

Exchange
knowledges and techniques
on roads and road transportation



WORLD ROAD ASSOCIATION



www.piarc.org

Resilience of Infrastructure

Claude VAN ROOTEN

President

WARSAW, 4/12/2019





What is PIARC?

- **PIARC** is the new name of the **World Road Association**
- We were founded in 1909 as a non-profit, non-political Association
- Our goal is to organise exchange of knowledge on all matters related to roads and road transport





PIARC's Four key missions

- Be a **leading international forum for analysis and discussion** of the full spectrum of transport issues related to roads and related transport;
 - Identify, develop, and disseminate **best practice** and **give better access to international information**;
 - Consider within its activities the needs of **developing countries and countries in transition** fully; and
 - Design, produce, and promote **efficient tools for decision making** on matters related to roads and related transport.
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- The Association mobilizes the expertise of its members
 - Through operations guided by a **4-year Strategic Plan**





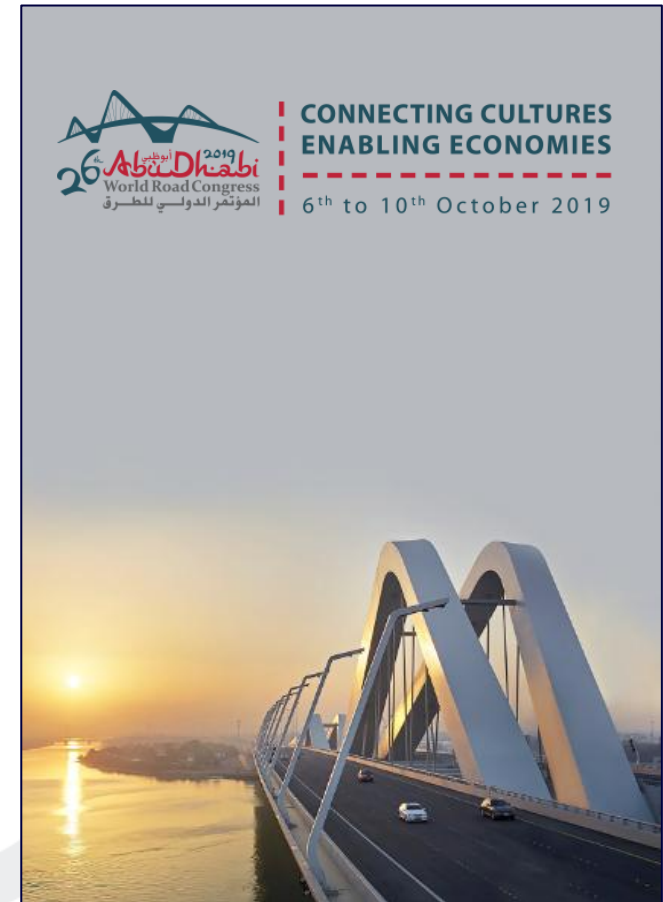
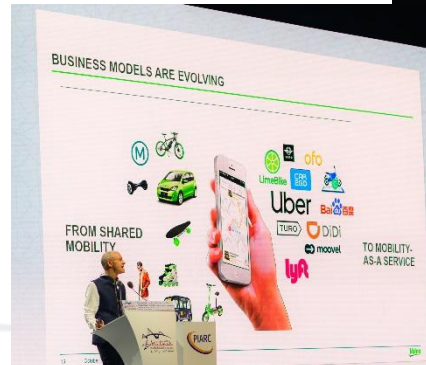
Extensive membership base

- **PIARC addresses the needs of all countries**
- **124 National governments are members of the Association**
 - Recent additions: Montenegro, Mozambique
- **Members from a total of 140 countries**
 - National governments
 - Regional authorities
 - Collective members - public or private, e.g. companies, research institutes...
 - Individual members
- **More than 1 200 experts are currently mobilised in our working groups**





World Road Congress 2019 Abu Dhabi



- **Strategic Session** - The progress of climate change adaptation and mitigation actions in the Transport Sector
- **Foresight Session on Resilience** - with TRB, AASHTO...
- **PIARC Committee Sessions:**
 - Adaptation Strategies / Resilience
 - Disaster Management
 - Security
- **Best presentations from our International Call for papers**

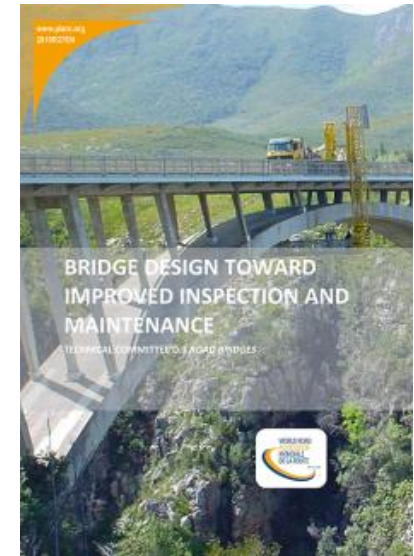
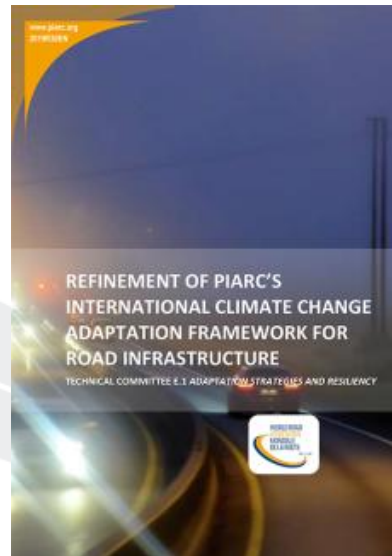
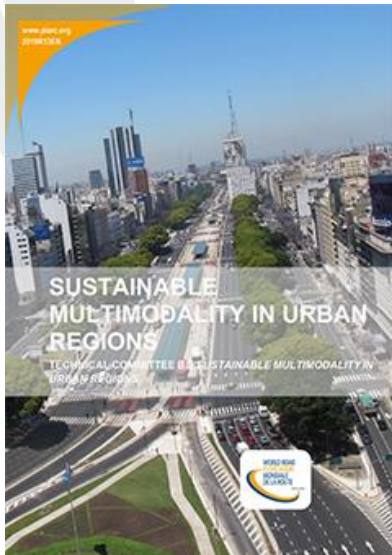


Special Projects (contracted out for quick guidance)

- **Special Projects: published**
 - **Climate Change Adaptation Framework**
 - Use of Unmanned Aerials Systems (Drones)
 - **Unpredicted Infrastructure Failures – Best Practices**
 - **Electric Roads Systems**
 - **Positive Energy Roads**
- **Ongoing Special Projects:**
 - Contribution of road transport to development
 - Road related data and how to use them
 - Legal weight limits standards and their implications



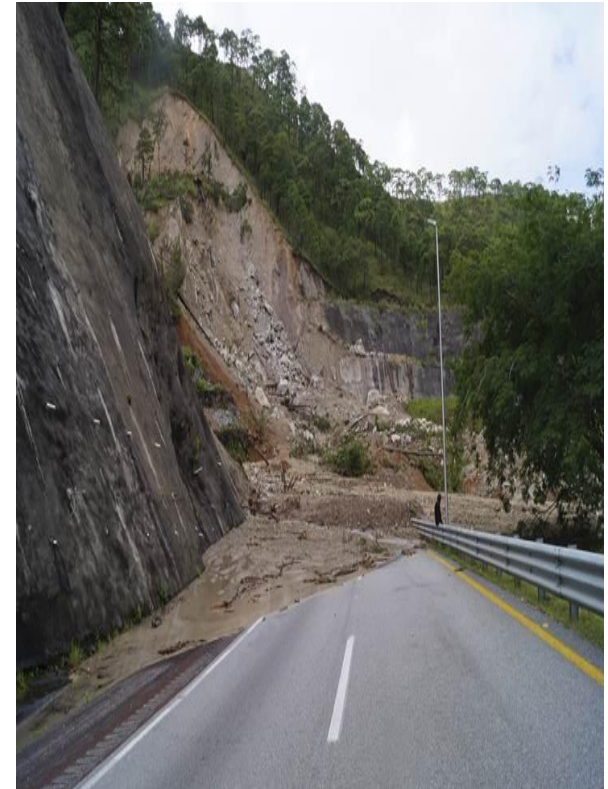
- Bridge Design Toward Improved Inspection And Maintenance
- Reducing the Life Cycle Carbon Footprint of Pavements
- Refinement of PIARC's International Climate Change Adaptation Framework for Road Infrastructure
- Sustainable Multimodality in Urban Regions



Impact of climate change on Road Authorities

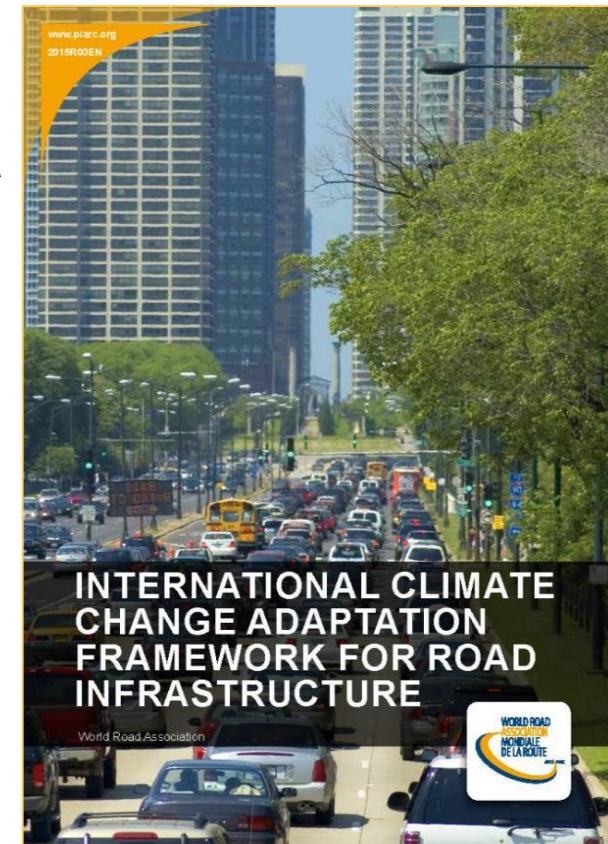
It is certain, Projected climate change will:

- Pose strategic organisational and operational risks
- Impact the design, construction, operation and maintenance of road infrastructure
- Threaten the ability of road infrastructure to provide access to and the delivery of critical infrastructure and services
- Have a knock-on impact on national, regional and local economies, communities and environments



The framework guides road authorities through the process of increasing the resilience of their networks and assets through the following stages:

- **Stage 1** - Identifying scope, variables, risks and data
- **Stage 2** - Assessing and prioritising risks
- **Stage 3** - Developing and selecting adaptation responses and strategies
- **Stage 4** - Integrating findings into decision making processes



Risk Scores and a Risk Register

Risk = Impact Probability x Impact Severity

	Severity				
Likelihood	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

Impacts can be rated and prioritised for action according to their overall 'Risk Score' and used to develop a Risk Register.

Prioritising risks in this way will subsequently aid the development and prioritisation of adaptation responses and strategies.





Adaptation Responses and Opportunities

- Examples:
 - Raising road levels
 - Road realignment
 - Installation of flood defences
 - Re-siting of critical infrastructure
 - Increasing drainage capacity
 - Using heat resistance materials
 - Slope stabilisation and reinforcement
 - Development and implementation of emergency response plans
 - Staff training and stakeholder engagement



Pavements in the future **must consider changes in the variables that influence their design**, such as temperature and precipitation, and include variables such as wind, atmospheric pressure, humidity and evapotranspiration.

Preventive actions to reduce risk in pavements include:

- **Updating of the design standards according to the new climatic thresholds** that allow to adapt the pavements to the changes of the climate.
- **An increase in the frequency of maintenance of drainage works** to ensure sufficiency despite changes in rainfall intensity.



Adapting pavements to climate change

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- Ensure that the **running surface is in good condition to prevent water from penetrating** into the different layers of the pavement.
- **Efficiently remove water from the pavement by modifying the pumping** on the carriageway.
- In order to **avoid moisture in the layers**, the appropriate degree of compaction must be guaranteed in each layer.
- **Include all necessary underground drainage** in the pavement to prevent water from entering the pavement layers.
- Maintain **strict adherence to quality control of the asphalt mix**, to ensure the quality of aggregates and asphalt, and thereby achieve high performance pavements.



- An **adequate design and materials according to the climatic zone**, can help a good performance in spite of temperature changes.
- The **use of additives such as hydrated lime improves the bond between asphalt and aggregate**, preventing detachment and therefore loss of wearing course quality.
- In asphalt pavements, **high modulus mixes (EME) are an effective approach to mitigate traffic deterioration** by decreasing deformations and fatigue and increasing permeability.
- **Materials with better hydraulic performance** should be used in the base or foundation layers.



Adapting pavements to climate change

4/4

- **Temperature risks can be avoided by incorporating better technology to improve asphalt performance**, there are currently many modifiers that help against the problems of climate change.
- **Modify the working hours in summers** that will be warmer to ensure good health to workers.
- There are **technologies to extract heat from the pavement and thus avoid deformations**, but they are still expensive, so it is recommended to apply only in special cases.
- The **placement of layers of coating to the pavement that allow to refract the solar rays**, avoiding the overheating of the pavement.





Our work on resilience With the G20 Group of Countries





Resilience is already A Major Problem

- Transportation and energy infrastructures are increasingly being classified as “critical infrastructures” (European Programme for Critical Infrastructure Protection)
- Global investments needed for roads are estimated to 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)
- Environment-related risks account for three of the top five risks (by likelihood) and four of the top five risks (by impact) threatening mobility infrastructures (World Economic Forum, 2019)
- Over the last 20-years, the reported economic losses due to extreme weather events has risen by 151% compared to the 1978-1998 period, reaching USD2,25 billion (UNISDR, 2017)
- For example between 2010-2013, *El Niño* and *La Niña* combined effects caused major damages to Queensland road network in Australia. 8,741 km of the state-controlled network required full or partial reconstruction, with a reconstruction budget of approximately USD 4.58 billion (Queensland Government 2016)





Resilience: a defining issue

- **PIARC recognizes the need for a uniform and holistic approach to resilience of road infrastructure and networks:**
 - There are many threats / This is a multi-faceted issue
- **For example:**
 - Adequate planning and financing
 - Structural aging of infrastructure
 - Proper funding for asset management / Maintenance strategies
 - Road Safety
 - Security vs man-made attacks
 - Future-proofing vs new uses and demands
 - Climate change and extreme weather



A resilient system shows:*

- reduced failure probabilities,
- reduced consequences from failures, in terms of lives lost, damage, and negative economic and social consequences,
- reduced time to recovery (restoration of a specific system or set of systems to their “normal” level of functional performance)



* Bruneau, M.; Reinhorn, A.- Exploring the Concept of Seismic Resilience for Acute Care Facilities



- **Develop strategies for infrastructure and transport systems**
 - Develop strategies at State level, such as to create the foundations for a proactive and holistic resilience engineering/resilience management.
 - Introduce educational initiatives including risk-based elements and cost-benefit analyses.
- **Establish policies and mechanisms for exchanging knowledge and experiences**
 - Assist LMICs in the long-term strategic planning of road infrastructure and in the implementation of efficient and cost-effective measures
 - Develop a strategy to monitor and coordinate policies and initiatives on resilient transport systems, regarding the international conference agenda



- Promote a socio-political based approach to resilience to facilitate the acceptability of infrastructure projects
 - Advocate the need that transport infrastructures be closely tied with territories and address more than functionality.
 - Encourage the development of some sort of “knowledge-sharing Academy”, with inputs of engineers, urban planners, economists, social scientists.,,
- Set up common methodology for measuring resilience
 - Establish mechanisms for the collection and evaluation of efficient and cost-effective solutions.
 - Raise political awareness with regard to resilient road infrastructure.
 - Encourage the adaptation of existing technical guidelines





Strategic Plan 2020 - 2023



- **Our Plan need to reflect mega-trends, including those that go beyond roads**
- **It also needs to place roads in the context of the global transport system**
- **Climate change**
- **Resilience**
- **Road safety**





Next Strategic Plan 2020 - 2023

1. Road Administration	2. Mobility	3. Safety and Sustainability	4. Resilient Infrastructure
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			
TF 1.1 Well-Prepared Projects	TF 2.2 Automated vehicles – Challenges and opportunities	TF 3.1 Road Infrastructure and Transport Security	TF 4.1 Road Design Standards
TF 1.2 HDM-4	TF 2.1 New mobility and its impact on road infrastructure and Transport		
Terminology Committee			
Road Statistics Committee			



Theme 1 - Road Administration

Strategic Theme 1. Road Administration	
Technical Committee 1.1 - Performance of Transport Administrations	
1.1.1	Framework for measuring efficiency and effectiveness of Transport Administrations.
1.1.2	The transformation and new role of Transport Administrations in face of sharing economy, emerging technologies and Mobility as a Service (MaaS).
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 Climate Change Adaptation Framework
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	
<i>To be defined during the cycle</i>	



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 unpaved roads
Technical Committee 2.3 – Freight	
2.3.1	Best practices, monitoring and regulation to reduce overloading and associated pavement damage on road networks
2.3.2	Greening of freight transport
2.3.3	Application of new technologies on freight transport and logistics
Technical Committee 2.4 – Road Network Operation/ITS	
2.4.1	Implication of new mobility to road network operation
2.4.2	Optimizing road operations and performances through new technologies and digitalization
2.4.3	Update of the RNO/ITS Manual
Task Force 2.1 – New Mobility and its impact on road Infrastructure and Transport	
2.1.1	<i>To be defined during the cycle</i>





Theme 3 – Safety and Sustainability

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 International Winter Congress – Calgary 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
Technical Committee 3.4 – Environmental Sustainability in Road Infrastructure and Transport	
3.4.1	Real-time evaluation of pollution and low cost air quality sensors assessment
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





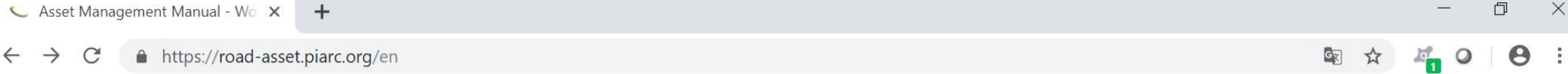
Theme 4 – Resilient Infrastructure

Strategic Theme 4. Resilient Infrastructure	
Technical Committee 4.1 – Pavements	
4.1.1	Recycled road 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 of road pavements
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 earthworks
4.3.2	Techniques and innovation for construction and maintenance of earthworks
4.3.3	Update Earthworks Manual “Design and Construction of earth-structures”
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) in urban and heavy traffic tunnels
4.4.3	Impact of new propulsion technologies on road tunnel operations and safety
4.4.4	Intelligent Transport Systems on tunnels
4.4.5	Update of the Tunnels Manual
4.4.6	Preparation of the 2nd International Conference of Tunnels
4.4.7	Support for updating and improving of DG-QRAM
Task Force 4.1 - Road Design Standards	
4.4.1	<i>To be defined during the cycle</i>





The Asset Management Manual



>> World Road Association website

Log in

EN

ASSET MANAGEMENT MANUAL A GUIDE FOR PRACTITIONERS!

MANAGEMENT DATA AND MODELING PLANNING APPLICATION

TOOLS

WELCOME TO THE PIARC ASSET MANAGEMENT MANUAL

Road infrastructure asset is the most valuable asset owned by the public sector in most countries and it supports a nation's economy. Traditional management methods will no longer be sufficient to meet 21st century business and political demands.

Asset management is a well-established discipline successfully implemented in several countries, for management of highways as well as other physical asset, addressing demands of a nation's citizens and industry for greater accountability and transparency, more efficient use of funds, greater focus on customer expectations and more sustainable solutions.

It is recognized that all road organizations manage their assets, but they do not necessarily all apply an asset management framework in order to achieve their desired outcomes from the delivery of their service to the traveling public and other stakeholders.

ARE YOU A RESEARCHER, A STUDENT OR A PROFESSIONAL?

CREATE YOUR FREE ACCOUNT TO ACCESS THE ADDITIONAL MEDIA MATERIALS AND RECEIVE ALERTS WHEN NEW CONTENTS ARE PUBLISHED.



REGISTER



The Asset Management Manual

- Available for free in English at: <https://road-asset.piarc.org/en>
- Focuses on **asset management principles** to support a more efficient approach to maintain road infrastructure assets
- Aimed at **national and local** road organizations
- Addresses **short- and long-term condition and performance** managing for the whole assets life





Conclusion

- PIARC Framework can be used irrespective of geographical, climatic, economic and environmental condition, locality, level of preparedness, and data availability.
- Universal, accessible framework developed through extensive literature review and consultation with international road authorities.
- Guidance provided on: identification of climate change impacts, potential risks and vulnerabilities, effective responses to risk and the integration of assessment findings into wider decision-making.
- Life cycle approach from inception to management and monitoring.
- **We continue to work on Resilience – join us**





PIARC CONGRESSES

Save the dates!

- **16th International Winter Road Congress**

- Calgary, Canada
- 8 – 11 February 2022



- **27th World Road Congress**

- Prague, Czech Republic
- 2 – 6 October 2023





Thank you for your attention



www.piarc.org



info@piarc.org



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World Road Association PIARC

Claude Van Rooten

PIARC President

claude.van-rooten@piarc.org

