible dangers to the users. Third, e-commerce is generating relevant flows of traffic based on a chain that involves many segments and players. These three factors imply the need of an NRA to plan and operate successful policies to rationalize the traffic flow of goods in the different contexts of the road network.

The heritage from the previous 2016-2019 PIARC cycle is the study of time reliability in transport studies, both in terms of the role of this factor in the project assessment process and of the metrics to embody it into the cost benefit analysis schemes. The concept of travel time reliability plays a central role in the urban roads as well as in the road links where heavy traffic is important; in both these cases there is a relevant percentage of users who assign value to the certainty of the time of arrival.

Mobility of people and goods, based on internet, big data, etc.

Big data are changing the arena of the mobility studies. They are prompting many private players in roles usually reserved to the Road Administrations in many areas of mobility. It is important to collect the cases from different administration and agencies related to the reaction of the Road Administrations to these trend, that in many cases implies the participation to these development processes.

At the same time, Road Administrations have started to control their data in a better way than it has been made in a recent past. The TC will try to understand which are the best options as well as to define some guidelines to participate to this process having in mind the special role of the national road operator.

In this Cycle, a full report based on the collection of case studies is expected to be completed.

Outputs	Expected Deadlines
• Collection of case studies	• December 2020
• Full report	• June 2021

1.2.2. Implementation of sustainable mobility plans

Strategies / Objectives
• Identify good practices in transport planning and multimodality, in particular within the new concept "Mobility as a Service". • Analysis of taking into account women and other vulnerable users when planning and designing road infrastructure. • Proposal to face increased pressure due to population growth, increased urbanization and global trade. Pay special attention to the impact of the increase of e-commerce on the transport of goods. • Evaluation of the emerging transport technologies (autonomous vehicles, automated and connected driving or hyperloop) in road transport system. • Encourage coordination with other TCs and TFs, such as *T.C. 2.1 – Mobility in Urban Areas, T.C. Accessibility and Mobility in Rural Areas, T.C. 2.3 - Freight, T.C.2.4 – Road Network Operation/ITS, T.F.B.2 – Automated vehicles – challenges and opportunities for road operators and authorities, T.F. 2.1 – New mobility and its impact on Road Infrastructure and Transport, and T.F.3.1 – Road Infrastructure and Transport Security.*

The core of this activity is the concept of sustainability in transport network planning. This is related to the way the trips are carried out, to the group of users of the road facilities/network, to the environmental balance of the mobility flows. Another aspect to be analyzed is the public health: though it is probably included in the aim to "identify, investigate and document the social value of transport", the integration of public health as a major consideration in road infrastructure planning, as well as its monitoring ex-post, should be prioritized, even more so as it has been underlined by ITF as an important consideration to ensure that infrastructure planning fully integrate the "indirect" costs and benefits in comparing alternatives. The issue covers direct impacts (emissions, noise, etc.) as well as effects on mobility taken as a intermodal chain (for example, how a road infrastructure may impact time spent walking.

Sustainability of transport plans is also related to accessibility and equity: since transport costs increase in many parts of the world, the Road Administrations have adopted as a part of their activity a pro-poor approach, i.e. the attitude to consider to which extent the most exposed part of the population to poverty can afford the existing road infrastructure and associated services. It may be that these issues do not directly fall specifically within the framework of the theme (road construction and road transport) and more from a strategic planning point of view. Still the current system based on highways and roads which often entail fractures in urban settings or enslave populations to car dependency is unsustainable. This is a relatively new aspect of sustainability analysis for the Road Administrations and the PIARC TC will investigate on it.

In this Cycle, a full report is expected to be completed.

Outputs	Expected Deadlines
• Full report	• December 2022

1.2.3. Economic and social contribution of road transport system

Strategies / Objectives

• Identify, investigate and document:
  ○ the impact of investment in road infrastructure to stimulate economic growth, productivity and competitiveness.
  ○ the social value of transport.
• Identify employment opportunities through road construction and road transport, taking into account the promoting of equity.
• Take in account the work and findings of the Special Project on Capturing the contributions of road transportation.
• Encourage coordination with other TCs and TFs, such as *T.C. 1.1 - Performance of Transport Administration* and *T.C. 1.3 – Finance and Procurement.*

Poor infrastructure is an obstacle to economic growth. Globally, but more specifically LMICs face various challenges with respect to road infrastructure, namely, to maintain what they have, provide accessibility to the non-serviced and under-serviced communities and to provide infrastructure expansions to improve accessibility and mobility.

Road infrastructure helps solve both long term and short-term economic problems. Short term investment in road infrastructure helps provide jobs for low skilled workers. Over the longer term it has a wide range of benefits e.g. job creation with a multiplier effect (creates direct, indirect and induced jobs), reduces congestion and carbon emissions and benefits business by reducing the cost of transport.

The legacy of the PIARC activities carried out between 2016 and 2019 is twofold. First, the ex-post analysis of road projects has been analyzed through the activity of the T.C. A.2, that provided a final report with methodologies and case studies. Second, the so called wider economic effects have been investigated, mostly from the viewpoint of their inclusion in the standard procedure of cost benefit analysis of road projects.

For this activity, the T.C. will progress both in the analysis of the techniques of impact analysis and in the identification of the best practices of ex-post project assessment. Indeed, although the core of the evolution of the methodologies is not so fast in these areas of transport economics, what is changing is the system of preferences of the stakeholders and the related sensibility of the road agencies and administrations. The use of public finance is more and more investigated (through the use of different tools that the T.C. will study and update) and the control made by many groups of stakeholders on the development of projects related to mobility is an issue that is growing in importance for the Road Administrations.

Due to the importance of the above mentioned aspects, as a part of its activity the TC will study the processes of dialogue between the road agency/administration and the different groups of stakeholders at different stages of development of a road project (from programming to preliminary design, to design, build and opeate). The area of knowledge for these issues relates to the experience of the “débat public” in France and the Public Inquiry in the English-speaking framework.

Finally, the study of the relationship between transport investments and economic growth will be updated: at the end of last cycle, some 20-25 papers have been submitted to the World Road Congress of Abu Dhabi, mostly from emerging countries and this is a good basis for inviting those scholars and Road Administrations officer to contribute to define a general framework to be used for this analysis in different contexts.

In this Cycle, a full report based on the collection of case studies is expected to be completed.

Outputs	Expected Deadlines
• Collection of case studies	• December 2021
• Full report	• June 2022

TECHNICAL COMMITTEE 1.3 – FINANCE AND PROCUREMENT

1.3.1. Best practices in funding and financing of road infrastructure

Strategies / Objectives

- World-wide scanning of road infrastructure construction and operation funding and financing (including public budgets, direct and shadow toll roads) as well as the relevant road infrastructures operation costs.
- Identify best practices in special Innovative funding models and Hybrid funding solutions for LMICs.
- Investigate methods of financing of road maintenance, small scale rehabilitation, road safety improvement works, ITS, traffic management and other similar investment related to road infrastructure.
- Encourage coordination with other TCs and TFs, such as *T.C. 1.1. – Performance of Transport Administration*, *T.C.1.2 – Planning Road Infrastructure and Transport to Economic and Social Development, T.F. 1.1 Well-Prepared Projects, T.C. 3.3 – Asset management .*

Obtaining sufficient funding for road infrastructure maintenance and expansion remain a key challenge for roads authorities globally. Roads authorities in many instances cannot simply rely on direct budget allocations from the fiscus and need to access alternative sources of funding to meet their funding requirements.

Traditional funding options will remain the basis for developing innovative and hybrid funding solutions. These solutions do have challenges and include:

- Budgets appropriated by Governments towards roads authorities. The origin of these funds is tax based and may be raised in different ways, from personal taxation, Value Added Tax (VAT), Goods and Services Taxes (GST), property taxes, etc. Roads authorities are exposed to variations in budget appropriations due to fluctuations in economic conditions and changes in governments' policy objectives. For LMIC's, social expenditure demands on their fiscus may have a more severe impact to obtain sufficient funds for road construction and maintenance.

- Fuel Taxes is an "easy to collect" indirect road user charge that has been used very effectively to fund roads development and maintenance, either by means of dedicated fuel funds or as a general tax. Taxation of fuel will remain a primary source of road funding in many countries, although its efficiency is threatened by various factors including political will to increase fuel taxes, improvement in vehicle fuel consumption efficiencies, the introduction of battery powered vehicles and the negative environmental impact associated with fossil fuels. As a result, fuel taxation as a "user charge" is becoming inequitable and unsustainable.

- Vehicle registration/licensing fees - Income generated from vehicle registration and license fees is a direct user charge that can be utilized to fund road infrastructure. It does not take into consideration the actual distance travelled on road infrastructure. These fees, if linked to actual road usage overcomes the issue related to fuel taxes and improved efficiencies. In many instances, these fees are not available to transport authorities for infrastructure provision since it is part of general revenue to national, provincial or municipal authorities and utilized elsewhere. These fees do provide a mechanism that can be further developed to fund specific projects in an equitable manner.

- Traffic fines are regarded by some authorities to be a revenue source for road funding. However, it should not and cannot be a sustainable funding mechanism since all roads authorities' objective should aim for zero revenue from traffic fines and full compliance to

traffic laws.

- Development impact fees are utilized as a funding mechanism by roads authorities to mitigate the impact of developmental traffic on existing infrastructure. Developer contributions towards infrastructure provision can be tailored in such a way to systematically provide new and/or upgraded road infrastructure based on a pre-determined route network improvement plan and allocate specific upgrades or new infrastructure to a specific development. Developer contributions can play an integral role to finance the local supporting road network. However, it is unlikely that developer contributions will be sufficient to fund upgrading and expansions of freeway networks.

- Tolling is an equitable way of implementing the user-pay principle and does not compromise fiscal integrity. It generates funding through borrowing to allow for the implementation of large road infrastructure projects, resulting in earlier project delivery and realization of road user and economic benefits. Tolling is becoming a more attractive option for LMIC's, especially through the implementation of PPP's where the private sector provides technical expertise and access to equity and debt to finance for large road infrastructure projects. The private sector is risk averse and may require additional guarantees from their government partners related to base traffic and traffic growth for especially green fields projects.

Several innovative approaches to funding highways are already in practice, while others are under consideration. Hybrid funding solutions are also becoming more popular. World-wide scanning of road infrastructure construction and operation funding and financing, as well as the relevant road infrastructures operation costs, investigation is extremely helpful to understand funding sources and needs of a road infrastructure.

The aim of T.C.1.3 will be to evaluate these funding options in special for LMIC's where funding is limited, if not available and further scrutinize the existing options. It will need to determine whether these options are possible or even sustainable for LMIC's and should also address external factors i.e environmental impact, social benefit etc. Furthermore, new innovative options should be explored, and it should be determined if a combination of available funding options in a hybrid fashion may provide alternative funding options that can also address the needs and circumstances of LMIC's.

In addition, funding and procurement of road infrastructures are strictly interconnected and the choice of the best solution to realize a road infrastructure projects depends on: (i) a well-prepared project; (ii) adequate project funding; (iii) appropriate contractual terms.

The three conditions above are deeply influenced by national legislations which often prevent or limit the possibility to achieve the most efficient solution.

An objective of T.C. 1.3 shall be to detect the main legal and economic factors affecting the way of funding and procuring road infrastructures in order to identify, first of all, which are the most efficient scenarios for the successful realization of a project.

In this Cycle, this technical committee will identify and illustrate case studies (regarding both large and small scale projects) highlighting pros and cons of the relevant funding systems in relation to construction and operation phases. The final report will include the outcomes of interviews with authorities and sectors' expert and an in-depth analysis of the most relevant literature and legal provisions.

Outputs	Expected Deadlines
• Collection of case studies	• December 2020
• Full report	• December 2021

1.3.2. Impact of new propulsion techniques on funding

Strategies / Objectives
• Analyze the direct and indirect impact of new propulsion techniques focused on decarbonization on funding road infrastructure. • Encourage coordination with other TCs and TFs, such as T.C. 1.1 – Performance of Transport Administration, *T.F.B.2 – Automated vehicles – challenges and opportunities for road operators and authorities and T.F. 2.1 – New mobility and its impact on Road Infrastructure and Transport.*

Advancement in vehicle design and technology has redefined the way in which vehicles burn fossil fuels by using electric, hybrid and solar energy systems to replace the traditional combustion and fuel engines in vehicles. As vehicles become more fuel efficient, the fuel levy / tax contribution will reduce over time or will completely fall away if a user converts to alternative fuels. This in turn as a direct impact on the ability for obtaining secondary funding for road infrastructure through the utilization of these funds.

Current vehicle propulsion systems alternatives to the fuel-fed engine system include:

- Gas-electric hybrids: Power split hybrid vehicles which contain both an internal combustion engine and an electric engine which powers the engine of the vehicle. This type of vehicle uses a battery to provide power at lower speeds, or to handle the stop/start action of an engine. Regenerative braking and the internal combustion engine of the vehicle is used to charge the battery.
- Plug-in hybrids are similar to gas-electric hybrids except that they have bigger batteries which can propel the car limit distances using only electricity thereby generating zero emissions.
- Electrics vehicles operate purely on electric energy which powers the engine of the vehicle.
- Ethanol and flex fuel: Flex fuel is fuel that contains up to 85% of ethanol.
- Biodiesel is fuel which has been manufactured from vegetable oil, animal fats or recycled restaurant grease.
- Propane is produced as a by-product of natural gas and crude oil refining. Propane costs approximately a third less than gasoline. Using propane in vehicles eases maintenance of vehicles and reduces emissions produced.
- Liquefied and compressed natural gas produces vehicle mileage similar to that of gasoline but does so by burning more cleanly.

Fuel cells: Hydrogen is attractive because it can be produced domestically, and it burns cleanly. Vehicles which are powered by fuel cells are two to three times more efficient than those powered by gasoline.

Solar powered vehicles use photovoltaic cells to convert sunlight into electricity. This electricity powers the vehicle's motor. Solar powered vehicles generate zero emissions.

It can be concluded that even though the fuel tax is not the primary revenue source to cover road infrastructure costs, it has an equitable link to road usage and therefore there exists a linear relationship between the consumption of fuel and road usage. Together, alternative fuels limit this as a funding option available to governments to generate a user fee revenue.

Some Administrations have started developing ways of generating revenue from owners of electric and autonomous vehicles through the following methods:

- Vehicle Miles Travelled Tax applies to drivers according to the distance travelled. Modern technology has improved the accuracy of determining the distance travelled by vehicles thereby enabling accurate calculations for vehicle miles travelled (VMT) taxes. The main

challenge encountered by these tax programs is related to implementation. These programs rely on tracking each vehicle's mileage via a device within the vehicle or by drivers reporting their mileage.

- Transportation Taxes on Electricity: tax applied to drivers of electric vehicles. An option of restoring equity, due to electric vehicle owners not being subjected to the fuel/gas tax, is to levy road taxes through the electricity that these drivers consume as they use the road infrastructure. As a fuel, the electricity consumed by a single electric vehicle is almost perfectly equivalent to the fuel consumed by a fuel powered vehicle.
- Rethinking Free-riding with Transport Network Companies (TNC): Passengers of autonomous taxis, or Uber, should contribute to a tax program per their usage of the service. Currently TNC's have drivers who operate fuel operated vehicles. It is envisaged that due to the transition from fuel operated vehicles to electric vehicles, TNC's will change their vehicles accordingly. Therefore, the vehicles owned by TNC's will no longer be subjected to a fuel tax/levy. The most effective method of ensuring that TNC's use the road infrastructure while contributing to the funding of the road is for them to charge riders based on the distance they travel per trip.

It is evident that the current user fee-based system will become redundant and a new method of recovering this portion of the revenue, previously recovered through the fuel tax/levy, needs to be developed.

The aim of this technical paper will be to evaluate the effect of these alternative fuels on the fuel tax considering the advantages and disadvantages for each type. The timeframes over when this fund will deplete and how it will affect current government infrastructure projects. It should also assess the risks and broadly address possible mitigation measures. In this Cycle, a briefing note is expected to be completed.

Outputs	Expected Deadlines
• Briefing note	• March 2022

1.3.3. Harmonization of procurement

Strategies / Objectives
• Identify good practices and success stories in road infrastructures procurement and elaborate conclusions on the most efficient procurement solutions. • Define criteria for homogenization and good practices on procurement. • Analyze best practices to encourage ethical and social responsibility through procurement procedures. • Encourage coordination with other TCs and TFs, such as *T.C. 1.1 – Performance of Transport Administration, TF 1.1 Well Prepared Projects* and *T.C. 3.3 – Asset Management.*

A major challenge faced by government departments and agencies is the effective procurement of service providers. All infrastructure development projects as a minimum, require a professional team of engineers to determine the scope for design, standards for construction and effective project delivery. The reality is that many authorities don't have the necessary skills and resources to successfully comply with all procurement requirements to appoint professional teams.

Without the appointment of professional teams, a project cannot get out of the starting blocks and the design and tender process for the appointment of a contractor is delayed or may never happen. The knock-on effect of this tendency is poor service delivery and a delay in the implementation of large infrastructure projects that are essential for economic growth and job creation. To ensure effective project delivery, serious consideration must be given to simplify the process to appoint professional teams.

The tender mechanism for the delivery of professional engineering services may have resulted in lower design and supervision cost, but there is a price to pay. And without generalizing, there may be unintended consequences such as reduced quality of design, specifications and supervision. Poor design and specifications result in cost inefficiencies, contractual claims and time overruns/delays during the construction phase.

Furthermore, there should also be more scope to accommodate partnerships between Government and the private sector and a reasonable level of flexibility in procurements processes to encourage innovation and speedier implementation.

A PIARC Technical Report in 2003 – Procurement of Works, Goods and Services by Road Administrations set out a framework for international collaboration on improving procurement of works, goods and services by Road Administrations. It develops the background for a dossier of best practice summaries linked to road network and organizational characteristics so that the information can be related to particular country situations and can be used as a background.

Some current industry criteria include:

- Free and fair processes ensuring competition in procurement is not only good practice but ensures transparency and visibility, but it also yields other project benefits. Competition facilitates market prices and spurs innovation, higher service levels and better value.
- Value for Money is a process of ensuring that the best value for money is obtained but still adheres to procurement rules and processes. For government agencies, best value must be obtained in utilizing public funds whilst still enabling government priorities and objectives. Optimal use of these funds needs to be assessed considering the combination of economy and efficiency.
- Ethics and Accountability ensuring that all parties act in each other's best interest and is fully accountable. They deal on a basis of mutual respect and trust conduct their business with integrity.
- The concept of Equity from a global perspective seeks to offer opportunities to new

participants who were previously disadvantaged by a means of unfair discrimination. This ensures that entities are fully inclusive and aligned to support their respective industries.

Other Criteria include integrity, control and efficiencies.

There is current limited research on this topic and a concerted effort should be undertaken by this technical committee to compile case studies of relevance.

The aim of the T.C. 1.3 will be to develop fundamental criteria that will govern procurement practices internationally through the evaluation of current processes and techniques. These overarching principles should form the basis of procurement guidelines for agencies. It should also address current challenges faced in the industry especially with emphasis on maladministration and corruption. The outcomes of the report should assist entities to align their procurement goals and deliverables and support good governance. It should aim to simply the processes whilst enabling faster and more efficient delivery of the service. For LMIC's, it should address the limited capacity available at authorities to follow process due to limited skills available and to consider the appointment of consultants to assist in the procurement.

Outputs	Expected Deadlines
• Collection of case studies	• June 2022
• Full report	• December 2022

TECHNICAL COMMITTEE 1.4 – CLIMATE CHANGE AND RESILIENCE OF ROAD NETWORK

1.4.1. Uniform and holistic methodological approaches to Climate Change and other hazards resilience

Strategies / Objectives

- Identification of hazards and environmental threats within the context of road infrastructure resilience.
- Approaches to:
  - Risk management within the context of resilience
  - Decision-making and uncertainties/deep uncertainties
  - Emergency management with the context of resilience
  - Resilience management and resilience engineering
- Economic aspects of resilience management
  - Identification of the socio-economic impacts of hazards on roads.
  - Identification of decision areas that need enhanced economic information, and on the key users of such information.
  - Impact and economic evaluation of measures to increase resilience on the availability of road transport infrastructure, and the cost-effectiveness of different adaptation strategies.
- Define criteria to implementation of resilience into asset management practice.
- Take into account works carried out by *T.C.E.1 –Adaptation Strategies/Resiliency w*ithin Cycle 2016-2019, in particular the re-evaluation of 100 already case studies to identify those with this holistic methodology.
- Encourage coordination with other TCs and TFs, such as *T.C.1.5 – Disaster Management, T.C.2.4 – Road Network Operation/ITS, T.C.3.2 – Winter Service, T.C.3.3 – Asset Management, T.F.3.1 – Road Infrastructure and Transport Security, T.C.4.1 – Pavements, T.C.4.2 – Bridges, T.C.4.3 – Earthworks, T.C.4.4 – Tunnels and T.F.4.1 – Road Design Standards.*

Owners and operators are required to manage a very broad spectrum of threats in the future. These alone and in combination (in particular) have a significant impact on the availability of road networks. Therefore, owners and operators must address these key challenges to ensure a reliable operation of their road networks, mobility and supply chains. It is also clear that there are interdependencies with other modes of transport as well as cascading effects which should be considered as part of a comprehensive uniform and holistic (all-hazard) approach. These hazards include:

- Climate change and extreme weather
- Aging infrastructure, state of good maintenance and repair
- Natural disasters
- Man-made disasters
- Cyber and cyber-physical threats.

Without forgetting that Climate Change is one of the main risks faced by the road network, there are others, as listed. For example, cyber-attacks are ranked fifth in term of likelihood, with expected increased risks in 2019, leading to more disruption of operations. The WEF Global Risks Report reflects on new instabilities caused by the deepening integration of digital technologies into every aspect of daily life. In the context of the rapidly advancing digital transformation, digital technologies will also play an increasingly important role in the operation of road infrastructure, whereby the aspects of cyber security, cyber physical security and cyber resilience will play a decisive role in the future.

This results in the question of creating the basis for a PIARC all-hazard framework for resilient road networks. This development requires a very close cooperation and networking effort with other Technical Committees.

Additionally, the road network is a fundamental component to the effective running of the economy. Where disruptions occur due to a range of hazards, the network is as a result compromised, and this leads to serious loss in financial and economic costs to agencies, road operators and transport users. Resilience is therefore of high importance to ensure that road user costs and socio-economic costs are reduced. In principle, when considering financial aspects within the framework of resilience management, the measurement of vulnerable road infrastructure and adaption options should be considered.

The deployment of 21st century mobility services depends on the availability of quality infrastructure. Transportation systems and their services need to be affordable, safe, timely, reliable and secure in order to provide optimal societal outcomes and contribute to the UN Agenda 2030 (NZTA, 2013). Additionally, the Sustainable Development Goal 13 highlights that Climate Action has the specific goal to 'Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries '.

The lack of quality infrastructure systems will delay the systematic implementation of such services. Low quality infrastructure and services induce extensive economic, social and environmental costs for transit authorities and users (e.g. accident costs, travel time and freight delays, vehicle operating costs and externalities). Additionally, the socio-economic impacts of hazards/climate change onto vulnerable communities is an issue identified by Sustainable Development Goal 1 – No Poverty, where "By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters".

It is estimated that the amount of global investment required for roads will be US$ 34 trillion between 2016 and 2040, while the current trend of investments for this period does not exceed US$ 26 trillion (Global Infrastructure Hub, G20). In other words, each country should spend more than 1.27 percent of GDP while current expenditure on average is approximately 1 percent of its GDP only. Many countries, both emerging and advanced, "have paid insufficient attention to maintaining and expanding their infrastructure assets, creating economic inefficiencies and allowing critical systems to erode" (Woetzel & al., 2016). On the contrary, a state of good repair and maintenance of existing infrastructure contributes significantly to increasing "resilience".

In addition to increasing the robustness and the protection level of elements of the road infrastructure, investments in improving resilience also contribute to enhancing the availability of the road infrastructure, and identification of approaches and tools e.g. Sustainability Rating tools, which includes requirements and guidance for dealing with resilience. These aspects also require an in-depth consideration within the tasks of the work of this T.C.

The aim of this Issue is to explore the effectiveness of a PIARC all-hazard framework for resilient road networks. In this respect, one could perhaps say that the climate change is a subsystem of a (future) resilience framework.

It is recognized that in related this Issue, there are starting points for this concept to be explored further. This will include the development of uniform and holistic methodological approaches to climate change and other hazards resilience. This task will also further develop the concept of the effectiveness of economic and financial methodologies addressed by the T.C.s, and to bring together and evaluate these by way of best-practice case study approaches.

Firstly, it is necessary to review the work carried out by T.C. E.1 – Adaptation Strategies / Resiliency (SP 2016-2019), that collected more than 100 case studies. Although this already provides a very good basis for work in the 2020-2023 cycle, the existing collection of case studies should be

continued and extended with regard to the issues identified for the 2020-2023 cycle. The tasks to undertake will be to:

- (Re)Evaluate already collected case studies from the previous cycle, including identification of case studies especially with regard to holistic methodologies on the topic of resilience, resilience measures and to approaches to financial aspects of resilience management.
- Develop a survey/questionnaire on the topics of holistic resilience approaches, resilience measures and financial aspects of resilience management.
- Coordinate and collect positions with the relevant T.C.s, in particular with those of Strategic Theme 4 "Resilient Infrastructure".
- Compilation, categorization and pre-evaluation of suitable case studies, framework approaches and etc. with regard to the tasks within this T.C.

A roundtable/Workshop involving other T.C.s (i.e. T.C.s of ST 4 “Resilient Infrastructure”, T.C .1.5 - Disaster Management, T.F. 3.2 - Road Infrastructure and Transport Security) could then be undertaken at a coordinated meeting location. This will provide an opportunity to share case studies and best-practice approaches, and ensure that the developments of each related T.C. are complementary. Additionally, a Seminar in a LMIC will also be undertaken throughout the cycle.

It is important to identify commonalities and links with this T.C. and other related T.C.s in order to avoid any overlap. Collaborative actions across T.C.s are proposed in this ToR by way of joint Seminars, technical sharing of objectives of the T.C. throughout the cycle, and a potential Special Project with common synergies across these T.C.s.

A Briefing note could provide a summary of the preliminary findings from the internal Case Study Task Force, and will benefit the T.C. in the development of the Full report.

The findings to date will then be presented at the Conference Session called “Winter resilience”, for World Winter Service and Road Resilience Congressin Calgary, and other possible conferences such as (TRB Annual meeting, TRA, IABSE, IABMA, ETC.).

Finally, a Full report will be developed using case studies. This will provide the basis for a PIARC all-hazard framework for resilient road networks.

Outputs	Expected Deadlines
• Collection of case studies	• December 2021
• Full report based on case studies	• December 2022

1.4.2. Update of the PIARC International Climate Change Adaptation Framework for Road Infrastructure

Strategies / Objectives

- Update of the PIARC Climate Change Adaptation Framework based in the work carried out on the other ToR of this T.C.:
  - Setting a strict separation of processes and methodologies.
  - Split the framework into two separate parts:
    - Part 1: processes and their descriptions
    - Part 2: overview of possible methodologies for risk assessment and risk management, their data requirements and application limits

  With integration of best-practice case studies.
- Consideration of new and innovative methodological approaches, in particular critically assessment, adaptation pathways and evaluation of the overall economic value of adaptation measures.

The International Climate Change Adaptation Framework for Road Infrastructure was initiated during the Strategic Plan Cycle 2012-2015 of the World Road Association. T.C.1.3 - Climate Change and Sustainability developed a proposal for a 'special project' with the aim to create an international framework for climate change adaptation which would be of practical use for road assets owners and managers. It was supported when in May 2014, the World Road Association launched a call for proposals for PIARC special projects. Accordingly, the International Climate Change Adaptation Framework for Roads was published and disseminated during the World Congress in Seoul, November 2015.

In the 2016-2019 cycle, tasks related to adaptation to climate change were assigned to Technical Committee E.1 - Adaptation Strategies/Resilience. T.C. E.1 had the task to formulate proposals for the refinement of the International Climate Change Adaptation Framework for Road Infrastructure, based on the case studies analyzed during the cycle and on findings from direct implementation of the Framework.

The final report developed by T.C. E.1 summarizes the results of the work on the refinement of the Framework. It provides examples of implementation, discusses the applicability of the Framework for various purposes, reports on feedback from countries comparing the Framework to their own ongoing adaptation work. It also reports the results of a benchmarking exercise, where the Framework was compared to other approaches for adaptation of roads to climate change. The report concludes with a list of proposed options for the refinement of the current PIARC Framework (2015).

The work undertaken by T.C. E.1 as part of SP 2016-2019 has therefore shown that the PIARC Climate Change Adaptation Framework is in general a good basis to analyze road networks and to select and assess the adaptation measures with regard to the consequences of climate change.

However, it also has become clear that the approach of the framework with a combination of processes and methodological approaches does not always meet the requirements of the users. Furthermore, it becomes clear from the work in the cycle 2016-2019 that, adjustments to the Framework processes are required to ensure more effective world-wide application. In addition, it has been shown based on the case studies analyzed, that new and innovative approaches have been put into practical use since the release of the framework in 2015.

For these reasons, there is a need for a fundamental update of the PIARC Climate Change Adaptation Framework, which is to be considered in this Issue. For it, the following points are to be addressed:

- The work should be based on case studies and in the work conducted previously by T.C. E.1.

- Strict separation of processes and methodologies.
- Division of the framework into two separate parts. In particular, this includes progressing the findings from both T.C. E.1 WGs by way of:
    - Part 1 should contain only processes and their descriptions (e.g. inclusion of the suggested refinements to the Framework from T.C. E.1 WG2 into the development of an updated Framework)
    - Part 2 should include an overview of possible methodologies for risk assessment and risk management, their data requirements and application limits (e.g. inclusion of worked examples of the methodological approaches identified in the T.C. E.1 WG1 report. This includes integration of best-practice case studies and data requirements and converting these into worked examples for each phase of the updated Framework). For example, how to perform a risk assessment, which measures to implement, and how to calculate costs and benefits.
- Consideration of new and innovative methodological approaches, which may also result in a modification of the processes of the framework. In particular, questions relating to criticality assessments, the concept of adaptation pathways and the evaluation of the overall economic value of adaptation measures are to be mentioned here.
- Furthermore, it is also considered necessary to identify ways of considering aspects of road resilience in the context of asset management.

The aim of this task is to extend the work developed by T.C. E.1 into the abovementioned new Framework. The framework is an approach to resilience from climate change.

Firstly, it is necessary to undertake a survey/questionnaire on the topics of holistic resilience approaches, resilience measures and economic aspects of resilience management, jointly with the proposed task for Issue 1.4.1, and to review the work carried out so far by T.C. E.1.

A roundtable/Workshop involving other T.C.s (i.e. T.C.s of S.T. 4 - Resilient Infrastructure, T.C. 1.5 - Disaster Management, T.F. 3.2 - Road Infrastructure and Transport Security) will then be undertaken at a coordinated meeting location. This will provide an opportunity to share case studies and best-practice approaches, and ensure that the developments of each related TC are complementary. Additionally, a Seminar in a LMIC will also be undertaken throughout the cycle.

The findings to date will then be presented at the Conference Session called “Winter resilience”, for World Winter Service and Road Resilience Congressin Calgary, and other possible conferences such as (TRB Annual meeting, TRA, IABSE, IABMAS,…).

Finally, a Full report will be developed, which provides a fundamental update of the PIARC Climate Change Adaptation Framework.

Roundtable / Workshops with participation of all relevant T.C.s and T.F.s will be carried out during this cycle. In addition, Climate Change Adaption Framework for Roads will be updated.

Outputs	Expected Deadlines
• Roundtable with participation of all relevant TCs and TFs	• February 2022
• Update Climate Change Adaptation Framework for Roads	• December 2022

TECHNICAL COMMITTEE 1.5 – DISASTER MANAGEMENT

1.5.1. Information and communication in disaster management

Strategies / Objectives
• Follow up works carried out by *T.C.E.3 –Disaster Management w*ithin Cycle 2016-2019 in gathering and diffusion information for disaster management, taking into account of new evolutions such as Big Data and Social Networks. • Study how to process huge amount of information acquired from the Big Data and Social Networks rapidly and efficiently in order to extract necessary and reliable information for disaster management. • Study how to evaluate the accuracy of information from the Big Data and Social Networks and ensure the quality of the information related to disaster management. • Study how to disseminate disaster information efficiently among the road users and the relevant parties through social networks. • Identify the best practice of disaster management techniques using recent evolutions in information, communication area such us Big Data and Social Network • Encourage coordination with other TCs and TFs, such as *T.C.1.4 – Climate Change and Resilience of Road Network, T.C.3.1 – Road Safety, T.C.2.4 – Road Network Operation/ITS, T.F.3.1 – Road Infrastructure and Transport Security and T.C.3.3 – Asset Management.*

A proactive approach in disaster management will receive a positive reaction from road users.

In this sense, information management is the primary and fundamental basis of disaster management. Developing a reliable information collection and sharing system is the first step of proactive disaster management toward engaging with internal and external stakeholders and understanding their information needs and expectations.

T.C.E.3 - Disaster Management (SP 2016-2019) made preliminary study on current status of information management especially in collection and provision of disaster information. According to the result of this study, within the management activities using conventional disaster information sources and outlets, effective and successful disaster management could be made with the disaster management center under the specific communicational procedures rather than structure, with the periodical practice training to ensure the procedures work well in emergency situations, and with establishing alliances with media.

It is needless to say that the quality of the information provided to road users and road administrators governs the quality of the subsequent disaster management. With the unexpected development in IoT technologies and devices, and unprecedented increase in mobile telecommunications and social media which can instantaneously convey a huge amount of disaster information data to road administrators as well as road users, management of disaster information is about to change using the benefit of those internet related data.

Internet related data can be divided into two, Big Data and Social Networks. In this paper, Big data is defined as the data generated by IoT devices and Social Networks is defined as the data generated by various activities of “people” such as opinions, evaluations, and behavior.

The most successful application of Big Data in disaster management might be “Passable road map”. Japanese car manufactures and ITS japan integrated their car probe data at the occasion of major disasters and provides “Passable road map” on the disaster area on the web.

Social Networks is also a powerful tool for information dissemination but is also a potential tool for information gathering in an emergency. Social Networks is currently used somewhat passively to disseminate disaster information to the road users and receive their feedbacks. The most successful case study can be found in the emergency operation at the Forth Road Bridge Closure. Social Networks has a potential tool for disaster management tool in terms of 1) emergency

communications and issue warnings; 2) receiving victim requests for assistance; 3) monitoring user activities and postings to establish situational awareness; and 4) using uploaded images to create damage estimates, among others (Source: OECD report, https://doi.org/10.1787/5k3v01fskp9s-en).

Big Data and Social Networks are pretty huge data, and Social Networks is "People" generated information. Therefore, the road administrator has responsibility for selecting good and concise information, for managing fake news, and disseminating good and accurate news on Big Data and Social Networks. In this meaning, the following studies are essential to road administrators:

- Study how to process huge amount of information acquired from the Big Data and Social Networks rapidly and efficiently in order to extract necessary and reliable information for disaster management.
- Study how to evaluate the accuracy of information from the Big Data and Social Networks and ensure the quality of the information related to disaster management.
- Study how to disseminate disaster information efficiently among the road users and the relevant parties through Social Networks.

Finally, integrating Big Data and Social Networks to disaster information management is in its early stage, this report, based on case studies, will provide the best practice of disaster management techniques using recent evolutions in such information communication area. This contribution from PIARC will be relevant and useful to not only to disaster management but also all kind of emergency management.

Outputs	Expected Deadlines
• Collection of case studies	• December 2021
• Full report	• December 2022

1.5.2. Financial aspects of disaster management

Strategies / Objectives

• Conduct case studies where:
  ○ To study effective practices for accelerating disaster recovery from the view point of financial, contract and procurement systems
  ○ To study financial aspects of disaster management during preparedness, mitigation, response, and recovery phases
• Explore and document good practices.
• Explore collaboration with TRB and other external organizations for a joint workshop.
• Encourage coordination with other TCs and TFs, such as *T.C.1.3 – Finance and Procurement, T.C.1.4 – Climate Change and Resilience of Road Network, T.C.2.4 – Road Network Operation/ITS, T.F.3.1 – Road Infrastructure and Transport Security, T.C.3.3 – Asset Management, T.C. 4.1 - Pavements, T.C. 4.2 - Bridges, T.C. 4.3 - Earthworks* and *T.C. 4.4 - Tunnels.*

Disaster can be defined as “a crisis situation that far exceeds the capabilities” - Quarantelli, 1985. Therefore, disaster management can be explained as a series of activities to improve the capability of the society.

Disaster management is generally divided into four phases and often discussed (preparation, mitigation, response, and recovery). The disaster prone countries have improved their technology to enhance capacity and management techniques in each phase based on their disaster experiences. Many of these capacity improvement technologies are shared in disaster prone countries. Disaster management in nature is inseparable from financial management in terms of technological improvement and its implementation. However, there are few studies that have organized disaster management from the financial point of view even for such disaster prone countries. The financial discussion in disaster management is often found at the prompt recovery phase in order to minimize the economic losses from the disaster.

In recent years, disaster management activities are evolving from the stage of sophistication of disaster response to the sophistication of disaster mitigation and preparedness. Therefore, the financial aspects in disaster management need to be discussed in not only in recovery phase but also preparedness, mitigation, and response phase.

At the phase of preparedness, disaster insurance and disaster recovery cost pooling, which have been experimentally implemented in some disasters prone countries, will be financially important research issues. In some countries, it is reported that the introduction of disaster insurance enabled effective and efficient disaster response. (Source: World Bank report, Sovereign Disaster Risk Finance in Middle-Income Countries, 2018)

At the phase of mitigation, it will be necessary to consider the improvement of road network redundancy and disaster prevention quality of infrastructure in order to minimize the disaster effect from the financial point of view. In Japan, after the 2011 East Japan earthquake, a new scheme for evaluating road project by considering their effect after disasters was established. They introduced a disaster mitigation benefit to the cost-benefit analysis for adopting a new road project. (Source: Routes/Roads pp72-pp79, #356, 2012)

At the phase of recovery, the development of procurement methods and contract systems for prompt recovery was an important financial issue. In recent years, it has been reported that, in view of securing a road network, the impact on the regional economy is also considered in the selection of the restoration method. (Source: PIARC report, Disaster Information Management for Road Administrators, 2019)

At the stage of response, securing safety and securing emergency activities are given the highest priority, so there are few cases where financial considerations becomes important, but further investigation is necessary.

In this meaning, the following studies are essential to road administrators:

- To study effective practices for accelerating disaster recovery from the view point of financial, contract and procurement systems
- To study financial aspects of disaster management during preparedness, mitigation, response, and recovery phases

Financial considerations in disaster management activities often include sensitive matter. Careful consideration and discussion will be needed in obtaining information and processing and analyzing the information.

Finally, financial considerations in disaster management are quite new concept to study. Therefore, it is important to collect various case studies from the world and introduce good and informative cases studies to the world. This contribution from PIARC will be relevant and useful to not only to disaster management but also all kind of incident or emergency management.

These case studies will be summarized in a briefing note.

Outputs	Expected Deadlines
• Collection of case studies	• December 2021
• Briefing note	• December 2022

1.5.3. Update the Disaster Management Manual

Strategies / Objectives
• Update of the Disaster and Risk Management Manual. • Take into account works carried out by *T.C.E.3 –Disaster Management* within Cycle 2016-2019. • Encourage coordination with other TCs and TFs, such as *T.C.2.4 – Road Network Operation/ITS, T.C.3.1 – Road Safety, T.C.4.3 – Earthworks, T.C. 4.4 – Tunnels, T.C.1.4 – Climate Change and Resilience of Road Network,* and *T.F.3.1 – Road Infrastructure and Transport Security.*

The core role of PIARC is knowledge exchange. PIARC organized technical committees that make a key role of dissemination and exchange of technical information during 4-year cycle period. For this purpose, T.C.s produces technical reports and holds at least two international seminars during the cycle period in Low-Middle Income countries, and some international workshop or roundtables in High Income countries. Those seminars, workshops, and roundtables are the good opportunities to exchange their technologies. The technical reports and slide files presented at seminars, workshops, and roundtables are uploaded to the PIARC website for disseminating the information of these activities.

Internet is a powerful, convenient, and economical tool to disseminating technical information to the world, but internet relies on the search engine to find out the information. PIARC is now exploring a good information type for disseminating technical information to be easily searched and to be easily referenced. One of the ideas is to produce “Manuals”.

T.C.E.3 – Disaster Management (2016-2019) made a technical report that contained a lot of information of management principles, precious case studies, and a bunch of element techniques that support disaster and risk management activities. T.C. E.3 compiled some of previous materials and launched an English version of on-line disaster and risk management manual at PIARC web site.

With the rapid changes in road administration environment and the development of management techniques, there is a need to constantly update this manual for sustainable use.

Disaster management is not a theoretical based activity but an experience based activities. Useful disaster management manual will be a well-organized bunch of lessons, experiences, and examples of successful practices. In this meaning, there is still significant work to be done to update articles that would not were implemented by the end of 2019.

Risk management is already well documented in the academic field. Our main concern is how the risk management concept can apply to the road engineering. Previous study revealed that the risk management technique is well implemented in the project planning phase, and is gradually implemented in the maintenance field. Enriching the contents of application of risk management is welcomed by the practical engineers.

The work of the cycle 2016-2019 covered some of the principles, technical tools, and case studies documented in the previous report. This cycle continues to effort on updating and enriching the contents of the manual in order to make it more attractive and more in line with what is expected from an online resource, and to make it rich with new case studies and other media.

- Update and enrich the articles using the PIARC latest work (Cycle of 2016-2019) related to disaster and risk management.
- Cooperate with related TCs for finding good case studies
- Update the manual for easy to use by using various forms: images and videos
- Update the manual in PIARC official languages
- Explore the possibility for a webinar for the side menu of the manual

This contribution from PIARC will be relevant and useful to practical engineers who are engaging with disaster management activities.

In this Cycle, a full report is expected to be completed.

Outputs	Expected Deadlines
• Update of the Disaster and Risk Management Manual	• December 2022
• Full report	• December 2022

TASK FORCE 1.1 – WELL-PREPARED PROJECTS

HOW TO IMPROVE BANKABILITY, ACCEPTANCE, ACCOUNTABILITY AND TRANSPARENCY

TF 1.1.1. Well-prepared projects

Strategies / Objectives

- Review literature and existing project preparation software (e.g. SOURCE, HDM-4, EIPP, GIH) and analyze good practices of project management for improving and optimizing public and private investment.
- Identify how well-prepared projects contribute to a culture of transparency and accountability.
- Establish recommendations on:
  - Definition of strategies to set outcomes, optimize project delivery and project lifecycle.
  - Requirements for road project preparation
  - Management relationship with financiers, with a view to maximizing project economic and possible budgetary return
  - Communication and engagement with stakeholders
  - Continue with the works carried out by *T.C.C.1 – National Road Safety Policies and Programs* and *T.C. C.2 - Design and Operation of Safer Road Infrastructure* within Cycle 2016-2019 to complete the incorporation of pertinent PIARC reports on road safety (from 2003).
- Encourage coordination with other TCs and TFs, such as *T.C.1.1 – Performance of Transport Administrations, T.C. 1.2 - Planning Road Infrastructure and Transport to Economic and Social Development, T.C. 1.3 - Finance and Procurement.*

It is widely recognized that good preparation of infrastructure projects, first and foremost road projects, is of utmost importance to secure their proper financing, wide acceptance and seamless implementation.

It is nowadays all too common to hear financiers claim that plenty of money is available for project financing, but that what is lacking is good projects.

Whatever the type of country considered (industrialized, emerging, or developing), a good preparation of road projects is of outstanding importance for the following reasons:

- For ordinary projects (e.g. procured on a traditional Design-Bid-Build procedure), there is a need for:
  - Improved acceptability by all stakeholders (e.g. by populations directly affected by social and environmental aspects of the project, or by other donors or public authorities participating in the cofinancing ,…);
  - Improved quality and resilience of the projects, in order to meet Sustainable Development Goals;
  - Reduced risk of delays and cost overruns in construction and its possible impacts on maintenance
  - Improved transparency in the procurement process and ethical behaviour of all parties.
- For complex projects (typically PPP or concession projects), in addition to the above-mentioned reasons, it is necessary to:
  - Explain to stakeholders the need to recourse to these complex procedures;
  - Minimize transaction costs and standardize contract documentation as much as possible;
  - Attract financing at favourable terms and conditions and sustainable funding;
  - Overcome project complexity, while accepting innovative solutions.

To sum up, the better a project is prepared, the smaller the risks of seeing the project rejected by various stakeholders, or unable to reach adequate financing, or fraught during implementation with poor quality, delays, cost overruns, maintenance uncertainties and possible unethical behaviours associated with ensuing change orders.

Topics to discuss in the TF will include:

- Are there big differences between the requirements for road project preparation in high- or low-income countries? Is it possible to define a set of minimum standards or recommendations to be observed in each case?
- How do road authorities manage relationship with financiers, with a view to maximizing project economic and possibly budgetary return?
- How do road authorities manage communication with stakeholders?
- Are available regional platforms [e.g. European Investment Project Portal (EIPP), Global Infrastructure Hub (GIH)] and/or tools (e.g. SOURCE platform, see annex) considered helpful? How could they be improved?
- The work will focus on available material and try to analyze best practices.

The T.F. will aim at representing a wide diversity of circumstances, including cases from several countries and continents.

The final report will be based on a collection of case studies and will outline the various aspects analyzed make practical recommendations for road administrations and authorities and will focus on policy issues both in the short- and medium to long term.

The T.F. will make references to other organizations, especially in the bank, contracting and consulting sectors. It will not duplicate their work.

Outputs	Expected Deadlines
• Literature review	• November 2020
• Collection of case studies	• April 2021
• Full report	• September 2021

STRATEGIC THEME 2 – MOBILITY

TECHNICAL COMMITTEE 2.1 – MOBILITY IN URBAN AREAS

2.1.1. Accessibility and mobility facing land use in urban and peri-urban development

Strategies / Objectives

- Data collection and analysis of inhabitants' mobility daily needs and accessibility and adequate level of urban and peri-urban mobility.
- Take into account low development areas with a high growth rate of population and lack of urbanization planning.
- Analyze the use of road infrastructure in urban areas by different vehicles: private cars, public buses, taxis, urban services (cleaning, ambulance, police, fireman…), bicycles, scooters… and role of road infrastructure in enhancing mobility policies.
- Identify good practices of integrating transport planning and land-use planning to optimize modal split.
- Identify good practice for building public support for sustainable urban mobility initiatives.
- Encourage coordination with other TCs and TFs, such as *T.C. 1.2 - Planning Road Infrastructure and Transport to Economic and Social development, T.F.B.2 – Automated vehicles – challenges and opportunities for road operators and authorities, T.F. 2.1 – New mobility and its impact on Road Infrastructure and Transport, T.C 3.1 – Road Safety, T.C.2.4 – Road Network Operation/ITS* and *T.F.3.1 – Road Infrastructure and Transport Security.*

This Technical Committee will focus on inhabitant's mobility needs in the commuting areas in order to make sure that all transportation trips in relation with the services delivered by cities will be taken into account.

This issue will be faced taking into account the work of T.C. B.3 – Sustainable Multimodality in Urban Regions (SP 2016-2019). Some of their findings are gathered below:

"Globalization and specialization have enabled cities to flourish and have led to the concentration of activities and populations, resulting in an increase in urban transport needs and a scarcity of public space. In these urban areas characterized by high population and employment densities, congestion of transport systems is the rule and the sharing of public space is a necessity. Moreover, in a context of scarce public finances, new developments were becoming increasingly difficult to implement, especially since in the past they had not succeeded in solving all travel problems. Thus, in these dense areas, it became necessary to organize and optimize existing transport systems.

Then, with the development of means of transport, more and more inhabitants have taken advantage of these new offers to reconcile the attractiveness of the city's jobs with the lower housing costs in the outskirts, or even the quality of life in the countryside. The result has been a rapid expansion of the area of influence of cities in terms of employment, which extends well beyond the urbanized area, well beyond congested networks, and a rapid increase in transport needs for everyday travel. PIARC's Strategic Plan has taken this phenomenon into account by requesting that the reflection on the city be extended to metropolitan regions, focusing on mobility needs and services (and no longer only on transport needs) and multimodality. Thus, in addition to the reflections on the density and scarcity of space, it was necessary to add a reflection on the links that unite rural territories, of very low density, to the dense areas of the city. What transport needs? How can access to jobs in the city center, and more generally access to the city's amenities (education, care, culture), be made possible under good conditions of social equity and cost? How can development be guided in order to limit transport needs without forgetting the essential needs of the inhabitants of the outskirts?

Finally, the 21st century has seen the rapid growth of digital technology and its many applications in the field of mobility (networking applications, car-sharing and carpooling services, electric bicycles, renewal of electric motor vehicles, autonomous driving, etc.) and the emergence of new behaviors (sharing economy, circular economy, etc.). PIARC wanted these trends to be included in the scope of the reflection.", etc.

"Some of the themes developed in the previous report have not been further developed. This is the case, for example, for active mobility, for which the reader may wish to refer to the reports "Strategies to balance the modal share of urban transport in order to improve mobility and reduce road congestion" and "Key issues to improve mobility strategies in large urban areas". However, new services such as bicycle sharing or electric bicycle are covered in this report.", etc.

"At the end of this four-year cycle, the committee wishes to share some questions but also one certainty.

The questions concern the future of mobility. We have seen in this short introduction that our societies have moved in less than a century from a traditional model with two types of living environment (cities and village communities) practically independent in terms of daily mobility, to a model of peri-urbanization where hundreds or even thousands of village communities located more than a hundred kilometers from a city live in close relationship with it, a relationship that translates into daily exchanges for access to employment, education, care or leisure. The question that arises today is whether this model of spatial occupation, consisting of a mosaic of geographically separated territories closely linked by daily exchanges, will continue to expand, stabilize or multiply?

Since digital technology already allows remote working, will we see a further dispersion of living and working places with less physical presence in the workplace? It will also bring essential services (education, care, etc.) closer to living spaces: it should therefore lead to a reduction in mobility needs. But it also makes it possible, in particular, thanks to the autonomous vehicle, to reduce transport costs, driver time lost and travel discomfort: the result should therefore be a rebound effect consisting in transforming these innovations (as has happened with each innovation in the field of transport) into new desires to travel further (or more often) to access new opportunities. Finally, how can we take into account the challenges of climate change and the scarcity of natural resources?

Certainty relates to the need to continue sharing observations, good and bad practices at the international level, and the multiplicity of views on these practices. It also addresses the need to broaden the transversally of reflection by confronting it with new approaches, particularly through the social sciences.

May these contributions help the road authorities to provide a sustainable response to the needs of the inhabitants of these territories."

As a consequence, for T.C 2.1 we should ask case studies, good practices, or policies, both in the field of local daily needs (urban mobility needs) but also in the field of daily needs between cities and their hinterland (i.e. commuting area which includes rural areas). In addition, a briefing note and a full report are expected to be completed during this cycle.

Outputs	Expected Deadlines
• Collection of case studies	• June 2021
• Briefing note	• December 2021
• Full report	• December 2022

2.1.2. Integrated transportation systems, multimodality

Strategies / Objectives
• Identify good practices of optimization of road networks through better integration with other forms of transport (rail, active modes, etc.) in terms of efficiency, resilience and sustainability. • Focus on multimodal transit center, collect data and analyze the efficiency, the resilience and the sustainability. • Encourage coordination with other TCs and TFs, such as *T.C. 1.1 - Performance of Transport Administration, T.C. 1.2 - Planning Road Infrastructure and Transport to Economic and Social development, T.F.B.2 – Automated vehicles – challenges and opportunities for road operators and authorities, T.F. 2.1 – New mobility and its impact on Road Infrastructure and Transport, T.C.2.4 – Road Network Operation/ITS, T.C 3.1 – Road Safety and T.F.3.1 – Road Infrastructure and Transport Security.*

Sustainable urban mobility is today a priority for all city administrations and governments. Concern for the organisation of all transport circulating in the city is therefore of paramount importance. Making cities less congested, cleaner and ecological does not consist in trying to eliminate the means of transport available to us, but in knowing how to use them more efficiently. In other words, treating all forms of transport equally, in order to guarantee access to citizens according to their needs. This is the starting point for the development of sustainable and environmentally friendly cities. This is how multimodality emerges, which is beginning to be applied in urban transport management plans as a way of promoting more sustainable and less polluting mobility, given the possibility of combining several forms of public and private transport on the same route, including, in addition to the private vehicle, active mobility (walking or cycling) and car-sharing platforms.

To be able to say that a city has a sustainable urban transport mobility plan and promotes multimodal mobility, it will be necessary to plan not only public transport logistics (transport cards, information systems, etc.), but also urban infrastructure (car parks, stations and stops, routes). The key lies in connecting all infrastructures and integrating services into one.

This is, for example, someone could leave the car in the dissuasive car park at the train station, go to the city centre by metro, and end the journey with a shared bicycle. All coordinated in an efficient way and with accessible costs for the population.

In fact, the key is to connect all infrastructures and integrate all services into one. For example, being able to make all payments (car parking, public transport voucher and shared bicycle fare) with a single transport card. Or connect the times and schedules of the different sections of the same route.

The challenge is therefore in the connection and integration of infrastructures and public services.

An additional challenge is posed by the orography of cities and peri-urban areas (with the problem of significant slopes or elements such as mountains or rivers), as well as geography (near the coast or in islands).

T.C 2.1 should ask case studies and good practices on multimodality in several cities and peri-urban areas. These case studies will be summarized in a briefing note.

Outputs	Expected Deadlines
• Collection of case studies	• March 2022
• Briefing note	• December 2022

2.1.3. Evaluating impacts of new mobility in urban and peri-urban areas

Strategies / Objectives
• Evaluate impacts and challenges of new mobility (automated driving, sharing, MaaS) on urban environment and social inclusion. • Identify good practices of smart cities using ICT Technology. • Analyze the ITS contribution to urban mobility. • Encourage coordination with other TCs and TFs, such as *T.C. 1.1 – Performance of Transport Administration, T.F.B.2 – Automated vehicles – challenges and opportunities for road operators and authorities, T.F. 2.1. - New mobility and its impact on Road Infrastructure and Transport, T.C. 3.1 – Road Safety, T.C. 2.4 – Road Network Operation/ITS* and *T.F.3.1 – Road Infrastructure and Transport Security.*

For the last few years, the appearance of new mobility formulas is producing a trend change in urban areas, which far from decreasing will increase in the future. There are two reasons for this:

- "Millennials" are used to the current Digital Era, and are betting on this new form of mobility, even having less purchasing power than previous generations.
- Ageing of the population is leading us to prefer forms of mobility than to do not require great physical capacities.

Other factors also have an influence, such as the growing awareness of the need to reduce the emissions produced by vehicles in urban areas. This leads us to an increase use of non-polluting vehicles, public transport, bicycles and other similar elements, and, therefore, to the promotion of intermodality, increasing the need to develop the concept "Smart Cities".

The impact on urban mobility needs to be analyzed, as well as which factors can contribute to its greater integration, such as ITS.

An analysis of how to tackle the problem of vulnerable users (pedestrians, cyclists, etc.) whose number is expected to rise considerably in cities, is necessary, considering the measures for their coordinated, and compatible with other modes, integration.

T.C. 2.1 will analyze this impact through case studies, considering cities of different sizes, as well as the impact on peri-urban areas, identifying good practices.

In this Cycle, a briefing note based on the collection of case studies is expected to be completed.

Outputs	Expected Deadlines
• Collection of case studies	• March 2022
• Briefing note	• December 2022

TECHNICAL COMMITTEE 2.2 – ACCESSIBILITY AND MOBILITY IN RURAL AREAS

2.2.1. Accessibility and mobility in rural areas

Strategies / Objectives
• Analysis of importance of roads for accessibility and adequate level of mobility in rural environment (job access, goods access, hospital, school access…). • Pay attention to vulnerable users. • Involvement of local communities in planning, construction and maintenance of rural road networks, particularly in LMIC. • Identify strategies and measures for enhancing public transport. • Encourage coordination with other TCs and TFs, such as *T.C. 1.1 – Performance of Transport Administration, T.C. 1.2. – Planning Road Infrastructure and Transport to Economic and Social Development, T.C. 2.4 – Road Network Operation/ITS, T.C. 3.1 – Road Safety, T.F.3.1 – Road Infrastructure and Transport Security, and T.F.4.1 – Road Design Standards.*

A very large part of the world's population lives in rural areas. This includes both low- and middle-income countries where their level of development means that a large part of the population is rural, as well as high-income countries where there are rural mountain areas with difficult access, or small towns that have suffered depopulation due to the exodus to large cities.

The road networks must guarantee accessibility and mobility in all these areas, but they face various problems, such as: the existence of geometrically tight routes; the circulation of different types of vehicles (cars but also agricultural or heavy mining vehicles that circulate at very low speeds, ...); and the use of these roads by different types of users (cars, bicycles, pedestrians,...). But without a doubt, the greatest challenge they face is the lack of economic resources for construction and maintenance of these rural roads, that sometimes not allowing an adequate and safe traffic, especially in adverse weather conditions, given that many of these road networks are the responsibility of local communities.

This Technical Committee will focus on inhabitant's rural needs including the trips in relation with urban areas (access to jobs, education, health services,…) and how road networks could solve those.

T.C. 2.2. should take into account the work done by the T.C. 2.5 (cycle 2012-2015) "Rural road systems and accessibility to rural areas".

T.C.2.2 should be asked about taking into account the accessibility to services located in cities (education, care, jobs, …) as well as good practices concerning transport services. It is a question of social inclusion.

In this Cycle, a briefing note based on the collection of case studies is expected to be completed.

Outputs	Expected Deadlines
• Collection of case studies	• June 2021
• Briefing note	• September 2021

2.2.2. Improving road safety in rural areas

Strategies / Objectives
• Provide findings and recommendations regarding strategies and measures for improving rural road safety. • Pay special attention to vulnerable users. • Analyze ITS contribution to rural road safety. • Encourage coordination with other TCs and TFs, such as *T.C. 3.1 – Road Safety, T.F.3.1 – Road Infrastructure and Transport Security, and T.F.4.1 – Road Design Standards.*

Rural roads tend to have strict geometric characteristics, many of them are not paved and are therefore more vulnerable to the actions of atmospheric agents. Furthermore, the Road Administrations or Local Communities do not have many resources to keep them in good condition.

In addition, as these rural roads are the only via of access, on them coexist very diverse vehicles (goods, agricultural, automobiles, cyclists, ...) and even pedestrians. An additional characteristic in many regions is the ageing of the rural population.

All this leads to the need to study measures to improve road safety on rural roads, paying particular attention to vulnerable users, which can develop with reduced budgets.

In this Cycle, a full report based on the collection of case studies is expected to be completed.

Outputs	Expected Deadlines
• Collection of case studies	• December 2021
• Full report	• June 2022

2.2.3. Technical solutions for paved and unpaved roads

Strategies / Objectives
• Define suitable materials and identify good techniques for construction and maintenance. • Encourage coordination with other TCs and TFs, such as *T.C. 4.3 – Earthworks, T.F. 4.1 – Road Design Standards* and *T.F.3.1 – Road Infrastructure and Transport Security*.

The materials and techniques used to build unpaved roads are key to keeping them in good condition and minimizing maintenance costs. This is greatly influenced by the surface treatments that protect the material that makes up the road from atmospheric agents and the transit of vehicles, often overweight.

There is a long tradition and experience in some Latin American and African countries in the use of local materials, although additional challenges have arisen such as the scarcity of these or the restriction of use for environmental reasons, but also opportunities motivated by technical advances.

Another very important issue to keep in mind in order to maintain rural roads in good condition is to adequately resolve drainage.

Finally, the approach must consider the complete life cycle of the infrastructure, and therefore, consider the materials and construction techniques needed to ensure greater durability, as well as the maintenance techniques to be used and the best time to carry them out.

In this Cycle, a full report based on the collection of case studies is expected to be completed.

Outputs	Expected Deadlines
• Collection of case studies	• June 2022
• Full report	• December 2022

TECHNICAL COMMITTEE 2.3 – FREIGHT

2.3.1. Best practices, monitoring and regulation to reduce overloading and associated infrastructure damage on road networks

Strategies / Objectives
• Investigate and asses the regulation compliance using WIM and direct enforcement (incl. overload control, speeding control, vehicle fitness control, etc.). • Study the potential and implementation of Performance Based Standards for heavy vehicles (regarding fleet/vehicle/loading control, safety compliance, driver condition, rollover stability, etc.). • Identify and improve heavy vehicle inspection and certification; including purposes, processes and facilities (incl. inspection centers). • Study the potential and implementation of Intelligent Access Programme (IAP) and Smart Infrastructure Access Policies (SIAP) for vehicle/infrastructure/service provider, using connected vehicles and smart infrastructure. • Pay special attention to LMICs and identify their challenges and potential applications. • Encourage coordination with other TCs and TFs, such as *T.C.2.4 – Road Network Operation/ITS and T.C.4.1 – Pavements, and with HVTT Forum and ISWIM, T.F.3.1 – Road Infrastructure and Transport Security, and T.F.2.2 – Electric Road Systems.*

This Technical Committee will focus on all type of territories (urban and rural). It will also examine the best practices, monitoring and regulation to reduce overloading and associated pavement damage on road networks.

Overloaded trucks, poor vehicle conditions, driver fatigue and speeding remain a big challenge in road freight transport, especially also in LMIC's. These issues can cause severe safety problems and substantial damage to the road infrastructure. Overloading leads also to unfair competition between transport modes and transport companies.

In Europe about 8 to 15% of the trucks are overloaded. Most overloads are between 5 and 10%, some go up to 20-25%. In LMIC's the share of overloaded trucks is expected to be much higher and also the share of overloads.

Different approaches have been implemented or are under development to improve the regulation compliance using WIM and direct enforcement (e.g. in France, the Netherlands), performance based standards (e.g. in Australia, South Africa), advanced heavy vehicle inspection centers (e.g. in Switzerland and other countries) and Intelligent Access Programme and the Smart Infrastructure Access Programme (e.g. ins Australia). Especially in high income countries more advanced approaches using new technologies have been implemented and or are in a testing phase. From these approaches positive impacts are expected regarding the compliance with regulation, to increase road safety and to prevent damages to the infrastructure. Also a reduction in fuel consumption and emissions can be expected.

It is therefore necessary to make a survey and collect case studies on good practices and current developments using traditional and advanced approaches in different countries. Successful approaches and experiences will be presented and discussed in a seminar in a LMIC. The results of the survey and the case studies will be integrated in a full report available at the end of the cycle.

This contribution from PIARC will be relevant and useful for the public sector and the industry.

The topic could be addressed at the ITS conference or a workshop in HIC.

In this Cycle, a full report based on the collection of case studies is expected to be completed.

Outputs	Expected Deadlines
• Collection of case studies	• June 2021

• Full report	• December 2022

2.3.2. Greening of freight transport

Strategies / Objectives
• Investigate infrastructure and vehicle related solutions for zero emission freight transport (electrification, hydrogen, etc.)Investigate further strategies and measures (technical incl. alternative fuels, logistics, infrastructural, regulatory, demand related, business behaviour, etc.) in order to reduce the greenhouse gas emissions and other pollutant emissions of road freight transport and the use of fossil energy. • Take into account Works carried out by Special Project – Electric Road Systems. • Provide recommendations regarding suitable framework conditions, support and implementation of strategies. • Encourage coordination with other TCs and TFs, such as *T.C. 1.2 – Planning Road Infrastructure and Transport to Economic and Social Development, T.C.1.4 – Climate Change and Resilience of Road Network, T.F.2.1 – New mobility and its impact on Road Infrastructure and Transport, T.F.B.2 Automated vehicles, T.C.3.4 – Environmental Sustainability in Road Infrastructure and Transport, T.F.3.1 – Road Infrastructure and Transport Security, and T.F.2.2 – Electric Road Systems.*

Transport contributes today to about one quarter of energy-related global GHG emissions and about one fifth of energy use. The share of road freight transport is increasing and at the same time road freight transport is heavily depending on fossil fuel. The requirements for fossil independency and other emissions will be tightened. The need to reduce greenhouse gas emissions is still a dominant issue in the debate over how the transport system should be further developed. There are increased demands from various stakeholders that the climate impact from the transport system should be reduced and fossil fuels phased out. Also, pollution and noise are important issues, especially in urban areas. Tougher policy instruments are seen as a precondition, but it is hard to get political consensus. Especially for freight transport, new solutions need to be tested quickly and come into effect. In many parts of the world, different types of electrical road systems are now being tested, with continuous charging of electricity. There are of course other types of solutions and they are constantly evolving. The hydrogen is also a potential solution for freight vehicles which should be more analyzed, both on the vehicle and infrastructure sides. Also multimodality should be further addressed.

To reduce greenhouse gas emission will remain a huge challenge mid and longer term. Strategies and measures reducing the greenhouse gas emissions of road freight transport should be further investigated. This will include technical, logistics, infrastructural, regulatory, etc. measures.

The topic of electric roads should be further investigated also taking into account the results of the ERS related special project.

It is therefore necessary to collect case studies and to provide good practice fact sheets on promising approaches which support the greening of road freight transport. Successful approaches and experiences will be presented and discussed in a seminar in a LMIC.

Based on the case studies and a good practice fact sheets a briefing note is developed containing a synthesis on the actual status of investigation of approaches contributing to greening freight transport. Because still some technologies are in development stage the briefing note can provide guidance at the right stage of the development to assist the public sector in preparing suitable framework conditions.

Outputs	Expected Deadlines
• Collection of case studies	• December 2021
• Briefing note	• June 2022

2.3.3. Application of emerging technologies on freight transport and logistics

Strategies / Objectives
• Investigate and document latest developments in platooning and partly and fully automated driving in freight transport. • Investigate and document other technology trends and their impact on logistics and freight transport and the potential for the management of transport systems (Internet of things, 3D-Printing, tube logistics, share economy logistics, big data, robotic & automation, drones, etc.). • Identify institutional and regulatory issues, potential impacts regarding efficiency, quality, safety and environment. • Provide findings and recommendations regarding suitable framework conditions and implementation strategies. • Encourage coordination with other TCs and TFs, such as *T.C. 1.2 – Planning Road Infrastructure and Transport to Economic and Social Development, T.C. 2.4 – Road Network Operation/ITS, T.F. 2.1 – New mobility and its impact on Road Infrastructure and Transport* and *T.F.B.2 – Automated vehicles – challenges and opportunities for road operators and authorities, T.F.3.1 – Road Infrastructure and Transport Security, and T.F.2.2 – Electric Road Systems.*

Technology trends as internet of things, 3D-Printing, big data, self-driving-vehicles, cloud logistics and robotics create new ways in doing logistics business and in managing the (freight) transport system. Higher degrees of automation in logistics and freight transport will lead to new types of decision support and services. Digitalization and automation will also have a substantial potential to increase the productivity, reliability and flexibility of logistics and transport services. But it also needs control by society to ensure that the use of the new technology contributes to the objectives of the transport policy. To realize this potential and to ensure the contribution to transport policy objectives several important questions have to be answered, especially regarding

- the impact of digitalization and automation on logistics and supply chains (incl. the trucking industry)
- the impact of digitalization and automation on freight traffic and traffic management on roads and combinations with other modes
- the benefits of digitalization for road and multimodal freight transport and road traffic management of public infrastructure and finally
- the necessary technological, organizational and legal framework conditions for implementation.

The application of new technologies is still at the beginning. Some countries started field trials regarding platooning or other application of big data. The topic needs exploration especially regarding the potential applications and impacts and suitable framework conditions for implementation. In addition, the role of the public sector has to be clarified.

So, firstly it is necessary to make a review of the work carried out so far by different organizations, and to collect and analyze different technologies and applications.

Based on them a briefing note is developed containing a synthesis on the actual status of investigation of new technologies in freight transport including interim results and remaining value for the private sector that wants to cooperate and applicate new technologies in freight transport. Because still many technologies are in development stage the briefing note can provide guidance at the right stage of the development to assist the public sector in preparing suitable framework conditions.

For the technologies which are more mature in application (e.g. platooning, partly automated driving) a full report will be provided.

This contribution from PIARC will be relevant and useful for the public sector and the industry.

The topic could be addressed at the ITS conference or a workshop in HIC.

In this Cycle, a full report. is expected to be completed. Prior thereto, a literature review and fact sheets could be released.

Outputs	Expected Deadlines
• Literature review and fact sheets	• March 2022
• Full report	• December 2022

TECHNICAL COMMITTEE 2.4 – ROAD NETWORK OPERATION / ITS

2.4.1. Opportunities of new mobility forms for road network operation

Strategies / Objectives

• Investigate the combination of different mobility forms, old and new ones (connected and autonomous vehicles, electric vehicles, sharing cars,…).
• Highlight risks challenges and opportunities in order to guarantee integrated transport to end users.
• Investigate MaaS business model, which the clear aim of address how scaled the model should to be in order to be effective for end users and attractive for road operators, with a specific focus on:
  ○ Who should it serve
  ○ How to manage the demand?
  ○ How to integrate the choices and focus clearly on the operational aspects?
• Provide some evidences in order to support the industry in implementation and decisions.
• Encourage coordination with other TCs and TFs, such as *T.C. 1.1 Performance of Transport Administration, T.F. B.2 - Automated vehicles – Challenges and opportunities for road operators and authorities, T.C.2.1 – Mobility in Urban Areas, T.F.2.1 – New mobility and its impact on Road Infrastructure and Transport, T.C.3.1 – Road Safety, T.F.2.2 – Electric Road Systems, and T.F.4.1 – Road Design Standards.*

Mobility as a Service (MaaS) is still fairly new concept as a tool of Intelligent Transport Solutions.

MaaS tools have been launched in several countries such as:

- Finland, where this idea was born. Through the website https://whimapp.com/, users are allowed to access various modes of transport through a single app.
- Vienna (Austria) with its SMILE project-pilot. Smart Mobility Info & Ticketing System Leading the Way for Effective E-Mobility Services, which offers a unique mobility solution for users. The pilot allowed 1,000 users access to a smart app to make transport choices with 16 different service providers. The results of the pilot study are shown here http://smile-einfachmobil.at/index.html.
- Hannover (Germany), where the world's first example of Mobility-as-a-Service has been launched. GVH´s (Greater Hanover Transport Association) 'Mobility Shop,' https://www.gvh.de/, the very first fully operational example of MaaS in Germany.

One last example has been developed in order to understand the concept of MaaS. KPMG has created an innovative MaaS requirements Index to help authorities gain a deeper understanding of their platforms and where risks and opportunities lie.

This topic still needs further exploration especially in regard to its effect on road infrastructure management and operations and is quickly evolving.

Where single public transport offerings i.e. rail, bus etc. have failed to entice the private car user, MaaS offers an integrated approach to satisfy all types of users. In a highly connected society, MaaS delivers tailored solutions to fit a user's need.

It represents a convergence of public and private transportation to provide a single integrated solution for individual users needs all while still attempting to address congestion, safety and convenience.

The MaaS concept is still in a developmental stage with various countries implementing pilot projects. As with all developing concepts, there may be many benefits, but risks and challenges need to be considered.

From a demand side, the user expects a myriad of transport choices, however the back end would require multiple private and public service providers to collaborate and provide the best offers of transport. Private partners whilst integrating into such a system will still need to protect their business model whilst partnering with public agencies.

From a supply side, it would require effective operations of road and infrastructure in ensuring that the journey combinations are reliable. This concept however places great emphasis on the reliability and accuracy of traveler information systems. Users will require real time data to make the relevant mode choices. The transportation network needs to understand travel patterns, optimize the network, and calibrate demand and supply.

The front end is where the user will interact with the system and should not only provide modal offerings but transport information that can affect their journey plans i.e. construction activity, traffic alerts etc. with a simple and easy to use interface.

The concept in itself is promising with the potential to transform the way mobility and technology relate to each other however the implementation and operations is complicated where multiple parties with differing needs to cooperate and manage their risks.

In addition, the emergence of autonomous vehicles is the subject of much works and studies within and outside PIARC. In most cases, the approach is vehicle-centered, forgetting the necessary evolution of the infrastructure. Nowadays, the higher the level of automation (from 1 to 5), needs the higher the performances requirements of the infrastructure. This subject has been briefly addressed (Routes/Roads No. 373) under the acronym HQoSH (High Quality of Service Highway).

The objective is to further develop this concept. This will include identifying all the characteristics of the road that are significant for the autonomous vehicle to be able to travel safely. For each of these characteristics, it may be necessary to define a metric in order to quantify the level of quality offered by the road. This quality level could be related to the level of automation required (for example, for autonomous driving at level n (n between 1 and 5), an infrastructure offering a level of quality at level p (p values to be defined) is required). The issue of the digital infrastructure (definition, condition for updating) needs also to be addressed. Beyond the technical aspect, business aspects, stakeholder's role and underlying value chain could also be addressed. Finally, investigating how private and public sectors should direct their trades and skills to meet these new challenges would be very valuable.

Definitely, the aim of this task is to explore the critical role effective network management and operations contribute to ensuring MaaS is an attractive solution to enable the shift from car ownership to usership for transport, taking in account all the new mobility technologies. It is to address the risks and challenges and the opportunities to mitigate and manage these challenges.

So, firstly it is necessary to make a review of the work carried out so far by different organizations, and to collect and analyze different experiences. Based on them, a briefing note addresses:

- How big the model should be for it to be attractive and viable?
- Who should it serve?
- How do you manage the demand and how would you integrate the choices and focus clearly on the operational aspects?

A briefing note of this nature will therefore not only benefit the public sector but the private sector that wants to cooperate and operate in this space.

Finally, with this concept still in its early stage, this report can provide guidance at the right stage of the development to assist the industry in implementation and decisions. This contribution from PIARC will be relevant and useful if completed early enough for consumption by the industry.

Outputs	Expected Deadlines
• Literature review	• November 2020
• Collection of case studies (2 releases)	• December 2021 • March 2023
• Briefing note	• September 2021

2.4.2. Optimizing road network operation decision-making through new technologies and digitalization

Strategies / Objectives
• Identify opportunities and best practices related to the application of data related technologies and data driven decision-making. • Investigate the use of data to support and optimize real-time traffic management strategies and techniques related to ITS systems. • Study of the current use of operations and maintenance KPIs within RNO and ITS systems in order to optimize decision-making. • Take in account the work carried out by the *T.C. B.1. Road Network Operations/Intelligent Transportation Systems,* in particular on "Big data in Road transport" and develop it more to promote knowledge sharing. • Encourage coordination with other TCs and TFs, such as *T.C.1.5 – Disaster Management, T.C.2.1 – Mobility in Urban Areas, T.C. 2.2 – Accessibility and Mobility in Rural Areas, T.C.2.3 – Freight, T.F.2.1 – New mobility and its impact on Road Infrastructure and Transport, T.C.3.1 – Road Safety, T.C. 3.2 – Winter Service, T.C.3.3 – Asset Management, T.F.2.2 – Electric Road Systems, and T.F.4.1 – Road Design Standards.*

As far as "Optimizing the operation and performance of existing facilities" concerns, this topic needs to be studied more deeply because of the fast changes in technology, concepts and processes.

Road network capacity is not fully utilized, as traffic demand is concentrated on only small proportion of the road network (i.e. bottlenecks) and time-of-the day (i.e. peak periods). A balanced operation of the road network has the potential to unlock untapped productivity of the road network resulting in less congestion delay and more reliable travel times.

In the several emerging countries, a lot of road operators and governmental agencies do not have enough knowledge and funds to optimize the performance of operation and maintenance due to different reasons (political, social, legal, technical and economical and/ or lack of knowledge, goals, objectives, will, management, analysis of risks and so on).

This aim of this topic seeks to optimize the performance of operation and maintenance with a systemic and transversal point of view, involving road operators, universities, NGO´s and, urban, interurban and regional Governments.

On the other hand, other topics such as optimizing mobility and education, jobs, welfare, health, industry with their KPI´s and their contribution to the growth of the country, have been taken into account. Another topic considered is the added value or transference of technology of the developed countries to the emerging countries. That process should be developed creating strengths into the local market and in the local engineers. Indeed, emerging countries need to develop their own technologies so that they can get out of the dependence on foreign technologies. In relation to this issue, studying the transition of technology between the existing facilities and the news and the use of the drones, Big Data, electric infrastructure and vehicles, V2V and I2V communications and AI (artificial intelligence) technologies to the process of optimization should be considered too.

In addition, data is the basis for road network operations. While in the past only data generated by own resources (sensor data) has been considered for road network operations, currently, several data sources can be used for a highly improved road network operation in all areas: planning, management and maintenance. Procedures and processes within road network operator need to be improved in order to enable road network operators to use data from different sources efficiently.

Within the new cycle, best practice examples for data driven decision making need to be collected and discussed. This includes how to collect data from vehicles (or vehicle fleets), how to use this data, how to merge data from vehicle sensors with own sensor data and data from 3rd parties, and how to improve existing services with these improved data sets.

Based on the experts' discussions, the future need of a road sensor network should be evaluated. Where road network operators will still need to invest in own sensors in the future, and under which conditions data from other sources might be able to replace own sensor data.

Furthermore, the emergence of more data on road network performance (i.e. Big Data for Road Network Operations) has opened new possibilities in managing and controlling road traffic. For example, ramp signals have taken advantage of data from high density detectors on motorways to prevent flow breakdown on motorways. Similar approaches can be developed for the whole road network, particularly for the arterial road network by employing emerging data on the road network, such as Bluetooth, more detectors, probe vehicle data, etc.

The research objective would be to identify best practice in increasing the productivity of the road network through the application of Big Data and data driven decision-making. The focus would be on the traffic management strategies and techniques, including off-line (e.g. traffic signal review) and on-line (e.g. balancing traffic density or gating) approaches.

By last, we know that data-driven decision making is highly important as soon it comes to connected and automated vehicles using the road infrastructure. Therefore, a clear approach needs to be given.

Besides, almost all technical committees are dealing with data-driven decision-making. The challenge of this cycle should be how to concentrate the knowledge. Ideally, more flexible committee meetings are needed, where committees start working closer or somehow coordinate with each other than to work isolated.

The output of the research work would be a best practice review and a collection of examples case studies. The research would also identify the scale of the impacts, where available. In addition, a Seminar and a Conference/Workshop carried out within the 2020-2023 Cycle have been part of the preparation of the report.

Over the last couple of decades, governments around the world have been seeking policy and investment solutions to meet the ever increasing demand for access and mobility as the world population continues to grow. Rather than focusing on building extra capacity, more efficient solutions can sometimes be found by using existing capacity, where possible and appropriate.

There are at least two aspects to the Smart Use of Roads theme, as defined above:

- How to apply Big Data to extract additional capacities from a congested road network?
- How to balance the various demand for road space from different road users (cars, freight, public transport, cyclist and pedestrians) in a congested network?

Both topics are considerable broad themes by themselves. Both are important but the nature of expertise and application are not the same. The first topic focusses strictly on optimizing vehicular throughout, while the second topic aims to incorporate people throughput, place-making and mode share policies.

Given that within 2016-2019 cycle groundworks on Big Data have been carried out, it appears logical to consider focusing on research on the application of Big Data to optimize vehicular traffic throughput, as it extends from the groundwork already done on Big Data for Road Network Operations. It is also more in-line with the nature of the RNO/ITS technical committee's scope and expertise.

Within the 2016-2019 cycle, a report on Big Data for Road Network Operations examined the potential for the application of Big Data to Road Network Operations. The main core of the report was the framework and benefits of Big Data. It did not examine in detail the traffic operation strategies and techniques that can translate the potential of Big Data to improved road network capacity. Therefore, the topic is a novelty and timely to be studied in this cycle.

To conclude, an expected output consists in a deep report of the current values of KPI´s of the performance of operation and maintenance and the comparison with the achieved values with the new tools and processes of optimization. It is necessary to analyse and describe the different processes in several countries and to compare them with specific KPI´s. Furthermore, a high impact summary is expected to be completed within this cycle.

Outputs	Expected Deadlines
• Collection of case studies (2 releases)	• December 2021 • March 2023
• Full report.	• December 2022
• High impact summary	• June 2023

2.4.3. Sharing RNO&ITS knowledge through PIARC dedicated online resource

Strategies / Objectives

• Investigate expectations of decision makers, young professionals and middle managers above all in developing countries.
• Identify obsolescences and new themes to be added in.
• Deliver a new lean version of the RNO&ITS web resource in order to:
  ○ Provide a medium-level overview / insight into RNO-ITS for decision-makers, middle managers and young professionals,
  ○ Provide technical advice relevant to countries and regions that have not developed any ITS project yet
• Encourage coordination with other TCs and TFs, such as *T.C.2.1 Mobility in Urban Areas, T.C.2.3 Freight , T.C.3.1 Road Safety, T.C.3.3 Asset Management, T.C.4.4 Tunnels, T.F.2.2 – Electric Road Systems, and T.F.4.1 – Road Design Standards.*

The Road Network Operation (RNO) and ITS online manual is one of the few thematic online resource of PIARC. It has been developed thanks to USDoT funds and ITS America expertise and was open to public after a huge work at the end of the cycle 2012-2015 in English, and afterwards In Spanish and French.

The focus of the RNO-ITS website is the role of ITS in Road Network Operations, not the entire scope of ITS. The website is a handbook for people who are not already ITS specialists. The target of the manual is therefore not the experts, but senior staff such as decision-makers or middle managers in road authorities. The website also has value for young professionals who are learning about RNO and ITS and RNO. Many road authorities in developing countries are new to road network operations and look to PIARC for advice and guidance. The RNO-ITS website addresses this need very well, but goes well beyond in trying to keep pace with the latest developments in ITS – such as ITS-based user services and connected and automated driving.

During the 2016-2019 PIARC work cycle, the objective was to maintain and to update the RNO and ITS online manual. In order to achieve this objective, a preliminary task was to create and to edit a monitoring file describing the content of each article: author, date of last change, associated case studies and videos, etc. This file has been consolidated in late 2018 and will be one deliverable of the work of the workgroup in charge of the maintenance and of the update of the website, however it may be an unexpected deliverable.

The main objectives of the development and the update of the Road Network Operations and ITS online manual are:

- Provide a medium-level overview / insight into RNO-ITS for decision-makers, middle managers and young professionals,
- Provide technical advice relevant to countries and regions that have not developed any ITS project yet,
- Exchange knowledge and techniques on RNO-ITS.

This resource is not meant to be an academic resource.

The website is currently composed of 4 themes:

- Basics of RNO and ITS,
- Road network operations,
- Building blocks,
- Emerging economies.

Some figures (2018) about the RNO-ITS online manual give an insight about the content:

- about 350 articles, making the equivalent of 1,050 pages if the whole manual was to be

converted as a A4-page report,
- 72 case studies, aiming at increasing with the new case studies written down during the 2016-2019 cycle,
- 53 videos,
- references to PIARC reports from previous cycles.

To achieve the objectives, the website needs to be:

- technically maintained in the three languages: the content, especially the content that is not hosted on the website such as medias and external links, needs to be always accessible,
- reviewed: since PIARC stands for high-quality, out-of-date content is not welcome on this website. The review will ensure that the content is still up-to-date or will suggest articles that needs to be updated. This is particularly true for technologies within RNO and ITS, which evolve quickly,
- updated: to get the latest content, either when content is not up-to-date anymore, or if a new topic has to be tackled with, such as connected vehicles, autonomous driving, etc,

Outputs	Expected Deadlines
• New lean version of the RNO/ITS Manual	• Up to June 2023

TASK FORCE 2.2 – ELECTRIC ROAD SYSTEMS

TF 2.2.1. Electric Road Systems (ERS)
Strategies / Objectives

- Literature review and synthesis document about the need of decarbonization of the road transport, both for passengers and freight, and which role ERS could play in that decarbonization.
- Literature review of different ERS technologies, their Technology Readiness Level (TRL) and their integration in the "smart road" infrastructure:
    - Analyze new experiences from demonstration projects around the world, strengthening the practical, engineering, operational, traffic management, road safety and cyber security perspectives and other effects of deploying ERS
    - Technological aspects of interoperability among ERS and interaction with other road systems.
    - Life cycle analyses (LCA) for different types of ERS including the life cycle costs (LCC) and benefits
    - Objective 1: common understanding of pros & cons of different ERS technologies
    - Objective 2: learnings/best-practices for building & operating ERS demo sites.
- Identify stakeholders for ERS.
- Identification and analysis of national policies promoting ERS.
- Review existing and planned projects implemented on roads open to public traffic, as well as research projects outside open roads.
- Establish potential business models for road and transport administrations including:
    - Different possibilities of vehicles using ERS: only HGV, also buses, or also light vehicles
    - Potential evolutions of technologies over the next years, including recommendations for interoperability of technologies and evolution of the vehicle's categories using the ERS
    - Potential subsidies that could be granted by Governments (at least at initial stages) in exchange of reduced emissions, and their Cost Benefit Analysis (CBA)
    - Evolutions of other technologies and their impact on ERS such as electric batteries capacity, ultra-fast static charging, autonomous and shared vehicles…
    - Assessment of needs to change legislation for the road operator to be able to implement ERS, particularly when road operators/administrations will be providing the service
    - Identify and existing forum and liaise with it (or establish an stakeholders consultation group) gathering relevant stakeholders from the energy, vehicles manufacturers and haulers/logistic sectors to exchange with them about feasibility of business models
- Establish recommendations on:
    - Strategies that could accelerate implementation of ERS including CBA and risk assessment
    - Steps forward for road and transports administrations in different stages of ERS implementations (willing to analyze ERS, first implementations, further development…)
    - Future international cooperation on ERS and role of PIARC
- Contribute to an international narrative for ERS.
- Coordinate with other TCs and TFs, such as *T.C.2.3 – Freight, T.C.2.4 – Road Network Operation / Intelligent Transportation Systems, T.C.3.1 - Road safety, T.C.3.3 - Asset*

Management, and T.C.3.4 - Environmental Sustainability in Road Infrastructure and Transport.

There is a need for decarbonizing the road transport all over the world both for freight and passengers. The international Paris Agreement about the climate challenge (UNFCCC) calls for action in every aspect of the modern society. The transport sector is addressed as well, and particularly the road transport, which represents above 75% of global inland transport.

So far ERS are more developed for freight transport than for passengers but both aspects must be addressed within TF 2.2 at different levels.

The Governments of Sweden, Germany and France have agreed to cooperate within the field of ERS. ERS is one possible solution for diminishing the carbon footprint from road bound freight transports in the near future and for road passengers transport some years later. ERS bears the advantage to overcome limitations in loading capacity and driving range that impede a large-scale application of batteries and fuel cells for heavy trucks with today's technology.

Both in Germany and Sweden different ERS projects or technologies are deployed. In France there are discussions on possible tests. There are also tests being planned or conducted in many countries for example in China, USA, South Korea, Italy, India etc.

Many of the ERS techniques can be used not only for HGV but also for buses and light vehicles. This means that a possible business model for ERS could be broadened to include more types of vehicles. ERS systems bears also many possibilities to interact with other ITS systems for roads and therefore can contribute to a "smart road".

Whatever ERS techniques that can be deployed a power system to supply the ERS is also to be established. Cooperation with the power suppliers is very important for any deployment of ERS. Other stakeholders should be approached as well.

TF 2.2 could play a leading role in exchanging knowledge and experience in ERS globally. Countries should be invited to share knowledge and experiences from their planned or conducted Research and Development projects as well as from demonstrators. Findings from these activities should be continually logged and extensive summaries from the reports will be translated into English and discussed inside the TF in order to produce a Collection of case studies, a Briefing note and a Technical Report on ERS.

To promote knowledge within the field of ERS, the TF is invited to address concerns raised by parliaments and administrations, as well as from industry and non-governmental organizations. TF is invited to address as well road operation, road safety, road maintenance and cyber security aspects. TF should asses the needs and broad principles to adapt legislation to enable ERS, particularly when road operators/administrations will be providing this service.

ERS do not evolve alone within the road sector and the evolution of other technologies could have an impact on ERS, their deployment and their relevance. TF is invited to offer a brief overview of these other aspects and how their evolution could impact ERS: electric battery capacity, speed of static charging, deployment of shared and autonomous vehicles, alternative engine energies with ultra-low CO2 emissions, etc.

The cooperation should also grasp the field beyond research and development. Ways to deploy ERS should be investigated using different scenarios.

Outputs	Expected Deadlines
• Collection of case studies	• April 2021
• Briefing note	• November 2021
• Full report	• September 2022

STRATEGIC THEME 3 – SAFETY AND SUSTAINABILITY

TECHNICAL COMMITTEE 3.1 – ROAD SAFETY

3.1.1. Specific road safety issues for LMICs

Strategies / Objectives
• Identify successful stories, paying special attention to those in LMIC countries, with specific examples of safety improvement and management of road safety (in terms of key performance indicators). • Take into account safety of vulnerable users. • Identify the existing tools, processes, checklist, etc. used to achieve success. • Identify successful stories, paying special attention to those in LMIC countries, in terms of improved approach to the management of road safety. • Identify current PIARC reports considered important for LMIC. • Analyze measures and plans related with *"Decade of Action for Road Safety 2011-2020"* and *"Agenda 2030".* • Encourage coordination with other TCs and TFs, such as *T.C.2.1 – Mobility in Urban Areas, T.C.2.2 – Accessibility and Mobility in Rural Areas, T.F.2.2 – Electric Road Systems, and T.F.4.1 – Road Design Standards.*

Road crashes continue to be a major cause of death and serious injury for low- and middle-income countries. At the global level, ninety percent of traffic deaths occur in these countries. In comparison to higher income countries, where the road deaths per 100,000 is 9.2, middle income death rates are twice 18.4 and low income rates are 24.1 (World Health Organization). Almost half of these deaths are among the most vulnerable road users, including people who bike, walk and use motorcycles.

These rates would suggest that much opportunity exist within these countries to building institutional capacity, focus on addressing known safety problems through careful countermeasure selection and adoption of design standards, and use of infrastructure road safety audits could be of significant benefit in reducing death rates.

The intent of this effort is to assess and identify best practice type activities with a focus on low- and middle-income countries, and to gather specific successful examples of safety improvement and safety management activities with a particular interest on the vulnerable road users.

For low- and middle-income countries safety practitioners there is often limited institutional capacity to develop and implement simple tools, process, checklist and other methods to begin to address the road safety challenges. This work will highlight these implementation aids from a review of previous work done by PIARC in past cycles and from other relevant literature, and within the case studies as appropriate. A full report will be produced.

Outputs	Expected Deadlines
• Literature review	• October 2020
• Collection of case studies	• June 2021
• Full report	• December 2021

3.1.2. Implementation of proven countermeasures

Strategies / Objectives
• Increase road safety through the implementation of proven countermeasures to reduce accidents in motorways, rural roads and urban roads, paying special attention to vulnerable road users, speed management and fatigue. • Describe the process for selecting countermeasures given road user consideration and define good practices in strategies related to traffic safety in urban areas, paying special attention to vulnerable road users. • Analyze contribution of proven countermeasures related with *"Decade of Action for Road Safety 2011-2020"* and *"Agenda 2030".* • Take into account works carried out by *T.C.C.1 – National Road Safety Policies and Programs* and *T.C.C.2 – Design and Operation of Safer Road Infrastructure* within Cycle 2016-2019. • Encourage coordination with other TCs and TFs, such as *T.C.2.1 – Mobility in Urban Areas, T.C.2.2 – Accessibility and Mobility in Rural Areas, T.F.2.2 – Electric Road Systems, and T.F.4.1 – Road Design Standards.*

It is important for road safety programs to have a process to identify and address high crash risk locations by identifying the contributing factors to those crash sites. Careful analysis allows for the safety professional to select and implement road safety countermeasures that are most likely to reduce the likelihood and severity of crashes at a given location.

Countermeasures are selected based on their benefit to cost of implementation. It is not unusual to see similar crash patterns and crash types occurring at sites sharing common characteristics throughout the road network. In these cases, similar countermeasures can be installed at multiple locations.

Safety professionals recognize that some countermeasures are more effective at reducing the number and severity of crashes. These higher performing countermeasures are often referred to as proven countermeasures because of their large scale use and effectiveness.

The intent of this effort is to increase road safety through the implementation of proven countermeasures. It is important to recognize that not all countermeasures can be applied to all road types and because of this, different roadway types will be highlighted as part of case study development. For example, urban and rural operating environments often experience the same types of crashes but some countermeasure applications are more appropriate in an urban setting and others in the rural locations. To highlight this, case studies will be developed for both contexts.

This work will also describe the process for selecting countermeasures because this is the most important step of the process when identifying, evaluating, and selecting countermeasures. Specific attention will be provided to considerations and effects on vulnerable road users. A number of PIARC and external documents will be considered for inclusion in the final report.

The final outcome of the work will be a full report based on the collection of case studies.

Outputs	Expected Deadlines
• Literature review	• August 2021
• Collection of case studies	• March 2022
• Full report	• October 2022

3.1.3. Update Road Safety Audit Guidelines

Strategies / Objectives
• Update the Road Safety Audit Guidelines for Safety Checks on New Road Projects (2011). • Add sections to provide exemplar guidance to LMICs. • Encourage coordination with other TCs and TFs, such as *T.C.1.1 Performance of Transport Administration, and T.F.4.1 – Road Design Standards.*

Today, road safety audits are a very useful tool to improve safety of roads, by diagnosing of existing problems and detecting possible inconsistencies and / or shortcomings in the design of all the elements.

The main objective of road safety audits is the assessment and definition of potential risks of accidents on the road by establishing a safety diagnosis and proposing actions and measures aimed at the elimination, or at least reduction, in accidents. They must be carried out during the stages of planning, design, construction and operating.

T.C. C.2 – Design and Operation of Safer Road Infrastructure (SP 2016-2019) reported the need of update of PIARC Road Safety Audit Guidelines for Safety Checks on New Road Projects (2011) including additional sections to provide exemplar guidance to LMICs. A clear analysis of improvements to be conducted as well as practical recommendations on how to conduct them were included.

T.C. 3.1 should update Road Safety Audit Guidelines paying special attention to provide guidance to LMICs.

Outputs	Expected Deadlines
• Update Road Safety Audit Guidelines (RSAG)	• December 2022

3.1.4. Implications of connected and automated vehicles

Strategies / Objectives
• Analysis on classification of traffic accidents which automated vehicle can/cannot prevent. • Evaluate implications of connected and automated vehicles in road safety from the point of view of road design considerations, CAV users and all other users in special vulnerable users. • Identify best practices taking into account CAV to improve road safety. • Identify safety issues as far as transition period to automated driving concerns. • Consider the PIARC report on Road safety infrastructure's role in the transition to automated driving systems. • Encourage coordination with other TCs and TFs, such as *T.F.B.2 – Automated vehicles – Challenges and opportunities for road operators and authorities, T.C.2.4 – Road Network Operation/ITS, T.F.2.1 – New mobility and its impact on Road Infrastructure and Transport, T.C.3.2 – Winter Service, T.F.2.2 – Electric Road Systems, and T.F.4.1 – Road Design Standards.*

The benefits of connected and automated vehicles on road safety will be very significant as an increasing number of vehicles are deployed into the transport fleet. The benefits of CAV to reducing many of the 90% human error related contributing factors to crashes caused by limited vision, reaction time, control, fatigue, distraction and driving under the influence of drugs and alcohol are apparent. Although the benefits will depend on the total percentage of transition into the vehicle fleet for each country.

Question remain, for instance, how might bicycle and pedestrian safety change as these road users will likely have no way of telling which vehicles have high levels of technology and which do not and the potential for errors are relatively high. With all the benefits, how drivers behave and act during this transition may change, and it is uncertain how this change may affect the number and severity of crashes.

How we design and operate our facilities may change overtime with CAV. At this point, we believe that the earliest changes will be about providing the necessary infrastructure to support CAV, through provision of striping, communication and information systems. With more wide scale adoption there may be changes in how we design and operate roadways because of changes from designing for drivers and driver errors versus designing for autonomous operations.

A workshop will be developed to discuss and debate these issues followed with a briefing note related to the Implications of connected and automate vehicles workshop.

Outputs	Expected Deadlines
• Workshop delivery	• October 2021
• Briefing note	• April 2022

3.1.5. Update of the Road Safety Manual

Strategies / Objectives
• Updates of Road Safety Manual focus on the work carry out by the TC. • Continue with the works carried out by *T.C.C.1 – National Road Safety Policies and Programs* and *T.C. C.2 - Design and Operation of Safer Road Infrastructure* within Cycle 2016-2019 to complete the incorporation of pertinent PIARC reports on road safety (from 2003). • Launch a survey among HMLICs regarding the use, needs, gaps and issues regarding RSM and perform gaps and needs assessment to recommend changes in how to implement activities, based on priority. • Develop case worksheets or checklist to aid in the implementation and understanding of the RSM, particularly for LMICs. • Encourage implementation of Road Safety Manual.

The Road Safety Manual (RSM) is intended to increase safety performance though capacity building in road safety management. The RSM state-of-the-art international reference to the safety professional in the areas of safe planning, design and operation of the road system. The Manual is online, and available for download and printing.

The RSM was developed to be a comprehensive and accessible technical document. It highlights the Safe Systems approach to road safety management. The manual sets out a path for road safety policy makers and practitioners at work in low, middle and high-income countries.

The third addition of the RSM is an update to the second edition of the road safety manual. It improves clarity and address new information from PIARC in the 2016 – 2019 Cycle. The update incorporates numerous case studies to demonstrate application in best practices from countries around the world.

In the next cycle, the RSM working group will focus on a) working closely with the other safety working groups of the Technical Committee, b) studying the use, needs, gaps and issues of the RSM, and c) support for implementation, and d) finding ways to promote implementation of the RSM.

The RSM working group will work closely with the other safety working groups of the Technical Committee. This will allow future RSM work to incorporate and coordinate work on new documents to ensure relevant and timely updates from new and relevant materials.

A survey will be developed for use by high, medium and low-income countries (LMICs) regarding the use, needs, gaps and issues regarding the RSM and then perform a gaps and needs assessment in how to increase implementation activities.

The RSM working group will also consider the development of case study worksheets and checklists to aid in the implementation and understating of the RSM, particularly for LMICs.

Further focus will on the promotion of the RSM with examples of how best to improve dissemination and use by safety practitioners and policy makers.

Road Safety Manual will be updated during this cycle. Furthermore, a survey among HMLICs regarding the use, needs, gaps and issues regarding the RSM will be carried out, as well as elaborating worksheets or checklists for the implementation and understanding of the RSM, particularly for LMICs.

Outputs	Expected Deadlines
• Survey among HMLICs regarding the use, needs, gaps and issues regarding RSM	• October 2020

• Worksheets or checklists for the implementation and understanding of the RSM, particularly for LMICs	• December 2021
• Update of Road Safety Manual	• Up to June 2023

TECHNICAL COMMITTEE 3.2 – WINTER SERVICE

3.2.1. Integration of the new technologies in winter services

Strategies / Objectives
• General description of state of the art of the existing technologies and new technologies for winter service. • Expected technology to be used in winter service in the future. • Make a projection on what could be automated or connected equipments for winter service in the future. • Encourage coordination with other TCs and TFs, such as *T.C.3.3 – Asset Management.*

Fighting snow and ice on roads with de-icing chemicals is a major task in winter maintenance. On the main road network usually sodium chloride is used. Various studies and practical experience have proven the high efficiency of sodium chloride treatments on traffic safety and national economy. The application methods have been enhanced worldwide in the past few years. Pre-wetted salting and application of only brine are more and more established on roads and also bicycle lanes.

However, researches point out that even with pre-wetted salt at 30 percent brine quotient, the potential of salt savings with pre-wetted technology is not fully tapped. Thus, new spreaders have been developed, allowing higher brine share and/or application of only brine via spray nozzles.

In the last PIARC cycle Technical Committee B.2 - Winter Service conducted a survey of winter maintenance in the countries represented in PIARC. Scopes were winter maintenance standards, type of de-icing chemical and application method. Besides current development and research projects have been compiled.

Matters of particular interest were the development of spreading techniques in different countries, especially the application method of pre-wetted salt and brine. The current status and different ways of development were analyzed comparative. Best practices and special developments of selected countries will be presented. The report also discusses open questions such as the limit of brine at low temperatures and gives an outlook on future developments.

Around the world, scientific projects and practical approaches concerning de-icing agents and application are conducted. Among the different projects, two main findings have been made independently. Brine, either in form of pre-wetted salting or brine application has been a success. Especially for preventive treatments, brine convinced practical users. The survey of application methods showed that brine is used more and more in the last years all over the world, especially for preventive actions.

The tendency to more brine usage will be going on the next years and should be followed in a PIARC report. Literature in form of research reports and experience of new technologies in operational winter maintenance could build the basis for such a report. The infrastructure needed with the increased use of brine should also be covered in the report.

Apart from spreading techniques there has been development in mobile sensors for winter maintenance application. Such sensors have been developed to measure information's critical for winter maintenance such as temperatures, road state and water/ice film thicknesses.

With accurate measurements from a sensor network it would also be possible to give this information to road users. This can happen either using web interfaces where potential routes to the road user's destination could be checked out before departure. Other ways to communicate this information will be social media or apps for smartphones. If the users are already on the roads, they could be informed using digital road signs or comparable.

Based in a deep research on worldwide use of new technologies on winter service, the report could give some examples of tests or studies to these topics.

Outputs	Expected Deadlines
• Literature review	• November 2021
• Full report	• March 2023

3.2.2. Winter maintenance in urban areas

Strategies / Objectives
• Make a precise description of the organization of winter service in urban areas. • Response to extreme climate events, information provision, traffic restrictions, etc • Propose a Best Practices Guide with different methods used for several winter maintenance operations. • Encourage coordination with other TCs and TFs, such as *T.C. 2.1 – Mobility in Urban Areas.*

In 2014, 54% of the world's population lives in cities. If we take the example of European territory the inhabitants live 80% in a city of more than 100 000 inhabitants, 30% of the population living in a city of more than one million inhabitants. In Japan, 92% of the population lives in urban areas. The vast majority of travels start and end in cities, if they even leave an urban area. This means that road authorities in cities have to provide a good winter maintenance in order to keep the city working. Much of the winter maintenance research tends to lend itself to roads that are of higher volume traffic, and/or non-urban in nature. The intent of this topic is to focus on delivery of urban road winter service, and documentation of successful examples of that.

Compared to rural roads or highways winter maintenance in cities is different in many ways. The different modes of transportation, the lack of space for snow, often very narrow roads and one-way streets make planning winter maintenance very complex.

Many different responsible organizations (Cities, residents, public transport companies…) lead to different service intervals and times on roads next to each other or on different parts of the road (sidewalk, bikeway, bus lane, street).

A specialty of cities are pedestrian areas with a huge amount of walking and shopping persons where winter maintenance is a challenge during times of high pedestrian volume. Thus, it is necessary to finish the winter maintenance during the night to have clean and ice-free pedestrian areas during the day.

Another challenge is the lack of space for snow to be stored temporarily in urban areas. To get the snow out of public traffic areas it has to be dispatched. Some cities have restrictions for storing/dumping contaminated snow that must be removed and transported out of the city centers. Even if there are larger areas where one could store snow, these often are occupied by urban furniture and equipment. It is also of interest what smaller cities do, they have often different problems.

Due to the large percentage of sealed surfaces, compacted soil as well as other environment factors trees and other plants face more troubles compared to the natural soil next to rural roads. Therefore, it is even more important so use as little spreading material as possible in urban winter maintenance.

The plurality of the mode of transport and multimodality is big (Cars, bicycles, buses, scooter, skateboard, tramway, metro, cable transport by air, ferries…) and will be even bigger in the future due to the Political will to reduce the use of cars. A coordination with T.C. 2.1 – Mobility in Urban Areas should be established.

Cities and urban areas with significant winter weather events experience unique challenges when it comes to delivering winter services to the traveling public. Even if regular snowfalls can be handled, extreme snowfalls need special preparations and actions.

Documentation of successful urban agencies and how they deal with these challenges would be beneficial to all cities and urban areas confronted with winter weather. Due to the fact that basic

conditions vary a lot between cities there might not be a “best practice”. A report collecting different approaches however will be a very good guide to find different methods.

The report will be based on a questioner that will cover the questions and problems like the following:

- Strategy to deal with the dense road network with large variations in traffic volume
- Optimization and minimization of the routes for maintenance vehicles.
- Treatment methods and vehicles for winter on bicycle lanes
- How to create a continuous bicycle lane network with different types of infrastructure?
- Sidewalk and pedestrian areas, accessibility (for those with reduced mobility), tactile paving.
- Equipment and layout of urban areas, what to do with the snow, remove or thaw?
- Best practices for tramways, buses and other public transportation, including the tracks and access to stations.
- Solutions to ploughing different surfaces without disadvantaging any transport mode

A particularly attractive session at the XV International Winter Road Congress in Gdansk with twelve papers were presented around 10 % of the communications was on the topic winter maintenance in urban areas. The interest is very high and a report with different strategies would be of good use for people looking for solutions in urban winter maintenance and will strengthen the urban session at the winter road congress.

In this Cycle, a full report and best practices Guide based on the collection of case studies is expected to be completed.

Outputs	Expected Deadlines
• Collection of case studies	• June 2022
• Full report and best practices Guide	• March 2023

3.2.3. Implications of connected and automated vehicles on winter services

Strategies / Objectives
• Identify, investigate and document implications of connected and automated vehicles on winter service. • Encourage coordination with other TCs and TFs, such as *T.F. 2.1 – New mobility and its impact on Road Infrastructure and Transport* and *T.F. B.2 – Automated vehicles – challenges and opportunities for road operators and authorities.*

"What are we talking about when we talk about autonomous vehicles and winter service equipment and where are the problems?". The idea is to know the development of technologies in the field of winter service as well as automated vehicles.

On one hand we need to know how the use of automated vehicles impact on winter service, since they could rely heavily on road markings or other types of sensors.

On the other hand the item could be how to manage traffic in wintery conditions using sensors. Mobile sensors for winter maintenance application have been developed to measure information's critical for winter maintenance such as temperatures, road state and water/ice film thicknesses. How can we use this information for automated spreading and how can you get it to the road users?

By last, another item would be the communication in order to manage data for better winter service. At the XV International Winter Road Congress in Gdansk 2018 there have been some presentations about the developments in Vehicle to Vehicle and Vehicle to Infrastructure communication to help winter maintenance with better forecasts and real-time information. The data may include typical weather observations such as air and road temperature or relative humidity, but may also include vehicle-specific relevant data like wiper blade speed and Anti-lock Braking System (ABS) status.

A briefing note that encompasses knowledge from sharing experiences between experts from the field of winter maintenance and automated vehicles would be a good contribution.

This issue could be also an item for the XVI World Winter Service and Road Resilience Congressin Calgary.

Outputs	Expected Deadlines
• Briefing note	• August 2022.

3.2.4. Update of the Snow and Ice Data Book

Strategies / Objectives
• To update the Snow and Ice Data Book with the case studies and main findings. • To stablish the Snow and Ice Data Book as a current resource for knowledge transfer globally. • Set up the methodology to update the SIDB. • Study the possibility of developing an online manual or similar.

The Snow and Ice Databook (SIDB) as a PIARC product contains general information about winter maintenance from many different countries which makes it a very good resource for comparisons or finding of new ideas. Therefore it should be established as a current resource for knowledge transfer globally and been updated.

Due to the long update cycles it takes some time for new information to be found in the SIDB, thus the possibility of an online manual which could be updated more easily should be checked out. This also means the inclusion of an interactive format to facilitate use by members of PIARC.

The Snow and Ice Data Book will be updated during this cycle. In addition, a Workshop on the possibility of producing an online manual or similar will be carried out.

Outputs	Expected Deadlines
• Update of the Snow and Ice Data Book	• December 2021 • June 2023
• Workshop on the possibility of producing an online manual or similar	• October 2021

3.2.5. Preparation of the 2022 World Winter Service and Road Resilience Congress (8th to 12th February 2022)

Strategies / Objectives

• Prepare the technical program for the Congress including:
  ○ Summary of the specific road safety issues related to winter service
  ○ Identification of the following steps for future works
  ○ Definition of additional topics to be proposed in order to be presented as individual speeches
  ○ Evaluation of abstracts and full individual speeches
  ○ Taking into consideration possible contributions from other Technical Committees
• Possible collaboration in Foresight Sessions.
• Possible collaboration in workshops.
• Contribution to the Proceedings

The 2022 World Winter Service and Road Resilience Congress will gather winter service experts from all over the world. Its objective will be share knowledge and exchange ideas on the latest development and challenges that winter road services are facing. This T.C. is expected to prepare a call for the Technical Sessions. In addition, it would be appreciated to collaborate in Foresight Session and/or Workshops, as well as contribute to the Proceedings.

Outputs	Expected Deadlines
• Technical Session	• IWRC 2022
• Possible collaboration in Foresight Session and/or Workshops	• IWRC 2022
• Contribution to the Proceedings	• May 2022

TECHNICAL COMMITTEE 3.3 – ASSET MANAGEMENT

3.3.1. Innovative approaches for asset management systems

Strategies / Objectives
• Develop a guideline for implementing Asset Management Systems in the road sector according to ISO 55001, taking in account different road organizations and at different maturity levels. The WG will consider also other approaches and different level of maturity in the case studies. • Incorporation of life-cycle management and risk approach. • Improve and innovate managing assets approach by taking into consideration of a triple bottom line of sustainability (PPP, i.e. profit, people, planet). • Investigate the use of BIM (Building Information Model), by using a standard format, in conjunction with current AMSs used by road owners and operators. • Investigate the use of Digitalization in Asset Management. • Take into account works carried out by *T.C.D.1 – Asset Management* within Cycle 2016-2019. • Encourage coordination with other TCs and TFs, such as *T.C. 1.1 – Performance of Transport Administrations, T.C.1.2 – Planning Road Infrastructure and Transport to Economic and Social Development, T.C. 1.3. Finance and Procurement, T.F. 1.2 – HDM-4, T.C.2.4 – Road Network Operation/ITS, T.C. 4.1 – Pavements, T.C. 4.2 – Bridges, T.C. 4.3 – Earthworks and T.C. 4.4 – Tunnels, T.F.3.1 – Road Infrastructure and Transport Security, T.F.2.2 – Electric Road Systems, and T.F.4.1 – Road Design Standards.*

Asset management coordinates financial, operational, maintenance, risk and other activities related to an organization's assets in order to obtain more value from them.

ISO 55001 defines the requirements for an asset management system. This management system provides a framework for establishing asset management policies, objectives and processes, and enables an organization to achieve its strategic goals. It uses a structured, effective and efficient process that leads to continuous improvement and increased asset value.

Developing, implementing and integrating an asset management framework based on ISO 55001 ensures that the organization manages its performance, risks and costs very effectively and efficiently. For this reason, the TC will develop a guideline for implementing Asset Management Systems in the road sector, according to ISO 55001, taking in account that there are different road organizations and networks with different levels of maturity.

All of this considering the life-cycle management and the risk management approaches.

In addition, during the last decade, the BIM methodology has been progressively implemented in different countries, being for some of them a priority objective of their Public Administrations, which have imposed or valued its use in public works.

Building Information Modeling (BIM) is a collaborative work methodology for the creation and management of a construction project. Its objective is to centralize all the information of the project in a digital information model created by all its agents. BIM represents the evolution of traditional design systems based on the plane, as it incorporates geometric (3D), time (4D), cost (5D), environmental (6D) and maintenance (7D) information.

Since the use of BIM goes beyond the design phases, encompassing the execution of the project and extending throughout the life cycle of the asset, allowing the management of the asset and reducing operating costs, research into its application to the road sector is a current need.

The same goes for digitization, an innovative process that has arrived with great force and whose application to the asset management sector must be investigated. Especially topics like Big Data, Smart Data, AR/VR, and AI, can be mentioned here.

In this Cycle, the guideline before mentioned and a briefing note based on the collection of case studies is expected to be completed.

Outputs	Expected Deadlines
• Collection of case studies	• June 2021
• Briefing note on life-cycle management and risk management	• April 2022
• Briefing note on BIM and digitalization	• July 2022
• Guideline for Asset Management Systems	• December 2022

3.3.2. Measures for improving resilience of road network

Strategies / Objectives
• Identify and quantify the risks and global losses associated to damages of transportation system and to establish efficient risk mitigation strategies within a holistic approach on road infrastructure. • Overview of existing PIARC reports on this matter. • Identify best practices and approaches of Road Asset Management measures to improve the resilience of the road infrastructure. • Encourage coordination with other TCs and TFs, such as *T.C. 1.1 – Performance of Transport Administrations, T.C.1.2 – Planning Road Infrastructure and Transport to Economic and Social Development, T.C. 1.4 – Climate Change and Resilience of Road Network, T.C. 1.5 - Disaster Management, T.F. 1.2 – HDM-4, T.C.2.4 – Road Network Operation/ITS, T.C.4.1 – Pavements, T.C.4.2 – Bridges, T.C.4.3 – Earthworks* and *T.C.4.4 – Tunnels, T.F.3.1 – Road Infrastructure and Transport Security, T.F.2.2 – Electric Road Systems, and T.F.4.1 – Road Design Standards.*

In the context of the Financial/Economic aspects of resilience, it is acknowledged that the road network is a fundamental component to the effective running of the economy. Where disruptions occur due to a range of hazards, the network is as a result compromised, and this leads to serious loss in financial and economic costs to agencies, road operators and transport users. Resilience is therefore of high importance to ensure that road user costs and socio-economic costs are reduced. In principle, when considering economic aspects within the framework of resilience management, the measurement of vulnerable road infrastructure and adaption options should be considered.

Road Administrations are responsible for the management of road networks, which are an important asset for a country. Efficient asset management requires preparing the infrastructure to cope with the various risks that can damage it. The approach to increasing the resilience of road networks must be holistic, to consider all possible risks and the interactions between them, and to determine what may be the most appropriate and cost-effective adaptation procedure.

In this Cycle, a full report summarizing measures to improve resilience of road networks is expected to be completed. Prior thereto, it would be interesting to carry out inteviews and case studies on this matter.

Outputs	Expected Deadlines
• Inteviews and case studies	• December 2021
• Full report	• December 2022

3.3.3. Renewal and rejuvenation of aging infrastructure

Strategies / Objectives
• Identify best practices and approaches of road asset management that support the renewal and modernization of aging road infrastructure, including the management of road renewal backlogs. • Take in account the emerging vehicle and infrastructure technologies. • Build on the findings of *T.C.D.1 – Asset Management* within Cycle 2016-2019. • Encourage coordination with other TCs and TFs, such as *T.C. 1.1 – Performance of Transport Administrations, T.C.1.2 – Planning Road Infrastructure and Transport to Economic and Social Development, T.C. 1.3. Finance and Procurement, T.C.2.4 – Road Network Operation/ITS, T.F.2.1 – New mobility and its impact on Road Infrastructure and Transport, T.F.B.2 – Automated vehicles, T.F.3.1 – Road Infrastructure and Transport Security, T.C. 4.1 - Pavements, T.C. 4.2 - Bridges, T.C. 4.3 - Earthworks, T.C. 4.4 – Tunnels, T.F.4.1 Road Design Standards, T.F.2.2 – Electric Road Systems.*

Several elements of the road networks are reaching the end of their working lives. Some of them are easy to reinforce or to replace, but others face more challenges. This is the case of structures, many of them around the world now are reaching a point where significant structural or material repair is needed.

Challenges are various. Changing needs place stresses on infrastructure that may not have been considered when they were first designed and built. For example, the weight and quantity of commercial vehicles in use have increased significantly. Bridges designed for traffic 40 years ago are now coping with very different loads; one reason why unforeseen use is one of the main causes of bridge failure.

Similarly, assets that were built to comply with less stringent safety standards than we expect today continue to play a fundamental role in our daily lives. Bringing those assets up to date carries inherent risks – both during maintenance and upgrade works and also during the remaining life of the asset.

How can Road Administrations evaluate the risks and prioritize strategies for rehabilitation, repair or replacement? These asset owners work closely with research and academic institutes to ensure scientific methods and cutting-edge knowledge is applied in order to measure the state of their infrastructure, since the core question is in the evaluation. It might struggle to calculate the remaining life of an existing structure. Most engineering programs focus predominantly on design, but now we are realizing that upskilling is required for those who are interested in age care of existing structures.

And finally, the huge challenge of finding the funds for evaluate, repair or replace the ageing road elements. At least, they must be carefully monitored and maintained regularly.

Ageing infrastructure is a global issue with potentially harmful consequences. Innovative approaches are required to address this main issue.

In this Cycle, a full report is expected to be completed, based on the literature review, interviews and case studies carried out in advance.

Outputs	Expected Deadlines
• Literature Review	• December 2020
• Interviews and case studies	• December 2021
• Full report	• December 2022

3.3.4. Update of the Asset Management Manual

Strategies / Objectives

• Upgrade the content of the Road Asset Management Manual by:
  ○ Increasing the number of cases studies in order to cover all levels.
  ○ Introduction of the following topics:
  ▪ Cross asset investment prioritization and optimization
  ▪ Incorporation of life-cycle cost analysis *"LCCA"* into asset management process
  ▪ Initiatives to integrate resilience management of risks posed by natural hazards into asset management of road networks
  ▪ Innovation elements to integrate BIM and database of management system
• Extend the education and dissemination section of the Road Asset Management Manual by:
  ○ Enhancement of existing training material
  ○ Adding further training material for:
  ▪ Various target audiences
  ▪ Different maturity levels
• Take into account works carried out by *T.C.D.1 – Asset Management* within Cycle 2016-2019.

During the 2012-2015 cycle, a Web-based electronic Road Asset Management Manual was designed and developed building on the work of the previous cycles and integrating the outputs of that cycle. The T.C. D.1 "Asset Management" (cycle 2016-2019) upgraded it by including case studies and practical examples.

The Road Asset Management Manual will be updated during this cycle by incorporating innovative approaches useful for Road Administration and by increasing the case studies. Make the education section available on the web and propose new sections will be, both, objectives for this cycle.

Special effort will be made to increase dissemination and training.

Outputs	Expected Deadlines
• New proposed sections	• December 2020
• Make the education section available on the web	• June 2021
• Additional case studies	• December 2022
• Update of the Road Asset Management Manual	• June 2023

TECHNICAL COMMITTEE 3.4 – ENVIRONMENTAL SUSTAINABILITY IN ROAD INFRASTRUCTURE AND TRANSPORT

3.4.1. Real-time evaluation of pollution and mitigation measures

Strategies / Objectives
• Identify traffic operations to minimize the health impact of vehicle emissions. • Investigate and assess how road administrations could help in order to improve air quality through a real time evaluation of pollution and use of low cost air quality sensors, and implement operational mitigation measures. • Take into account works carried out by *T.C.E.2 –Environment Considerations in Road Projects and Operations* within Cycle 2016-2019. • Encourage coordination with other TCs and TFs, such as *T.C.1.4 – Climate Change and Resilience of Road Network, T.F.2.1 – New mobility and its impact on Road Infrastructure and Transport, T.F.B.2 Automated vehicles and T.C. 2.4 – Road Network Operation/ITS, T.F.3.1 – Road Infrastructure and Transport Security, T.F.2.2 – Electric Road Systems, and T.F.4.1 – Road Design Standards.*

Air pollution problems are often observed in the roadside areas of metropolitan regions, where a lot of emission sources such as factories, business offices, residential houses and vehicles accumulate.

Such air pollutions are caused by emissions of SO2, NO2, CO, HC, PM10, PM2.5 etc. which are designated as air pollutants in most countries across the world.

In order to carry out air pollution abatement measures we have long-term evaluation values and short-term evaluation values as regulation standards of air pollutant emissions, and as a step of implementation of the measures we compare real-time evaluation values with the short-term values of regulation standards.

There are several low-cost air quality sensors being used across the world, and they are, of course, different from each other depending on the air pollutants to be evaluated. Such sensors should be assessed in terms of accuracy in measuring and cost.

We also need to prepare a menu of various traffic operation measures to be adopted when real-time values of air pollutant concentrations exceed the short-term regulation standards, and we will select some measures from the menu by examining their applicability to actual sites where air pollution problems occur.

In this Cycle, a full report is expected to be completed. Prior thereto, a Workshop will be carried out.

Outputs	Expected Deadlines
• Workshop	• September 2021
• Full report	• October 2022

3.4.2. Noise mitigation

Strategies / Objectives
• Identify improvements of pavement design, construction and maintenance in order to optimize the acoustic performance – as a joint collaborative effort between design, paving, construction and acoustic specialists. • Identify factors and criteria that may affect the choice of a solution to protect against road noise in accordance with the principles of sustainable development. • Update the database that includes traffic noise policy requirements across PIARC member countries. • Take into account works carried out by *T.C.E.2 –Environment Considerations in Road Projects and Operations w*ithin Cycle 2016-2019. • Encourage coordination with other TCs and TFs, such as *T.C. 2.4 – Road Network Operation/ITS, T.C.4.1 – Pavement,* and *T.F.4.1 – Road Design Standards, T.F.3.1 – Road Infrastructure and Transport Security, T.F.2.2 – Electric Road Systems, and T.F.4.1 – Road Design Standards.*

Road traffic noise problems emerge along trunk roads, which usually have large traffic volume including a number of heavy freight vehicles and have many residential houses in their roadside areas.

Road traffic noise mainly comprises engine noise, intake air noise, exhaust gas emission noise, Aeolian noise and tire-pavement noise (road noise), which are considered noise sources of the road traffic noise.

Such noise sources variously contribute to the road traffic noise depending on vehicle types and vehicle driving modes like low-speed driving or high-speed driving and further stable driving or accelerated driving.

In terms of tire-pavement noise (road noise) road pavement types and maintenance levels of pavement surface affect the noise level very much.

Pavement characteristics in tire-pavement noise differ from one pavement type to another. Asphalt pavements in general have a low noise profile compared to concrete pavements.

Within the asphalt pavements, so-called drainage pavement, which has a lot of pores in its structure, has a lower noise profile than the dense-graded asphalt pavement commonly used. This means the drainage pavement has a reduction effect on the road traffic noise, although the pavement has been developed for water being drained through the pores to avoid water staying on the pavement surface and then to enhance traffic safety during raining.

As to the road surface maintenance levels, unevenness degree of the pavement surface and micro-texture of the surface definitely affect the road noise level, and over-time degradation of the pavement surface make the noise level higher.

The concrete pavements have generally coarse surface micro-texture compared to the asphalt pavements, which is thus a factor that the former makes larger tire-pavement noise. And therefore surface treatments of the concrete pavements should be needed to make surface texture finer and thus to improve their noise emission performance.

In this Cycle, Workshop, as well as a briefing note are expected to be carried out. In addition, during this cycle, the Database will be updated.

Outputs	Expected Deadlines
• Workshop	• August 2021
• Briefing note	• February 2022
• Update Database	• June 2023

3.4.3. Road and road transport impact in wildlife habitats and their interconnections

Strategies / Objectives
• Understand how road and road transport impact in wildlife habitats and their interconnections. • Develop a road corridor landscape design and its role in ecological habitat connectivity. • Identify barrier effect mitigation for wildlife. • Encourage coordination with other TCs and TFs, such as *T.F.4.1 – Road Design Standards, T.F.3.1 – Road Infrastructure and Transport Security, and T.F.2.2 – Electric Road Systems.*

When road construction is implemented in the areas with affluent natural environment, the following various impacts take place in a vicinity of the road construction, which we should recognize:

- Natural habitats of wildlife disappear at the road construction site.
- The natural habitats are divided and fragmented into pieces of small habitats.
- Road traffic noise and vehicle emission gases affect fauna and flora in the roadside areas.
- Animals passing the road would collide with the running vehicles and might die, so-called road kills.
- Artificial constructions of roads do not match the natural environment and damage the natural scenery.

Planting areas, median-dividers and road slope surfaces of embankments and cuttings are preferably planted in order to harmonize the road construction with its local natural environment. At the same time, such areas above within the roads need to be designed in structures and devices in order to allow small animals to easily go through the areas, securing connectivity of wild habitats and forming so-called ecological network.

When wildlife habitats fragmented by the road construction, some of animal species will not be able to survive if living on such small fragmented habitats which cannot feed enough food. In such a case fauna passages are required to connect both sides of the road constructed, and we would need to investigate some knowledge and devices for the animals to easily use such fauna passages.

In this Cycle, a full report based on the collection of case studies is expected to be completed.

Outputs	Expected Deadlines
• Collection of case studies	• December 2021
• Full report	• December 2022

TASK FORCE 3.1 – ROAD INFRASTRUCTURE AND TRANSPORT SECURITY

T.F.3.1.1. Embedding security into other infrastructure / transport-related topics

Strategies / Objectives

- Starting from the outputs in the final report of T.F. C.1 (SP 2016-2019), tailored contribution to the following PIARC TCs/TF:
  - TC 1.1 Performance of Transport Administrations
  - TC 1.4 Climate change and Resilience of Road Network
  - TC 1.5 Disaster Management
  - TC 2.1 Mobility in Urban Areas
  - TC 2.2 Accessibility and Mobility in Rural Areas
  - TC 2.3 Freight
  - TC 2.4 Road Network Operation/ITS
  - TF 2.1 New Mobility and its Impact on Road Infrastructure and Transport
  - TC 3.1 Road Safety
  - TC 3.3 Asset Management
  - TC 4.2 Bridges
  - TC 4.4 Tunnels
  - Terminology Committee
- Auditing, testing and monitoring : the Security Consideration Assessment (SCA) process.

The final Report "Security of Road Infrastructure" of PIARC TF C.1 (SP 2016-2019), set out the general principles of a security-minded approach as well as the technical and operational recommendations to protect against a range of physical and cyber threats.

The issues associated with road infrastructure are varied and complex, and with the increasing use of cyber-physical systems in their monitoring and management, many more disciplines involved in the lifecycle of road assets need to have an understanding and appreciation of the security issues that arise. Furthermore, the modern complexity of road issues requires a holistic attitude and by its nature security is contrary to a silo approach and transversal skills are required. Therefore, light-touch inject into the work now being undertaken by each of the PIARC TCs/TF that are affected by security risks is required.

In the 2016-2019 cycle, TF C.1 did not draw any correlations between its work and that being undertaken by any of the TCs or TFs. Therefore, an important aspect to be integrated in the 2020-2023 cycle will be to identify these correlations, develop the inject required, build the relationships with the interested technical committees and task forces and to work with them to embed the content and concepts which have been produced. It will be essential to consider not only the current security risks, but those which are likely to evolve from a national and international perspective.

Particular attention will need to be paid to security considerations in relation to automated vehicles and smart roads. The report produced by the TF B.1 "Road design and infrastructure for innovative transport solution" (SP 2016-2019) entitled "Connected vehicles", acknowledges security as being an important challenge that needs to be tackled by appropriate experts. A new TF B.2 "Automated vehicles: challenges and opportunities for road operators and road authorities" was created in 2018 and its work is currently due to come to an end in 2020, just at the beginning of the cycle 2020-2023.

As well as providing high-level guidance for different road infrastructure specialisms on embedding security and security-mindedness , TF 3.1 will produce a more detailed guidance document on the utilisation of a Security Consideration Assessment (SCA) process that can not only facilitate embedding a holistic security-minded approach within and across road infrastructure organisations

and their supply chains, but also with keeping the number and severity of security incidents to a minimum throughout the lifecycles of the different assets.

This TF 3.1 is expected to develop a full report including the recommendations for each TCs/TF around the awareness raising in security and the development, implementation and management of appropriate and proportionate, practical risk mitigation measures and provide specialist glossary to the Terminology Committee.

A final workshop or Seminar will be organized to disseminate and share knowledge of holistic security measures to deal with physical and cyber security threats based on the content contained in the final report of TF 3.1. and to raise awareness and encourage Road Administrations and operators to embed security in their organization and to promote de use of the SCA process.

Outputs	Expected Deadlines
• Literature review	• October 2020
• Full report	• November 2021
• Workshop/Seminar	• June 2022

STRATEGIC THEME 4 – RESILIENT INFRASTRUCTURE

TECHNICAL COMMITTEE 4.1 – PAVEMENTS

4.1.1. Use of Recycled Materials in Pavements

Strategies / Objectives
• General description of state of the art of the existing technologies and new technologies for recycling pavements. • Evaluate the use of these techniques in the world, separating by type of road, traffic flow, type of pavement, type of recycling, etc. taking into account the regulations and whether or not there are incentives. • Identify successful pavement recycling projects. • Encourage coordination with other TCs and TFs, such as *T.C. 3.3 - Asset management and T.F. 4.1 – Road Design Standards.*

The issue of recycling road pavements has been addressed in earlier cycles. In 2003 PIARC published a report from TC C7/8 on “Pavement Recycling”. This report contains guidelines for in-place recycling with cement, emulsion or foamed bitumen and hot mix recycling in a plant. During the 2012-2015 cycle there was another objective on “Recycling and Reuse of Materials for Pavements”. However, the report was never finalized and hence not published.

The first part of task 4.1.1 can built on these earlier reports to give a state of the art of existing technologies and to update with new technologies that have emerged during the last decade. In this Literature Review both in-place and in-plant techniques should be addressed, as well as the use of hydraulic (cement and other) or bituminous binders. The recycled materials can be bituminous bound materials, cement concrete, bound and unbound base layers, etc. The purpose is to as comprehensive as possible.

The second output is a Collection of Case Studies. This report should contain a collection of successful implementations from around the world from the techniques discussed in the Literature Review. These case studies can also be non-technical, e.g. how recycling is introduced in a certain country, how to deal with environmental aspects such as the recycling of dangerous substances (tar, asbestos, ...).

A Briefing Note could summarize the main findings.

Outputs	Expected Deadlines
• Literature review	• December 2020
• Collection of case studies	• June 2021
• Briefing note	• September 2021

4.1.2. Innovative pavement maintenance and repair strategies

Strategies / Objectives
• Identify innovative pavement maintenance and repair strategies of pavements in motorways, urban roads and rural roads. • Pay attention to innovative mechanization or even robotics. • Encourage coordination with other TCs and TFs, such as *T.C.2.2 – Accessibility and Mobility in Rural Areas and T.C.3.3 –Asset Management.*

The purpose of this task is to publish a Collection of Case Studies regarding innovative maintenance.

The different pavement “families” should be addressed - asphalt, concrete, ... - as well as different road types. T.C. 2.2 has the task to provide “technical solutions for unpaved roads”, which also covers maintenance, so unpaved roads are out of scope for T.C 4.1, although a collaboration between the two committees will be carried out however.

Innovation can be on the technical level, such as the use of special/new materials or the use of special techniques. But innovation can also be on the organizational level to answers questions on how to do maintenance on motorways with limited interruption of traffic or in urban areas to reduce hindrance to residents.

Several research programmes (e.g. by CEDR in Europe, Infravation projects, ...) deal with innovative materials to do maintenance/repair, which could be input for this task.

Therefore, a Collection of case studies that let know best practices would be a good approach to this issue. The main findings would be included in a Briefing note.

Outputs	Expected Deadlines
• Collection of case studies	• June 2022
• Briefing note	• September 2022

4.1.3. Road monitoring and management based on Big Data and Data Analytics

Strategies / Objectives
• Investigate the use of Big Data for monitoring the condition of roads. • Encourage coordination with other TCs and TFs, such as *TC 3.3 – Asset Management.*

In the last two cycles, two reports on Road Monitoring have been published. The first report (published in 2015) dealt mainly with traditional road monitoring techniques, the second report discusses also technologies in the development and experimental stages. Both reports have (short) chapters on the use of smartphone data and CAN-bus data.

The purpose of Issue 4.1.3 is to give a more comprehensive Literature Review on the use of Big Data in the field of road monitoring and should deal with how data is collected and analyzed, the data quality, what distresses can be measured, etc. The main findings would be included in a Briefing note.

The result of this task could be an input to update the PIARC Asset Management Manual, which is maintained by T.C 3.3.

Outputs	Expected Deadlines
• Literature review	• December 2021
• Briefing note	• March 2022

4.1.4. Measures for improving resilience of pavements

Strategies / Objectives
• Identify materials and construction and maintenance techniques for enhancing resilience of pavements. • Encourage coordination with other TCs and TFs, such as *T.C.1.4 – Climate Change and Resilience of Road Network T.C. 3.2. Winter Service, T.C.4.3 – Earthworks and T.F.4.1 Road Design Standards.*

This is the main task of the TC which covers the whole strategic theme “Resilient Infrastructure”.

T.C E.1 – Adaptation Strategies / Resiliency (SP 2016 2019) of the former cycle has done already some preliminary work on the subject of resilience. They defined resilience as “the ability to repel, prepare for, take into account, absorb, recover from and adapt ever more successfully to actual or potential adverse events, i.e. catastrophes or processes of change with catastrophic outcome which can have human, technical or natural causes”. T.C 1.4 continues this work with a holistic approach to resilience, its PIARC Climate Change Adaptation Framework is also input for this task.

The first part of the Full Report should analyse how this definition of resilience translates to pavements and can cover “adverse events” such as

- climate change and extreme weather conditions
- natural and man-made disasters
- increased traffic or higher axle loads
- ...

A second part should identify how to deal with these threats to enhance the resilience of a pavement. This can be done via

- the choice of materials
- road design, cfr. T.C 4.1
- construction and/or maintenance techniques
- ...

This second part could take the form of a collection of case studies.

Outputs	Expected Deadlines
• Collection of case studies	• June 2022
• Ful report	• December 2022

4.1.5. Carbon footprint

Strategies / Objectives
• Make the PIARC community aware of the existence of the report “Reducing the life Cycle Carbon Footprint of Pavements (2019R33).

Environmental consciousness is on the rise and many owners and operators of road infrastructure are looking for solutions to make their practices and policies greener or more sustainable. The purpose of this topic is to collect and analyze tools as well as practice ready solutions with regard to the CO2 indicators for road pavements over its entire service life.

Outputs	Expected Deadlines
• High impact summary	• March 2021

4.1.6. 9th Symposium on Pavements Surface Characteristics (SURF 2022)

Strategies / Objectives
• Organize in conjunction with a PIARC National Committee and the Secretariat General the 9th Symposium on Pavements Surface Characteristics SURF 2022. • Prepare the technical program for the Symposium.

Every four years the Symposium on Pavements Surface Characteristics, SURF for short, is organised. The former SURF symposiums were organised in:

- 1988: Pennsylvania, USA
- 1992: Berlin, Germany
- 1996: Christchurch, New-Zealand
- 2000: Nantes, France
- 2004: Toronto, Canada
- 2008: Portoroz, Slovenia
- 2012: Norfolk, USA
- 2018: Brisbane, Australia

Traditionally, a road research institute takes the lead in organizing the symposium. Some members of the TC will be part of the scientific committee. All members will be involved in the review process of abstracts and/or papers.

Outputs	Expected Deadlines
• Symposium	• Up to September 2022.

TECHNICAL COMMITTEE 4.2 – BRIDGES

4.2.1. Measures for increasing adaptability to Climate Change

Strategies / Objectives

• Collect case studies of damage resilient measures in different countries to climate change.
• Establish criteria for the design and construction of more resilient bridges.
• Search for innovative solutions to extend the service life of the bridges and rehabilitate them in the most-effective way:
  ○ Advancement of inspection techniques/technologies and bridge management systems
  ○ New rehabilitation materials and technologies.
• Encourage coordination with other TCs and TFs, such as *T.C.1.4 – Climate Change and Resilience of Road Network, T.F.3.1 – Road Infrastructure and Transport Security, T.C. 4.3 – Earthworks, T.F.4.1 – Road Design Standards, and T.C.3.3 – Asset Management.*

There are already signs of extreme weather in certain parts of the world resulting in events heavy rain, flooding and typhoons. The frequencies of some of these events are also increasing.

In general, there are extreme natural events being experienced in many countries resulting in loss of lives and loss or damage to infrastructure.

Climate change has become a global issue of concern and it is for this reason that PIARC has incorporated it into the strategic themes and technical committee bridges for the terms of 2008-2011 and 2012-2015.

PIARC's International Climate Change Adaptation Framework for Road Infrastructure was produced by PIARC T.C E.1 - Adaptation Strategies and Resiliency (SP 2016-2019). Outputs associated with the issue "Measures for increasing resilience to climate change" will be expected to provide several measures which will be options for road owners within this Framework.

With regard to road bridges, concerns associated with climate change are the extreme day and night air temperatures causing expansion and contraction of bridge superstructures, frequency and intensity of rainfall (causing major flooding), and so on.

Importantly, however, most countries cannot qualify that these events are as a result of climate change. Furthermore, there is very limited information about the effects of climate changes on bridge design and maintenance.

Because of that, it is important first to clear and define the climate change for bridges in order to collect proper information and case studies associated with measures for increasing resilience to climate change.

Based on the above recognition, the scope of this study was first to investigate how the various countries define climate change and policies through literature review and questionnaires, and second to collect case studies with respect to the defined climate change impact, which are applied as measures for increasing resilience to climate change. The main findings would be included in a Briefing note.

Outputs	Expected Deadlines
• Literature review	• April 2021
• Collection of case studies	• April 2022
• Briefing note	• October 2023

4.2.2. Forensic engineering for structural failures

Strategies / Objectives
• Investigate current approaches to forensic engineering in order to ensure safety of the bridges and improve bridge standards.   ○ Identify good practices in managing all data and documentation obtained from failure captures in order to produce actionable information • Encourage coordination with other TCs and TFs, such as *T.C.1.5 – Disaster Management, T.C.3.1 – Road Safety, T.C.3.3 – Asset Management, T.F.3.1 – Road Infrastructure and Transport Security, T.C. 4.3 - Earthworks and T.F. 4.1 – Road Design Standards.*

Despite modern inspection methods and approaches, there are still bridge collapse disasters due to deteriorated materials or systems, construction defects, overloads, and poor design. Recent examples include the collapse of the I-35W Bridge over the Mississippi River in Minnesota as well as the Genova Bridge in Italy.

When a bridge collapse occurs, engineers investigate the cause of collapse to identify how design, materials, workmanship, and/or overloading affected structural performance.

In this meaning, Forensic engineering plays an important role in improving the safety of bridges. Engineers learn from the results of the Forensic engineering investigations and make improvements to the requirements of design, construction and maintenance in order to prevent these tragedies from reoccurring.

Laboratory experimental techniques and computer simulations have become highly developed to analyze material and system failures.

Expert witness testimony is commonplace to determine criminal and civil liabilities. Strategically placed cameras and data recording systems can often capture failures as they occur, greatly reducing the uncertainty of conflicting eyewitness reports.

An understanding of how to best capture all of this data and documentation to produce actionable information would be of value to the bridge engineering community and lead to the improved safety of bridges. Therefore, it is required to investigate the current approaches to forensic engineering in order to improve the safety of bridges and to include the findings in a report.

Outputs	Expected Deadlines
• Full report	• June 2022

4.2.3. Advancement of inspection techniques / technologies and bridge management systems

Strategies / Objectives
• Including electronic inspection techniques, drones, structural health monitoring/bridge instrumentation, Lidar, Radar, Thermography, big data analysis, machine learning – AI, BIM modeling, scour monitoring) • Encourage coordination with other TCs and TFs, such as *T.C 3.3 - Asset management, T.F. 3.1 – Road Infrastructure and Transport Security, and T.F.4.1 – Road Design Standards.*

Bridge inspections form an essential basis for the maintenance management of bridges and engineering structures. New technologies such as remote sensing and the use of a variety of sensors have the potential to significantly improve the quality of the results of structural inspections, but due to a lack of experience on the part of owners and operators they are not yet being used comprehensively.

The aim of the topic is to collect and process experience on the use of these new technologies on the basis of case studies and thus to make these technologies more readily available.

Outputs	Expected Deadlines
• Collection of case studies	• March 2021
• Briefing note	• October 2021

4.2.4. New rehabilitation materials and technologies

Strategies / Objectives
• Analyze the use of new materials and technologies such as steel (new combinations of strength and ductility), concrete (new cement, high performance shotcrete), composite, 3D printing for bridge repair. • Encourage coordination with other TCs and TFs, such as *T.C 3.3 - Asset management, and T.F.4.1 – Road Design Standards.*

Aging infrastructure with only limited functional capacity pose a major problem in terms of maintaining the mobility of people and the transport of goods. Bridges and other engineering structures are particularly important here because of their bottleneck function.

Within the framework of this topic, solutions are to be identified which can be used to accelerate and improve the repair and structural upgrade of bridges under traffic. In addition to new high-performance materials, the focus is also on the use of new technologies and construction methods with the focus on "Construction under Traffic".

Outputs	Expected Deadlines
• Collection of case studies including TC members comments	• April 2022
• Briefing note	• November 2022

4.2.5. Bridges damage-resilient in seismic areas

Strategies / Objectives
• Evaluation of the effectiveness of different retrofit techniques to enhance seismic resilience of highway bridges. • Comparison of different measures to improve the seismic resistance. • Encourage coordination with other TCs and TFs, such as *T.C.3.3 – Asset Management, T.C.4.3 – Earthworks,* and *T.F.4.1 – Road Design Standards.*

Seismic events caused severe damage on road bridges in seismic areas. It had resulted in closing of road networks.

Bridge damage causes not only bridge repair and restoration, but also produces indirect economic losses due to network disruption as well as traffic delay.

Therefore, it is always desirable to minimize these negative consequences from extreme events and to maximize disaster resilience of highway infrastructures.

Seismic retrofitting of road bridges is one of the most common approaches accepted by bridge owners to enhance system performance during seismic events.

In this relation, this issue evaluates the effectiveness of different retrofit techniques to enhance seismic resilience of highway bridges.

Seismic resilience of bridges can be represented as a combined measure of bridge seismic performance and its recovery after the occurrence of seismic events.

Comparison of different measures to improve the seismic resistance will be a good example for road owners to make decisions. They could be analyzed by a collection of case studies.

Hence, results obtained from this study would be drafted in a report that helps in educated decision-making for selecting efficient and cost-effective seismic design and/or retrofit strategies for highway bridges.

Outputs	Expected Deadlines
• Collection of case studies	• June 2022
• Full report	• December 2022

TECHNICAL COMMITTEE 4.3 – EARTHWORKS

4.3.1. Measures for increasing resilience of Earth Structures to natural hazards

Strategies / Objectives

- Collect existing references about resilient earth structures under natural hazards including those due to climate changes.
- Collect case studies: focus on existing structures affected by natural hazards and see how the stakeholders managed during and after the event. Consequences during (impact) and after (modification of works?) the technical failure of the earth structure. Study how previous failures have generated the use of preventative measures during new earth structure construction. Collate lessons learned and case studies on how we can increase resilience to be prepared and prevent those failures, including successful stories of resilient roads.
- The final report will gather information about what can be done after a failure and if preventive measures can be put in place so that it can be avoided.
- Encourage coordination with other TCs and TFs, such as *T.C.1.4 – Climate Change and Resilience of Road Network, T.C. 2.2 – Accessibility and Mobility in Rural Areas and T.F.4.1 Road Design Standards.*

Resilience is a new term which can explain the adaptation of the road infrastructure to an external event. The infrastructure is considered resilient when, after an extreme and destructive event, its repair makes it possible to return to a sufficient level of use, close to the one preceding the event.

Challenges? Minimize the delays of shut down for axis of transport. Some can be identified as major or critical for mobility. The disorders caused to earthworks are often disorders affecting the entire structure, generally cutting off traffic and mobility on this axis and making dangerous the immediate surroundings.

The damage, caused by a climatic event and / or a natural hazard, are numerous and varied. They range from the complete destruction of the section, to obstruction or degradation of the quality of use by cracking, deformation or rutting.

The natural hazards in question are most often:

- earthquakes,
- landslides,
- rockfalls,
- erosion phenomena,
- storms, tsunamis, hurricanes
- rising water,
- drought, fires,
- collapses of cavities

One frequently cited example of the need for resilient infrastructure is earthquake disasters. An earthquake generates in a few seconds or minutes significant damages and casualties around its epicenter. The material damages evolve shortly after the event, while the number of victims can double or even triple if access to affected areas, are not quickly re-opened to help.

Often linked to the transport infrastructure, the water network, telecommunications and energy networks (electricity, gas) are sorely lacking after an earthquake and networks failures worsen the situation. A health disaster is added to the natural disaster.

(extract RGRA n ° 961, G. Rul) "The floods of June 2016 in the Loiret led to the cutting of the A10 motorway, strategic axis between the center of France and Paris, and to the paralysis of the northern sector of Orléans. That same year, the forest fire near Marseille requiring the closure of

the highway had repercussions on all transport networks. Finally, the landslide of Chambon in 2015 caused the closure of the tunnel on the RD1091, the isolation of the population and the paralysis of a whole valley. "

The 5th generation road will have to be thought as resilient from the moment of its conception. For that, it can be proposed the following:

- Road designers will have the list of hazards that can likely affect sections of roads, and these hazards will be listed from the worse to the less important on each sections of identical issues.
- Stakeholders will have to define the minimum level of use they want to maintain in the event of a hazard, and in the same time, the maximum tolerable delay during which the infrastructure cannot be used, and therefore the delay for its repair.
- The design will assess the economic and social risks associated at the occurrence of the hazard.

The subject of resilience for earthworks is a new subject. Therefore, it requires specific thinking that can first be based on key definitions. A consensus will have to be found around these definitions. The Report drafted by Technical Committee T.C. D.4 - Rural Roads and Earthworks (SP 2016-2019) “Management of Earthworks” should be completed by the way.

The return to an optimal or sufficient level of use, strongly depends on identified parts of earthworks i.e.: embankments, natural ground, construction tracks, unpaved roads, fills… The proposal is first to identify the damages that are related to these parts and how they affect the mobility on the road. The following question will be to define the level of use for the stakeholder, and what are the expectations for a return to normal infrastructure.

The level of use will have to be defined from sufficient to guarantee the transport of relief or goods, to extreme mobility in any weather or any type of vehicle. In other words, what is the level expected for resilience? And, what is the place of earthworks in reaching the expected level of resilience for the stakeholder?

This subject is a real opportunity to show that earthworks occupy a significant place in the road. The global level of the infrastructure strongly depends on the relative "good" condition of the earthworks. Previous reports have shown that few countries maintain their earthworks, often for cost reasons.

The T.C .4.3 may be an ideal place to identify the main damages that affect earthen structures. Working on specific damages that affect earthworks may suggest their importance in a global scope of road management, and it may lead to a methodology that could increase the client's awareness and point out the main challenges.

From the list of disorders affecting earthworks, it could be interesting to establish a list or a classification of soils or rocks that can be used in earthworks, from the most to the least vulnerable to natural hazards or climate events.

Damages, once they exist, must be repaired to ensure the resilience of an infrastructure. This, whatever the conditions of intervention, which can be difficult or even dangerous. Therefore, to investigate from different case studies could be an approach. A full report would be drafted based on the case studies collected.

Outputs	Expected Deadlines
• Literature review.	• December 2020
• Collection of case studies.	• June 2021
• Full report.	• December 2021

4.3.2. Techniques and innovation in earthworks

Strategies / Objectives

- **Collect case studies representing the adoption of new techniques in countries around the world where Technical Committee members are located. These should consider in particular:**
  - **New and innovative techniques for construction and repair of earthworks, including extreme situations such as harsh weather, inaccessible sites and technological risks.**
  - **Maintenance techniques.**
  - **Innovation, new methods and equipment for the construction, monitoring and maintenance of earthworks (robotics, drones, equipment, GPS, monitoring, BIM, etc.)**
- **The final report will present the evolution of Earth Structures in the future**
- Encourage coordination with other TCs and TFs, such as *T.C. 2.2 – Accessibility and Mobility in Rural Areas, T.C.3.3 – Asset Management, and T.F.4.1 Road Design Standards.*

The techniques of construction in earthworks all around the world may be subjects of differences as well as technical and scientific questions, both for earthmoving companies and for contractors when they are faced with companies from other countries.

These questions have already been raised at European level when it came to writing the European standard for earthworks. Highlighting the differences in international practices and bringing out the specific advantages or disadvantages of each practice is a topic that can be very motivating for TC.4.3 members.

This subject can help to understand the design of earthworks and can reveal the specificities of each country. LMIC could find here a way to valorize their specificities, highlighting the difficulties of their sites, the geology and type of materials, or even the constraints imposed by the administrative rules.

Maintenance and resilience: these are two prospective topics for earthworks companies as well as for stakeholders. Consultation can be conducted in a way that brings out existing maintenance practices, if they exist, and what should be the best practices?

As a new topic, it should be very interesting to discuss about the need of maintenance or not of earthworks? What are the difficulties, the needs, the levels of maintenance that can be thought, the link with the desired resilience?

Maintenance is easily accepted when it is for the benefit of the stakeholder or the user. There is reasons to think about the benefits and costs of maintenance. But maintenance does not mean repair: the separation between the two functions will have to be clarified.

Adaptation is the key word of earthworks companies: it is vital to be able to adapt to all situations and constraints when working soils and rocks. The design is not the only way to find good solutions and the company is a real force of proposal when works begin to be difficult. It brings their technicity and their means, sometimes innovative, that should be highlighted.

Adaptation does not necessarily mean innovation. For that, forward looking should be done within TC.4.3 highlighting the innovations in equipment or practices that companies or experts have developed to improve today's earthwork and what can be expected for the next few years.

Innovation can also be the answers of not well-formalized needs: the TC.4.3 can be a place to discuss the future prospects of earthworks 2.0.

Innovations are sources of motivation and progress for men, companies and stakeholders. For example, earthworks monitoring is a completely prospective subject. Currently reserved for researchers, monitoring can be a way of information that should help to define the level of performance of the works, or the need of specific maintenance. It can also be a source of information on the state of the structures, the location of a localized damage and its importance, and the triggering of appropriate maintenance or repair operations.

A collection of case studies would be carried out to gathered best practices. And a full report based on those findings would be drafted.

Outputs	Expected Deadlines
• Collection of case studies	• June 2021
• Full report	• June 2022.

4.3.3. Earthworks Manual

Strategies / Objectives
• Update Earthworks Manual “Design and Construction of earth-structures”.

The Earthworks Manual was developed within the framework of the issues defined in the PIARC 2012-2015 by TC.4.4 "Earthworks and Unpaved Roads". The Earthworks Manual is a collection of rules and good practices with the purpose of enlightening and sensitize readers on Earthworks management, at the design stage of earthworks, the project and the execution of earthworks. The Manual takes into account the different PIARC technical reports produced in previous sessions.

In the context of this topic, the manual is to be updated with regard to new rules and findings with regard to current TC 4.4 reports.

Outputs	Expected Deadlines
•	•
• Publication of Chapters 2A to 2E in French	• December 2020
• Translation of Chapters 2A to 2E into English	• March 2021
• Publication of Chapters 2A to 2E in English	• December 2021
• Incorporation of Chapters 2F and 2G into manual.	• December 2022
•	•
• Publication of a ready product in French (and if possible in English) of Part 2 of Earthworks Manual.	• March 2023
	•

TECHNICAL COMMITTEE 4.4 – TUNNELS

4.4.1. Measures for increasing resilience of tunnels

Strategies / Objectives
• Use current experience on management of tunnel in order to develop best practices on design and construction for road tunnel operations. • Establish criteria for the design and construction of more resilient tunnels for road tunnel operations. • Identify resilience measures with regard to risk reduction measures and associated risk management methods. • Encourage coordination with other TCs and TFs, such as *T.C. 1.4 Climate Change and Resilience of Road Networks, T.C.2.4 – Road Network Operation/ITS, T.C.3.1 – Road Safety, T.F.3.1 – Road Infrastructure and Transport Security, and T.F.4.1 – Road Design Standards.*

In the past cycles the topic of best practices in design and construction has been dealt with in different reports like e.g. “Lay bys and protection against lateral obstacles - Current practices in Europe (2016R16EN)”. In these reports the focus was mainly on user safety and associated measures to increase safety.

In this topic the new focus should be on increasing the resiliency of the tunnel system, i.e. measures to increase the availability of the tunnel for users and measures to increase the robustness (construction and operation) of the tunnel.

Past PIARC work on risk assessment and risk management includes reports like e.g. “Risk analysis for road tunnels (2008R02EN)” and “Integrated approach to road tunnel safety (2007R07EN)”. For existing tunnels, various countries have investigated the possibility of using risk reduction measures as an alternative to structural measures that are very expensive or technically impossible to implement. These types of measures might be temporarily implemented, provided decisions-makers are able to demonstrate an equivalent level of safety through risk analysis. The risk management methods described in the existing reports will be updated regarding best practices for the identification of alternative risk reduction measures and resilience measures.

The approach would be a literature review and a briefing note including collection of case studies to gathered best practices. A full report would be drafted including the findings.

Outputs	Expected Deadlines
• Literature review	• January 2021
• Briefing note including collection of case studies	• January 2022
• Full report	• March 2023

4.4.2. Best practices in management (maintenance and traffic operation) in urban and heavily trafficked tunnels

Strategies / Objectives
• Identify best practices in management (maintenance and traffic operation), particularly of urban tunnels and tunnels with high traffic volume. • Take into account Data-driven approaches / Data Analytics with regard to preventive or predictive maintenance. • Encourage coordination with other TCs and TFs, such as *T.C.2.1 – Mobility in Urban Areas, , T.C.3.3 – Asset Management, and T.F.3.1 – Road Infrastructure and Transport Security, and T.F.4.1 – Road Design Standards.*

Since the major fires that occurred in Alpine tunnels, numerous equipment has been installed in road tunnels. The maintenance of this equipment is increasingly complex and has become an important issue. This is notably the case in urban tunnels or tunnels with heavy traffic where accessing equipment and conducting road works while the tunnel is open to traffic can be particularly challenging. Other important issues in this context are special safety aspects and maybe additional resilience measures which should be taken into account during maintenance work under traffic conditions. Additionally, best practices shall be shared on how reductions of redundant safety equipment could take place in order to reduce the “ever increasing workload” of tunnel operators. In Routes/Roads No.378 first approaches were discussed under the label “LeanTech”. Sharing best practices in this field could be beneficial to the whole road tunnel community.

This is the reason why the tunnel committee published various reports dealing with these challenging issues during the past cycles, notably:

- Introduction to the RAMS concept for road tunnel operations (2019R05EN),
- Road tunnel operation: first steps towards a sustainable approach (2017R02EN),
- Best practice for life cycle analysis for tunnel equipment (2016R01EN),
- Recommendations on management of maintenance and technical inspection of road tunnels (2012R12EN) and
- Good Practice for the Operation and Maintenance of road Tunnels (2004/05.13.EN).

In order to summarize, highlight and update the best practices in this context, it is suggested preparing a report dealing with "Best practices in management (maintenance and traffic operation) in urban and heavy traffic tunnels", based on the best practices studied from case studies.

Outputs	Expected Deadlines
• Collection of case studies	• October 2021
• Full report	• April 2022

4.4.3. Impact of new propulsion technologies on road tunnel operations and safety

Strategies / Objectives
• Identify the impact of new propulsion technologies on road tunnel operations and safety. • Analyze how to prevent and mitigate the potential consequences of incidents involving alternative fuel vehicles. • Encourage coordination with other TCs and TFs, such as *T.F.2.1 – New mobility and its impact on Road Infrastructure and Transport, T.F. 3.1. Road Infrastructure and Transport Security, and T.F.4.1 – Road Design Standards.*

Regarding New propulsion technologies (NPT), considerable headway has been made in this field in recent years. The experience shows that in a road tunnel context these technologies can have a potentially significant impact on user safety. The objective would be to focus on the impacts of NPT on road tunnel operations (e.g. ventilation) and safety. It should notably discuss the many and varied types of alternative fuels now being explored in the industry. Example technologies include: hydrogen, liquefied natural gas (LNG), compressed natural gas (CNG), biodiesel, ethanol and electric vehicles.

Whilst such vehicles remain a small overall proportion of the vehicle fleet, the combination of impacts of Government policy and technological advances in alternative fuels is expected to accelerate their increase in numbers on the road and in tunnels in coming years. There may also be particular initiatives in certain geographical areas, such as on airport land for example, where much higher proportions of alternatively fuelled vehicles are seen much sooner than on the open road. As a result, the nature of tunnel safety risk (including fire) is expected to change with time and detailed consideration of the risk of significant incidents involving such vehicles is required. This should include the evaluation of incident consequences with particular attention paid to fire characteristics and toxic emissions and their impact on tunnel users, ventilation and on intervention strategies. One main focus shall be on batteries, as future vehicles will increasingly be equipped with large batteries. Batteries, mostly Lithium-ion-type, will be for years the leading technology in new-energy-carrier vehicles. This will be the case regardless of the type of propulsion: for example, hydrogen fuel cell vehicles also require large buffer batteries.

In the strategic cycle 2016 to 2019 a Technology Watch document has been produced on the topic of NPT (Technology Watch: Road tunnel safety implications of alternatively fuelled vehicles, Technical Committee D.5 Road Tunnels (SP 2016-2019), 25.04.2019). Additionally, an article in R/R was written summarizing the current state of the art regarding NPT and tunnels (RR378-054).

The objective is to prepare a full report on the topic based on a collection of case studies and the before mentioned Technology Watch document.

Collaboration with ITA-COSUF is planned for this topic.

Outputs	Expected Deadlines
• Joint Workshop with ITA-COSUF	• November 2021
• Collection of case studies	• April 2022
• Full report	• March 2023

4.4.4. Intelligent Transportation Systems in tunnels

Strategies / Objectives
• Investigate and define the technological advances in ITS related to a road tunnel environment that can have a significant impact on operation and user safety. • Highlight the main expectations from the tunnel community regarding these systems. • Take into account role of Big Data and Data Analytics in road tunnel management and operation. • Encourage coordination with other TCs and TFs, such as *T.C.2.4 – Road Network Operation/ITS, T.F.2.1 – New mobility and its impact on Road Infrastructure and Transport, TF.B.2 – Automated vehicles, T.C.3.1 – Road Safety,T.F.3.1 – Road Infrastructure and Transport Security, and T.F.4.1 – Road Design Standards.*

Regarding Intelligent Transports Systems (ITS), the last few years have seen considerable technological advances in this field. In a road tunnel environment, these systems can have a significant impact on operation and user safety. The objective of this task would be to focus on the impacts of such systems on road tunnel operations and safety.

At first sight, it would appear that the main issues to be discussed within this context are as follows:

- Given the very quick development of ITS on open roads, how can service continuity of such systems be guaranteed in the specific context of road tunnels?
- Are there any obstructions for the development of ITS in current tunnels that should be dealt with?
- What changes do we expect in terms of required safety and traffic management systems in a tunnel: what systems could possibly be deleted (under which conditions) and what new systems do we need (under what conditions)?
- What are the tunnel community's expectations with regard to these ITS: safety distance control, lane departure warning systems (LDWS), heavy vehicle guidance systems, vehicle localization and counting systems, identification of hazardous goods vehicles,...
- More generally speaking, how can these ground-breaking systems improve user safety in road tunnels?

Past T.C. Road Tunnel Operations reports dealt with ITS topics in connection with user communication and user behavior (e.g. 2016R06EN). The new evolving topics of Vehicle to Infrastructure communication and new vehicle assistance systems were not covered by these reports. In the strategic cycle 2016 to 2019 a Technology Watch document was produced on the topic of ITS.

The objective is to prepare a full report on the topic based on a collection of ITS technological advances and the before mentioned technology watch document. This report will not focus too much on details regarding ITS-technological issues but will definitively highlight the main expectations from the tunnel community.

Outputs	Expected Deadlines
• Full report	• October 2021

4.4.5. Update of the Tunnels Manual

Strategies / Objectives
• Complete the EN and ES versions of the Tunnel Manual. • Translate and complete the FR version of the Tunnel Manual. • Update EN, FR and ES versions of Tunnel Manual incorporating the works carried out by *T.C.D.5 – Road Tunnel Operations w*ithin Cycle 2016-2019 and the new products of the 2020-2023 Cycle.

The expected target audience for the Online Road Tunnel Manual includes:

- Operators: Manual allows them to quickly find any relevant document they are searching for in a few clicks,
- Countries with little tunnel culture: Manual gives them an overview of the main aspects of road tunnel design, safety, equipment, operation and maintenance, that can allow them to discuss issues with foreign consultants and various stakeholders,
- Tunnels owners and administrations: Manual gives them an overview of road tunnel complexity and links to detailed information,
- The tunnel community in general: Manual is a tool that integrates all the PIARC recommendations with links to detailed information (technical reports, R/R articles, and other relevant websites).

At the end of the cycle 2016 to 2019, the T.C. on Road Tunnel Operations will have produced approximately 45 technical reports plus many R/R articles and special issues. The main added value of the Tunnel Manual is to incorporate and disseminate this information through an electronic document currently published in 10 languages, so as to reach the widest possible audience.

In the future development and update of the Manual (starting from this strategic cycle 2020 to 2023) the main focus will be on the EN, FR and ES versions. Other language versions could be updated under the responsibility of the respective countries.

Outputs	Expected Deadlines
• Update of the Tunnels Manual	• Up to June 2023

4.4.6. Preparation of the 2nd International Conference on Tunnels

Strategies / Objectives

• Define topics of interest to the road tunnel sector and develop an appropriate technical program, including:
  ○ PIARC works carried out on those topics
  ○ Identification of the following steps for future works
  ○ Definition of additional topics to be proposed in order to be presented as individual speeches
  ○ Evaluation of abstracts and full individual speeches
  ○ Taking into consideration possible contributions from other Technical Committees
• Contribution to the Proceedings.

The previous international conference in Lyon (October 2018) was a very successful event.

Outputs	Expected Deadlines
• Technical Program	• October 2022
• Contribution to the Proceedings	• January 2023

4.4.7. Support for updating and improving of DG-QRAM

Strategies / Objectives
• Support the work on DG-QRAM (phase 2).

DG-QRAM (Dangerous Goods – Quantitative Risk Assessment Method) is a software developed overtime by PIARC and its TC on Tunnel for European countries.

In November 2016, PIARC decided to update it in two phases, both funded by volunteering European countries:

- Phase 1: updating of the tool (compatibility with recent OS versions)
- Phase 2: upgrading of the tool, based on feedback of users

Once that Phase 1 was finished in 2018, Phase 2 started in 2019. It consists of:

- improvement of the guidelines
- verification of the ventilation model
- results according to ADR regulations
- extended influencing parameters

It is expected that TC 4.4 works on DG-QRAM: management of phase 2 (improving the software) in coordination with the relevant Task Group.

Outputs	Expected Deadlines
• DG-QRAM: management of phase 2 (improving the software) in coordination with the relevant Task Group	• Up to March 2023

TASK FORCE 4.1 – ROAD DESIGN STANDARDS

TF 4.1.1. Road Design Standards

Strategies / Objectives

- Provide the PIARC member road administrations with materials for their road geometric design standards to be improved and fortified further.
- Analyze analogies and differences and make a list of standards in the geometric design of roads, based on traffic flow rate and composition, road functionality and orographic constraints.
- Analyze the reliability of various models, such as:
  - stopping distance
  - stopping sight distance
  - overtaking distance
  - overtaking sight distance
  - decision-making distance
  - decision-making sight distance
  - crossing distance
  - crossing sight distance
  - minimum radius in curves
  - speed change distance for entries and exits
  - additional lane on ramps
- Investigate the use of Big Data with regard to the geometric design of road infrastructure.
- Analyze the implications of the new mobility (electric vehicles, connected and automated vehicles,…) in geometric design of road infrastructure.
- Encourage coordination with other TCs and TFs, such as *T.C.1.2 – Planning Road Infrastructure and Transport to Economic and Social Development, T.C.1.4 - Climate change and resilience of Road Network, T.C.2.4 Road Network Operation/ITS, T.C.3.1 – Road Safety, T.C.3.3 – Asset Management T.C.3.4 Environmental Sustainability in Road Infrastructure and Transport, T.C.4.2 - Bridges, T.C.4.3 - Earthworks and T.C.4.4 - Tunnels.*

Road Administrations have standards establishing the technical requirements that roads must meet depending on the type of road planned and the flow rate and composition of traffic. In this way, the design of the road lay-out is defined according to various factors such as the independence of the carriageways, access control, orographic conditions, the urban environment and its functionality as part of the general transport system. The minimum parameters of the horizontal alignment, vertical alignment and cross-section are defined, as well as the general criteria for obtaining adequate coordination between them, based on functionality, road traffic comfort and road safety, together with economic and environmental considerations.

The aim of the Task Force focus on collecting these standards from several countries and analyzing analogies and differences to make a list of standards in geometrical design, taking into account the type of road, based on its functionality, the flow rate and composition of traffic, as well as other orographic, environmental and economic constraints.

The models used to define the lengths of the various lay-out elements, as well as those used to calculate the sight distances required for various driving actions (stopping, overtaking, taking decisions based on signs and unforeseen events, making a track crossing, …) have not been reviewed for many years and their current reliability needs to be checked.

In addition, it is necessary to check their reliability to face the new mobility - new propulsion techniques and connected and autonomous driving-.

Task Force investigates the use of new tools such as Big Data to reconsider design parameters and models based on road user behavior and use, in order to achieve higher levels of safety and comfortability in road networks.

Outputs	Expected Deadlines
• Literature review	• March 2021
• Full report	• September 2022

TERMINOLOGY COMMITTEE

Updating the World Road Association Dictionary

Strategies / Objectives

- Update and upgrade the existing version of the web-based Road Dictionary in each of the current languages.
- Increase the number of languages of translation of the Road Dictionary in liaison with World Road Association member countries.
- Improve the management of the web-based Road Dictionary and keep adapted to potential developments of the website of the World Road Association (including the development of an app for the use of the Dictionary on tablets and smartphones if resources are available)
- Encourage coordination with Technical Committees and Task Forces of PIARC to analyze new needs an to collect technical words and definitions.

In 1931, the first edition of the "Technical Dictionary of Road Terms" was published in six languages (Danish, English, French, German, Italian, and Spanish). The World Road Association has continued working on terminology ever since. In 2007, the eight edition was released in five languages (English, French, German, Portuguese, and Spanish).

The multilingual terminology database can be accessed on-line for making term searches and searches per theme, and the results can be displayed simultaneously in three languages.

This database is constantly updated by the PIARC Committee on Terminology, thanks to contributions from all PIARC Technical Committees. This coordination with other Technical Committees of PIARC is a key point for the next Cycle. In order this to be achieved, information should flow between committees. Thus, Committee on Terminology will be able to collect and analyze technical words and definitions, and afterwards, be included in World Road Association Dictionary.

Each line of the Dictionary provides the following information: the term, its definition (or a reference to the main term related to the concept involved), the term's code and its translation into the other languages, always set out in the same order.

This dictionary has been compiled in alphabetical order, as customary in dictionaries or glossaries. At the end of the dictionary a nomenclature with a logical methodical classification is presented, followed by the codes of all terms recorded.

The on-line Road Dictionary is far more comprehensive than the printed version; moreover, it is regularly updated. It offers you to search for one word or part of a word in one language and to obtain the results simultaneously in other languages, including the search language. Grammatical attributes, synonyms and their geographical origins, terminology classification and any illustration shown with the general term are displayed immediately.

The languages available on the Internet since January 2016 are: Arabic, Czech, Chinese, Croatian, Danish, Dutch, English, Finnish, French, German, Greek, Hungarian, Icelandic, Italian, Japanese, Norwegian, Persian, Portuguese, Romanian, Russian, Serbian, Slovenian, Spanish, Swedish, Ukrainian and Vietnamese.. However, the input of equivalent terms is improvable because it is still incomplete in most of these languages.

Thanks to the interactivity provided by the Internet, everybody is invited to suggest the addition, amendment or deletion of a term directly on the website. Thus, with the involvement of PIARC's Technical Committees and everyone's contributions, this collective work will become a most valuable tool for both experts and the general public.

A more intensive promotion of the Road Dictionary as a PIARC flagship product would be very important, both within the Association (including for the translation of its technical reports, manuals, other publications and reference documents) and outside it.

Committee on Terminology will focus on promoting the inclusion of specialized glossaries in the reports and manuals developed by the Technical Committees and on the use of these glossaries. Develop an app for smartphones and tablets, and the possibility of creating and printing personalized lexicons with baskets of words or themes, would be a great improvement for this Committee.

Outputs	Expected Deadlines
• Upgrade and update the web-based Road Dictionary.	• June 2023

ROAD STATISTICS COMMITTEE

Road Statistics Data Book

Strategies / Objectives

-
- Selection and analysis of data items wich really suits the needs of the member countries and can offer enough comparability, in addition to those determined and specified in the PIARC Databook of Road and Road Transport (2014-2018)
- Clarification of data definitionwhich is linked with data comparability and consistency, alongside each data source located
- Comprehensive and comparative analyses of road and road transport data combined with some kinds of primary data in each member country: population, surface area, GNI, etc.
- Liaison with technical Committees of PIARC to collect and analyse more data of wider technical areas with valuable information stored in their archives
- Maintenance and upgrade of outputs in the following working cycles
- Possibility of collaboration with the other international road statistics if needed

The Main objectives of this Committee are to:

- Enable an international comparison of road statistics among the countries on the same definition and requirements, thereby allowing us to accurately gauge maturity of road and road transport of each country, and
- Provide statistical data as well as the outcome of their analysis for road administrations of member countries who conduct quantitative research on and make an objective assessment of actions based on such data analysis when formulating the road policies and measures.

Topics to discuss include:

- Selection and analysis of data items which really suits the needs of the member countries and can offer enough comparability, in addition to those determined and specified in the PIARC Databook of Road and Road Transport (2014-2018),
- Clarification of data definition which is linked with data comparability and consistency, alongside each data source located,
- Comprehensive and comparative analyses of road and road transport data combined with some kinds of primary data in each member country: population, surface area, GNI, etc.,
- Liaison with Technical Committees of PIARC to collect and analyze more data of wider technical areas with valuable information stored in their archives,
- Maintenance and upgrade of outputs in the following working cycles, and
- Possibility of collaboration with the other international road statistics if needed.

In this working cycle (2020-2023), some simple questionnaire surveys will be conducted among member countries to retrieve the data items selected from their road statistics while clarifying each data definition.

Based on the survey results, a report as a databook will be published in the final year of the cycle to provide member countries with accurate, reliable and extensive dataset accompanied by results from comprehensive, comparative and statistical analyses of data garnered. All data of this report is clearly defined and internationally comparable. Nevertheless, some advanced reports could be published during the cycle.

It is expected that the ambitious goal of outputs is to create international Key Performance Indicators (KPIs), which represent the quality of road and road transport (some important attributes

possessed) in each country. Such KPIs in wider areas will hopefully become the global standard of measurement for road and road transport.

Outputs	Expected Deadlines
• Full Report Data Book of Road and Road Transport (2020-2023)	• June 2023

PIARC COVID-19 RESPONSE TEAM

PIARC COVID-19 Response Team (CRT)

Strategies / Objectives
• Explore the rapid sharing of knowledge and practice between PIARC members in terms of the impacts of the pandemic and the associated economic and social crisis and the relevant responses. • Propose and implement specific short-term adaptable actions to support PIARC member organizations, individual members, and professionals in the roads and transport sector, in facing the pandemic. • Track the course of the pandemic and advise on further actions that need to be taken by the Association and others, as the World and PIARC members move through the crisis and into the recovery period. • Advise on what considerations should be given to studying the medium- and long-term implications of the pandemic on the roads and transport sector, and how these should be reflected in PIARC activities. • Undertake and publish technical reports, surveys and other analysis of the pandemic and its impacts on the roads and transport sector, on its own or in collaboration with other industry bodies and stakeholders. • Present its activities, findings and recommendations (including lessons learned) during various PIARC's meetings or alternative channels from time to time at the request of the General Secretariat.

Since its emergence at the end of 2019, the COVID-19 virus pandemic has caused severe disruption to individuals' lives, to organizations and to the delivery of goods and services across the World. Like public agencies in multiple sectors, PIARC members are affected as well and taking various actions to respond. Many PIARC members are also being thrust to the forefront, as governments look to them to maintain critical lines of supply and to keep essential workers and goods moving.

With the pandemic, and its impacts, having greater duration and complexity than initially expected and now expected to last into 2021, and possibly beyond, PIARC has moved to established a formal PIARC COVID-19 Response Team (CRT).

Furthermore, it is recognized that the ideas and examples shared through the CRT are shared to support timely and mission-critical responses by road and transport agencies in tackling the COVID-19 pandemic and they are shared in the spirit that a good idea now could save lives, improve business resilience and minimize disruption of services.

In some instances, issues identified through the work of the CRT, whether they were presented in webinars or included in articles and synthesis notes, may not necessarily represent official policy of PIARC or its members. These ideas and examples will be subject to further evaluation by the CRT and the appropriate TCs and TFs in delivering recommendations for policy and practice in due course.

Outputs	Expected Deadlines
• Webinars	• On-going
• Synthesis Notes	• On-going
• Full report for Phase I	• December 2020
• Full report for Phase II	• December 2021

SPECIAL PROJECTS

Special Projects enables the Association to outsource the development of high-level studies in response to critical issues identified by members and that are not within the scope and capacities undertaken by Technical Committees and Task Forces.

Special Projects to be developed in 2020

- **Overweight vehicles impacts on road infrastructure and safety**. The purpose of this project is to offer to road administrations and decision makers a clear image of the impact of overweight vehicles on the road infrastructure (material and economic impacts) and road safety, and to propose some mitigation or enforcement tools and policy to ensure better compliance between the heavy vehicles and the regulations. The project should offer:
    - A quick overview of weight limits around the world and their trend along time, without entering in the detail of the special cases of authorized overweight vehicles;
    - An overview of overweight vehicles existence and use frequency around the world, if possible, by category of road network and type of vehicles;
    - Understanding of overweight vehicles impacts on road infrastructure both from a technical / structural perspective and from an economic perspective. Understanding of overweight vehicles impacts on road safety. Quick understanding of freight business to use overweight vehicles;
    - Compilation of best practices and policies (and unsuccessful ones) to tackle the detection and enforcement against overweight vehicles: technological ones (weigh in motion and others), prosecution (fines, immobilization of cargo, etc.), change of behavior of drivers and freight industry (education, etc.).
- **Road related data and how to use it**. In the course of the rapidly advancing digital transformation, the collection and fusion of data forms a central building block for future real-time applications for the operation of road infrastructure as well as for data-driven predictive and/or cognitive approaches for the management of road infrastructure. It can be assumed that, in addition to the data already available and maintained by the owners and operators of road infrastructure, data from other sources are beneficially.

  On the other hand, road owners and operators have a wide range of data which are of to road users and for the development of services for road users, either directly by road operators (e.g. Variable Message Signs, Real Time Traffic Information services) or by private companies.

  The topic of data usage has already been dealt with in several research projects and scientific publications. However, an overview and compilation of the state of the art, including the identification and analysis of the state of the art, is still lacking and shall be developed within the RRD project.

  The focus of this Special Project should not be solely on the technical aspects but should rather enable PIARC members to consider possible cooperation with private data providers and to develop appropriate approaches and strategies both for road infrastructure management and for providing services to road users.

Special Projects to be developed in 2021

- **Oversize Strikes**. Bridge and tunnel strikes by over-height/over-dimension trucks are a threat to safety, and highway infrastructure. These incidents cause significant damage to infrastructure, injuries and fatalities, secondary crashes, traffic delays, emergency response, rerouting of traffic to remove the truck and repair the damage, and economic costs related to response and recovery efforts. At their worst, bridges can fail, resulting in

serious injuries or fatalities and costly economic and quality of life impacts until the roadway can be reopened to traffic.

The purpose of this study is to examine proven countermeasures, practices, and technologies used to reduce the incidence of oversize trucks striking bridges and tunnels along with effective processes for accurately reporting and tracking bridge strike occurrences. Some of these practices for truck routing and permitting may also be useful in preventing bridge overloads.

The study will identify successful technologies, approaches, and mitigation strategies to address bridge and tunnel strikes and bridge overloads, allowing information transfer to other countries. This will include lessons learned from other countries on deploying and operating various countermeasures, practices, and technologies. This project could specifically identify practices and technologies that can be utilized in low- to middle-income countries.

Preventing bridge strikes provides benefits through reducing damage to bridges and trucks, injuries and fatalities, and secondary crashes with other vehicles. Preventing bridge strikes protects critical bridge and tunnel assets that are costly to repair. Operational benefits may include elimination of the delays and negative economic impacts associated with bridge-strikes and bridge repair.

- **Smart Roads Classification**. Road classifications are a basic tool for planning and managing road networks, with high influence on road geometry and traffic capacity. These classifications have traditionally been centered on the balance between mobility and accessibility, but new approaches have added more factors, such as economic-administrative functionality, environment, and users. These new approaches, despite being recent, do not consider a newer factor: the proliferation of semi-autonomous vehicles.

  The increasingly presence of connected and autonomous vehicles makes it very convenient to have a road classification system that, in addition to the factors mentioned above, includes information about how ready the road feature is to support autonomous and/or connected vehicles. This information should indicate from null to full readiness to autonomous driving, incorporating different degrees of partial support. Connectivity capabilities should also be considered.

  The classification system should be physical and digitally indicated. Drivers will be informed by means of physical signs – such as existing vertical ones – whereas the digital classification will provide detailed information to driving automation systems (e.g. road geometry). This information could be used by driving automation systems to determine their potential disengagement zones in advance.

  This classification system should be compatible with existing driving automation systems, as well as very resilient to their technological development, to ensure very fast adaptation to future abrupt changes. Additionally, it should be a universal classification (i.e., being adaptable to roads worldwide), and with consensus, ensuring a fast implementation. This also requires compatibility with different proportions of non-autonomous and other road users.

  An integral road classification system would also allow an efficient planning of public investments on physical infrastructure, by enhancing operativity of driving automation, and on digital infrastructure by increasing the benefits of connectivity between highways and their users (V2X).

OTHER OUTPUTS

THE WORLD ROAD CONGRESS – PRAGUE, 2023

The World Road Association organizes a World Road Congress every four years. During the cycle 2020 – 2023, the XXVII World Road Congress will take place at Prague (Czech Republic) in 2023.

The Congress will gather experts from all over the world. Its objective will be share knowledge and exchange ideas on the latest development and challenges that road infrastructure and transport are facing.

he XXVII World Road Congress will serve as a forum to share progress achieved over the four-year work cycle. Each Technical Committee and Task Force has to contribute by preparing a Technical Session on its topic and by collaborating in other types of sessions and activities.

Preparation of the XXVII World Road Congress

Strategies / Objectives

- Prepare the technical program for the Technical Session including:
  - Summary of the works carried out during the cycle with the highlighted conclusions.
  - Identification of the following steps for future works.
  - Definition of additional topics to be proposed in order to be presented as individual speeches.
  - Evaluation of abstracts and full individual speeches.
  - Taking into consideration possible contributions from other Technical Committees.
- Possible collaboration in Foresight Sessions.
- Possible collaboration in workshops.
- Contribution to the Proceedings

THE WORLD WINTER SERVICE AND ROAD RESILIENCE CONGRESS – CALGARY, FEBRUARY 2022

The World Road Association organizes an World Winter Service and Road Resilience Congressevery four years. During the cycle 2020 – 2023, this important event will take place at Calgary (Canada) in February 2022.

As a novelty in this cycle, the scope will be wider than just winter road issues. It has been requested that more Technical Committees and Task Forces should be involved since more topics will be added to the Congress.

The Congress will gather experts from all over the world. Its objective will be share knowledge and exchange ideas on the latest development and challenges that road infrastructure and transport are facing.

Preparation of the 2022 World Winter Service and Road Resilience Congress (8th to 12th February 2022)

Strategies / Objectives

- Prepare the technical program for the Congress including:
  - Summary of the specific climate change and resilience of road network issues related to winter service.
  - Identification of the following steps for future works.
  - Definition of additional topics to be proposed in order to be presented as individual speeches.
  - Evaluation of abstracts and full individual speeches.
  - Taking into consideration possible contributions from, at least, other Technical Committees and Task Forces such as:
    - TC 1.4 - Climate change and resilience of Road Network
    - TC 1.5 – Disaster management
    - TC 2.4 – Road Network Operation / ITS
    - TC 3.2 – Winter Service
    - TC 3.3 – Asset Management
    - TC 4.1 - Pavements
    - TC 4.2 - Bridges
    - TC 4.3 - Earthworks
    - TC 4.4 -Tunnels
- Possible collaboration in Foresight Sessions.
- Possible collaboration in workshops.
- Contribution to the Proceedings

OTHER OUTPUTS

Other outputs to be defined by each Technical Committee

Strategies / Objectives
• Disseminate and share knowledge. • Encourage networking.

During the four-year cycle, each Technical Committee has to organize seminars in two low- or middle-income countries. Since it takes about one year to organize a seminar, they are usually scheduled during the two middle years - i.c. 2021 and 2022 - of the cycle. A seminar should be 3 days and can be part of, or be appended, to a regional congress.

The purpose of a seminar is to exchange knowledge between members of the TC and the host country. This knowledge exchange can be added to the content of the reports of the objectives of the TC.

Furthermore, it would be interesting to schedule Conferences / Workshops /Webinars in High Income Countries, as well as producing Articles for Routes / Roads magazine.

Outputs	Deadlines
• 2 Seminars in LMIC	• Up to June 2023
• Possible Conferences/Workshops in HIC	• Up to June 2023
• Possible Articles in Routes/Roads	• Up to December 2023

Such outputs from Task Forces are also welcomed.

IMPLEMENTATION

The 2020-2023 Strategic Plan begins to be implemented in early 2020. To this end, the working structures have been established beforehand and have even participated in the elaboration of the plan. It has main intermediate milestones such as the XVI International Winter Road Congress, Seminars, Conferences and the Mid Term meeting and culminates with the XXVII World Road Congress. Throughout the cycle several outputs will be provided to reinforce knowledge sharing and keep the PIARC audience informed on an ongoing basis.

The Strategic Plan envisages yearly updates of its Plan of Activities with inputs from:

- XXVI World Road Congress.
- Kick off meetings.
- XVI World Winter Service and Road Resilience Congress.
- First Delegates.
- Findings from ongoing work within the TCs/TFs
- The assessment of the performance of Strategic Plan at the Mid-Term Meeting, or at any other given time within the cycle.

These updates would allow the Ex-Com to include new Task Forces (using those that already has been requested by PIARC's members and that are included in the main structure) and new Special Projects, and to amend slightly the terms of reference of the Technical Committees or, if necessary, to reconsider them based on the TCs' capabilities.

In this way the Strategic Plan will be updated throughout the whole cycle, gaining a better addressing of the new needs arising from PIARC members and gaining a better adapting to a quickly changing world, this means, in short, gaining flexibility.

APPENDIX

ORGANIZATIONAL STRUCTURE OF PIARC

The Council of the World Road Association has the ultimate responsibility for the governance of the organization. It is composed of delegations from member countries, each led by a First Delegate. The Council elects the President, the Vice-Presidents, the Secretary General, and the members of the Executive Committee. The Council meets at least once each year.

The Executive Committee is responsible for the administration of the Association in accordance with policies approved by the Council. The Executive Committee is supported by the Commissions (Strategic Planning, Finance and Communications) and the General Secretariat.

The General Secretariat ensures the daily management of the Association in accordance with the resolutions and decisions of the Council and the Executive Committee. It also provides a secretarial service for the Council, the Executive Committee, and the Commissions and services to the Technical Bodies. The General Secretariat is responsible for the Association's website, and for editing the Routes/Roads magazine and various publications. It assists in the planning and preparation of World Road Congresses and International Winter Road Congresses.

National Committees operating in more than 43 member countries contribute to the dissemination of the Association's outputs and organize local activities such as meetings, conferences, and seminars. National Committees further undertake some membership services and administration duties in their own countries.

The technical work of the World Road Association, described in Section 2. Plan of Activities, has been organized into Strategic Themes. The Technical Committees, Task Forces, and Regional Working groups lead the work performed under each Strategic Theme. Besides, other Committees address cross-cutting issues as well as Response Teams address specific issues In addition, Special Projects deal with emerging issues or new needs identified by members during the cycle.

Technical Committees, Task Forces and Cross-cuttng Commitees are made up of skilled volunteers from member countries, who work together to generate the information products and knowledge sharing events that constitute the Association's core activity. Committees on Terminology and Road Statistics work directly under the supervision of the General Secretariat with a mandate to update and expand a technical dictionary and a data of key indicators, which will further a common understanding of relevant terms and figures in the transport sector.

Response Teams will be chaired by the PIARC Secretary General or the SG's designee, who will select the members of the Team based on their ability to make ongoing contributions to the activities and outputs expected.

Regional Working Groups are a facility that aims to address the needs of low and middle-income country members in connection with specific Technical Committees. Regional Working Groups are made up of skilled volunteers from member countries of the same world region and address issues that may not be directly tackled by the Association's main technical bodies.

Special Projects enables the Association to outsource the development of high-level studies in response to critical issues identified by members and that are not within the scope and capacities undertaken by Technical Committees and Task Forces.

World Road Association (PIARC)

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