

Session Report

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**FORESIGHT SESSION RF3: RESILIENCE FRAMEWORKS AND METRICS FOR ROAD STAKEHOLDERS
TUESDAY FEBRUARY 8, 08.00 AM TO 09:30 AM**

1. KEYWORDS

Resilience Frameworks, Resilience Metrics

2. PRESENTATION OF THE SESSION

This foresight session stems from the need to present indicative perspectives of state-of-the-art resilience frameworks and metrics that are of interest and applicable to road stakeholders. This is of particular relevance to PIARC’s TC1.4- Climate Change and Resilience of Road Network having in its scope of work for 2020-2023 for taking into account holistic methodologies and approaches concerning resilience in view of the update of PIARC’s proposed International Framework on Climate Change Adaptation for Road Infrastructure but also to the PIARC’s Strategic Theme 4 dealing with Resilient Infrastructure.

The aforementioned perspectives cover a wide range including resilience considerations in freight movements from disruptive events, methods and concepts for assessing the resilience of transport infrastructures, guidelines proposed for measuring resilience and prioritizing intervention, a framework for investment considerations and, use of Big Data in improving resilience.

A roundtable discussion on the presentations and on key selected questions with the participation of key experts representing ECTRI, TRB and PIARC and the presenters will shed further insight into the presented issues and how these could be best exploited by various stakeholders, including LMICs.

3. PROGRAMME OF THE SESSION

Session Chair: Dr. Ioannis BENEKOS

Session Organiser: European Conference of Transport Research Institutes (ECTRI) and the Transportation Research Board (TRB); supported by PIARC’s TC 1.4 on Climate Change and Resilience of Road Networks.

Session Secretary: Dr. Ioannis BENEKOS (also assisted by Mr. Bill ANDERSON for the session report).

Person	Organisation, Position	Title of the presentation
Dr. Ioannis BENEKOS	PIARC TC 1.4 member and ECTRI Rapporteur of Thematic Group on Security & Resilience – CERTH/HIT Head of Laboratory on Risk Management and Resilience – Greece	Welcoming; introduction; conclusion of the session.
Caroline ALMERAS	ECTRI Secretary General – Belgium	Welcoming on behalf of ECTRI
Neil J. PEDERSEN	TRB Executive Director; National Academies of Sciences, Engineering, and Medicine – USA	Welcoming on behalf of TRB
Caroline EVANS	Chair of PIARC’s TC 1.4; Principal Policy Advisor at the National Transport Commission – Australia	Welcoming on behalf of PIARC TC 1.4
Anne STRAUSS-WIEDER	Director, Freight Planning, North Jersey Transportation Planning Authority, and Chair of the TRB Transportation Resilience Section – USA	Considering Freight Movements and the Effective Practices Learned from Previous Disruptive Events
Dr. Claudio MARTANI	Research associate, ETH Zurich – Switzerland	Measuring the resilience of, and prioritizing interventions for, road transport systems

		using expert opinion (Part 1)
MSc Eng. Concepción TORIBIO	Researcher, CEMOSA – Spain	Measuring the resilience of, and prioritizing interventions for, road transport systems using expert opinion (Part 2)
Dr. Kalliopi ANASTASSIADOU	Senior researcher, Division Bridges and Structural Technology / Section Tunnel and Foundation Engineering, Tunnel Operation, Civil Security, Federal Highway Research Institute (BAST) – Germany	Methods and concepts for assessing the resilience of Transport Infrastructure (see also paper IP0338)
Prof. Joseph L. SCHOFER	Professor Emeritus of Civil Engineering & Transportation; Associate Dean, Robert R. McCormick School of Engineering and Applied Science, Northwestern University; Chair of the TRB Transportation Resilience Measures Policy Study – USA	Framework for Guiding Investments in Transportation Resilience
Toni LUSIKKA	Research Scientist, VTT Technical Research Centre of Finland Ltd. – Finland	Improving road infrastructure monitoring and resilience with Big Data collected from in-vehicle sensors
Dr. Ralf HEDEL	Moderator of ECTRI’s Thematic Group on Security & Resilience; Researcher and Project Manager, Department of Strategy and Optimization, Fraunhofer IVI – Germany	Roundtable Discussion
Bill ANDERSON	Senior Program Officer at TRB; National Academies of Sciences, Engineering, and Medicine – USA	
Juan Fernando MENDOZA SÁNCHEZ	PIARC TC 1.4 Spanish Secretary. Head of Environment Research Group, Mexican Institute of Transportation – Mexico	

4. TECHNICAL FINDINGS AND DEBATE

Below, please find a brief summary of main point from the roundtable discussion:

Q1: How can state-of-the-art approaches best be approached by countries that do not possess the experience and / or the necessary resources, in particular LMICs for their implementation?

Suggestions: It is important to know what information is available so as to perform vulnerability and criticality analysis as different elements contribute in a different way. The local community can play an important role as one is as resilient as the lowest critical level can be. Learning lessons from the past should consider an interdisciplinary approach. It is important for LMICs to participate and share their experience in relevant knowledge hubs.

Communities can fail and this is seen in “Ghost Town” studies. Failure occurs because the community and its neighbouring communities did not work together to prevent it. The best approach for resilience is to work together on a regional scale. One does this because if one community fails its loss impacts nearby communities. Those communities either need to be prepared to accept the social and economic impact or support the endangered community making it more resilient. The regional resilience partnership approach is scalable and can include economic megaregions and supply/value chains.

Q2: How can holistic methodologies and approaches concerning resilience be effectively collated and incorporated into resilience frameworks?

Suggestions: Both qualitative and quantitative criteria should be considered. Obtaining the different perspectives and exchanging information across different levels and organizational types should help to avoid in-silo approaches. Building trust, considering available resources and clear communication among

involved parties are essential. When it comes to cost-benefit considerations a key point is to consider externalities for both indirect impacts and benefits for a more equitable approach.

Q3: What are good practices for considering equity in transportation resilience planning?

Suggestions: It is important to understand who is served by the transport system, how they are served, what their needs and characteristics are. This is a multidisciplinary task. Using hurricane Katrina as an example, showcased the inadequacy of access to privately owned transport modes by population living in rural areas and an inadequacy of existing redundancies. Understanding the correct timing and requirements for individuals is important as these may have important lags at the various stages of an emergency.

Q4: Transportation is an inherently multi-modal system. How can resilience planning for private sector transportation providers (e.g. trucking companies, barge lines, railroads) be integrated into overall transportation resilience planning and/or network resilience?

Suggestions: The answer to this question relates to questions two and three. The transport system cannot be resilient without the people and the externalities (energy (fuel and power), water and food, and health). The pandemic exemplifies how important workforce and health are to mobility and accessibility. A multi-modal transport system must understand its core functions and services with a clear focus on mobility to understand what is essential to move safely and securely, how it is funded and resourced, and how it is governed. It should also understand why mobility of people and cargo is important for the times that it may need to prioritize limited resources and plan/prepare to be more resilient to always provide core functions and services to the users. Lastly, decision makers should understand the consequence of failed resilience. A disaster occurs because someone failed. Resilience in its core functions and services is important.

5. RECOMMENDATIONS FOR DECISION MAKERS, FOR PIARC OR FOR INTERNATIONAL ORGANISATIONS

Transport resilience is the matter of an interdisciplinary and intermodal approach. Coordinating, collaborating and communicating is a useful toolbox for proactively managing disruptions, understand and address multi-stakeholder considerations. Bow-tie approaches, risk registers and clear time considerations are essential. It is also important to keep workforce safe and healthy and enhance the system's connectivity & use of IT so as to ensure business & community continuity.

However, a single resilience metric is unlikely to be found. Therefore, there is need for a collection of metrics and a strong decision support framework. In this respect, defining appropriate resilience indicators and setting relevant targets is very important as well as prioritizing resilience interventions by using a structured process such as the Analytical Hierarchy method proposed may facilitate strategic decision-making and be complementary to traditional cost-benefit analysis.

The loss of functionality and time for recovery are important resilience indicators. Input of Expert knowledge in preparedness is a must. Proactive maintenance and management of road assets are essential in improving resilience. In this respect, in-vehicle sensors are an important tool. A very interesting study was also presented for informing investment decision-making & planning in considering resilience of existing transportation infrastructure and equity of potential impacts.

We need to define and understand the different terms and know what is available and what is not.

6. PREPARATION OF THE SESSION

This session was planned, designed and organised as follows:

- The session was jointly proposed by ECTRI and TRB and was actively endorsed and supported by PIARC TC 1.4 – Climate Change and Resilience of Road Networks. ECTRI's Secretary General, Ms. Caroline ALMERAS, TRB's Executive Director Mr. Neil J. PEDERSEN and PIARC TC 1.4 Chair Ms. Caroline EVANS led this effort.
- Coordinated the session's organization: Dr. Ioannis BENEKOS.

The Chair wishes to specially acknowledge all participants, attendees, and contributors and their affiliations as they are listed in the aforementioned Session Programme, PIARC's General Secretariat for their interest in the proposal, the Canadian Organizing Committee for their hosting and provision of technical support (in particular Leanne and Liz from Speakers Management), and, Evelina AKESSON from PIARC for their continued support during the entire period of the organization of the session.