



CHALLENGES IN RESILIENCE BUILDING FOR ROAD DISASTER MANAGEMENT COORDINATION AND COOPERATION IN DIFFERENT REGIONS

SUMMARY OF PIARC & REAAA JOINT
SESSION AT THE PIARC OSAKA
WORKSHOP MAY 2025

TECHNICAL COMMITTEE 1.5 *DISASTER MANAGEMENT*



STATEMENTS

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

The study that is the subject of this report was defined in the [PIARC Strategic Plan 2024-2027](#) and approved by the Council of the World Road Association, whose members are representatives of the member national governments. The members of the Technical Committee responsible for this report were appointed by the member national governments for their special competences.

Any opinions, findings, conclusions and recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of their parent organisations or agencies.

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AUTHORS

Technical Committee 1.5 Disaster Management of the World Road Association (PIARC) prepared this report following the presentations and panel discussions at the PIARC and REAA joint panel session at the PIARC Osaka Workshop in Osaka, Japan on May 27, 2025. The theme of the workshop was "Road Disaster Management: Enhancing Coordination, Cooperation, and Diversity."

The authors of this report are members of Technical Committee 1.5 Disaster Management and the REAAA Climate Change, Resilience, and Disaster Management Working Committee, as well as engineers from Japanese expressway companies. They have all made significant contributions by sharing how their countries and organizations deal with disaster management during extreme weather events in terms of coordination and cooperation. These experts are listed below in alphabetical order.

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The language quality control of this document was carried out by **Christoher ENGELBRECHT**, **Alain LEFEBVRE**, and **Marcelo MEDINA**, English, French and Spanish speaking secretaries of PIARC TC1.5 respectively.

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- Information Technology Co., Ltd.
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In addition to this support, the PIARC & REAAA panel session “Challenges in Resilience Building for Road Disaster Management Coordination and Cooperation in Different Regions” was organized as a part of the PIARC international workshop on road disaster management – Enhancing coordination, cooperation, and diversity -.



EXECUTIVE SUMMARY

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CHALLENGES IN RESILIENCE BUILDING FOR ROAD DISASTER MANAGEMENT COORDINATION AND COOPERATION IN DIFFERENT REGIONS

**SUMMARY OF PIARC & REAAA JOINT SESSION AT THE PIARC OSAKA WORKSHOP,
MAY 2025**

The international workshop was organized by the World Road Association (PIARC) through its Technical Committee 1.5, "Disaster Management," and the Japan Road Association (JARA). The Road Engineering Association of Asia and Australasia (REAAA) collaborated with the event through its Climate Change, Resilience, and Disaster Management Committee. The workshop theme was "Road Disaster Management: Enhancing Coordination, Cooperation, and Diversity". This event provided information on the latest disaster management practices in road communities worldwide.

As part of the workshop, a special panel session was organized. PIARC Technical Committee 1.5 and the REAAA Climate Change, Resilience, and Disaster Management Committee jointly organized the session, titled "Challenges in Resilience Building for Road Disaster Management Coordination and Cooperation in Different Regions."

The workshop aimed to share global case studies on the challenges of building resilience in road disaster management coordination and cooperation in collaboration with the REAAA. Seven panelists were invited: three PIARC specialists from the USA, the UK, and South Africa; two REAAA specialists from Thailand and New Zealand; and two Japanese specialists from NEXCO East and West Japan. The session was well organized and included many discussions among the panelists.

The panels covered the seven topics: "Expressway closures restriction before disaster with considering intensity and cumulative volume of rain fall", "Rapid impact assessment – The UK journey to embed resilience across a nation", "The use of alerting systems and technology to enhance preparedness and coordination to natural hazards", "Impact of extreme weather events across bordering countries", "Initiatives to strengthen disaster response capabilities on expressways", "Coordination and cooperation of nature-based solutions for resilient and sustainable slopes in Thailand", and "US coordination among federal, state & municipalities to build transportation resilience".

After the presentations, the panelists discussed the following topics in a moderated session:

- 1) Challenges in achieving consensus across many stakeholders for disaster management
- 2) Trends of coordination and cooperation taking place in their countries
- 3) How weather forecasts are used for disaster management
- 4) Information and communication: How real-time data is shared, and the challenges

The workshop also highlighted the importance of the hybrid format, which enabled REAAA specialists facing travel difficulties to participate online. This format enhances the opportunities for face-to-face meetings and encouraged the participation of experts from around the world.

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1. INTRODUCTION

The PIARC Technical Committee 1.5 Disaster Management is one of 21 committees for the 2024-2027 cycle. Its purpose is to advance research, share expertise, and promote international cooperation in disaster management. The Committee is structured into four Working Groups (WG):

1. WG1 Coping with extreme weather
2. WG2 Social resilience within communities and public authorities to cope with extreme weather, Task Force: Gender inclusion and diversity issues in disaster management
3. WG3 Infrastructure resilience for supporting supply chain during extreme weather events
4. WG4 Update of the Disaster Management Manual

Technical Committee 1.5 held its third meeting in Osaka, Japan during the week commencing 26th May 2025, alongside the International Workshop on Road Disaster Management – Enhancing Coordination, Cooperation and Diversity.

It is recognized that collaboration with regional road associations is a significant task for PIARC. PIARC and REAAA organized a panel session at the workshop to delve into social resilience. Seven panelists from six countries discussed challenges in their respective regions to improve social resilience, aiming to share best practices and lessons learned in disaster management activities responding to extreme weather events affecting road networks.



Figure 1.1 Workshop second announcement

Table 1.1 PIARC & REAAA session program

International Workshop on Road Disaster Management -Enhancing Cooperation, Coordination and Diversity- Osaka, Japan, on May 27th, 2025	
14:10 - 15:40	<p>Panel Session 1 (PIARC and REAAA Joint Session): Challenges in resilience building for road disaster management coordination and cooperation in different regions</p> <ul style="list-style-type: none"> • Challenges in resilience building for road disaster management: coordination and cooperation in different regions, Caroline EVANS, AUS, Strategic Theme Coordinator, Road Administration, PIARC • Highway closure restriction before disaster with considering intensity and cumulative volume of rainfall, Akira MITSUISHI, NEXCO-E, JPN • Rapid Impact Assessment - The UK journey to embed resilience across a Nation, John LAMB, UK Chair - Adaptation, Biodiversity & Climate Board (TC1.5) • The use of alerting systems and technology to enhance preparedness and coordinated responses to natural hazards, Willis MACBETH, WSP, NZL (REAAA) • Impact of extreme weather events across bordering countries, Kwanele SIMELANE, SANRAL, ZAF (TC1.5) • Initiatives to strengthen disaster response capabilities on expressways, Hiroshi FUJIWARA, NEXCO-W, JPN • Coordination and cooperation of nature-based solutions for resilient and sustainable slopes in Thailand, Auckpath SAWANGSURIYA, Dept. of Highways & Apiniti JOTISANKASA, Kasetsart University, THA (Road Engineering Association of Asia and Australasia (REAAA)) • US coordination among federal, state & municipalities to build transportation resilience, Christopher ENGELBRECHT, Missouri DOT, USA (TC1.5) • Panel Discussion



Figure 1.2 Photos of the PIARC & REAAA panel session

2. SOCIAL RESILIENCE – COORDINATION , COOPERATION AND DIVERSITY

2.1. SOCIAL RESILIENCE

In a global context, extreme weather events, such as floods, droughts, hurricanes, and heatwaves are increasing in frequency and intensity. It is becoming more crucial to understand how societies react and adapt to these challenges.

Social resilience refers to the ability of individuals, communities, and societies to cope with shocks, stress, or disruptions—such as natural disasters, economic crises, or social conflicts—while maintaining their essential functions and rebuilding in a way that makes them better prepared for future challenges.

More specifically, social resilience encompasses several aspects:

1. **Capacity to Absorb Shocks:** Resilient societies can withstand the immediate impacts of disruptions without suffering irreversible damage.
2. **Capacity to Adapt:** Beyond managing crises in the short term, social resilience involves the ability to adapt to long-term changes, whether by modifying practices, developing new infrastructure, or revising policies.
3. **Capacity for Transformation:** This involves the willingness and ability to transform social, economic, or political structures that make a society vulnerable, in order to prevent or better manage future crises.
4. **Social Cohesion:** An essential aspect of social resilience is the strength of social bonds. Communities where members help each other, share resources, and support the most vulnerable are generally more resilient.
5. **Innovation and Learning:** Social resilience also depends on the ability to learn from past crises, innovate to address new threats, and continuously improve practices and policies.

In summary, social resilience is a quality that enables a society not only to survive disruptions, but also to strengthen and transform itself to better face future impacts from hazards.

2.2. COORDINATION, COOPERATION AND DIVERSITY

Collaboration and cooperation are essential to disaster management. Figure 2.1 shows where coordination is necessary between road authorities, operators and asset managers. Cooperation within communities and public authorities for extreme weather is also required. Disaster management is dependent on these factors working together to maintain and reduce the impacts on system performance levels, and to reduce recovery times and the effects of an event in the most efficient way possible. Figure 2.2 outlines these interrelationships between system performance levels and the time taken to resolve

and recover from the impacts of a disaster. The intersection point between these areas is the degree of disaster management required to ensure that infrastructure and the community are more resilient to future events.

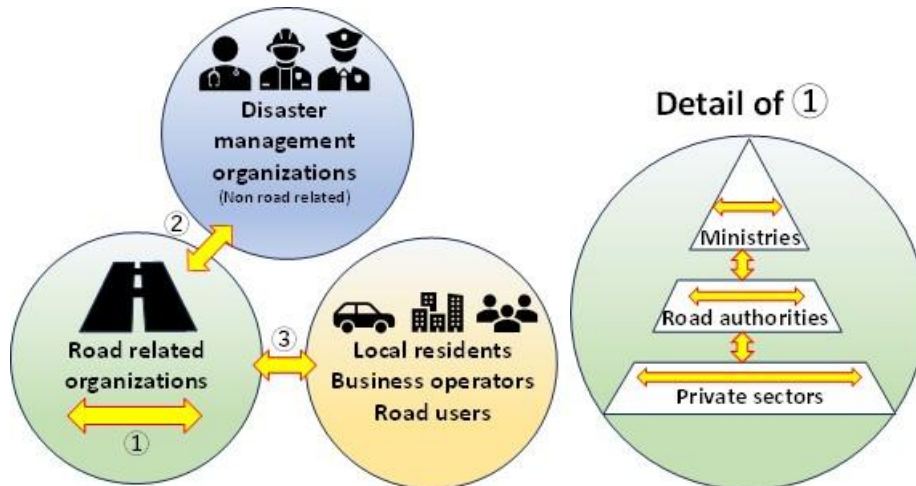


Figure 2.1 Component of the social resilience in road disaster management

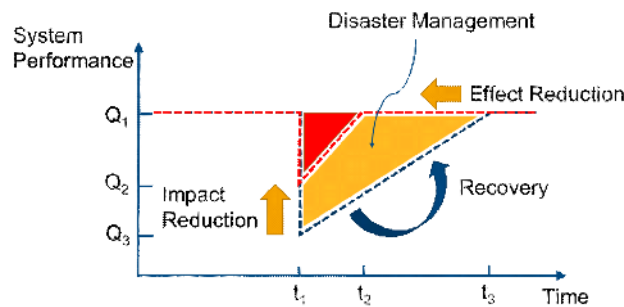


Figure 2.2 Components of the social resilience in road disaster management

2.3. SCOPE OF THE TECHNICAL SESSION

The purpose of the technical session was to identify how different regions of the world are addressing coordination and cooperation within disaster management activities. The session also sought to identify good practice examples that will be beneficial to other countries, including Low-Middle Income Countries (LMICs). The main areas of focus were:

- Response and recovery against road damages for local residents, business operators and road users (detour, construction and inspection etc.)
- Utilization of road facilities against non-road damages for local residents, business operators and road users (evacuation, provision of information and supplies etc.)

3. PRESENTATION SUMMARIES

3.1. SESSION GUIDANCE: CHALLENGES IN RESILIENCE BUILDING FOR ROAD DISASTER MANAGEMENT: COORDINATION AND COOPERATION IN DIFFERENT REGIONS



EVANS, Caroline

Strategic Theme 1 Coordinator, PIARC

Co-Chair, Climate Change, Resilience and Disaster Management Working Committee, REAAA

Principal Policy Officer, Infrastructure Victoria, AUS

Caroline Evans from PIARC moderated the session “Challenges in resilience building for road disaster management coordination and cooperation in different regions”. The session aimed to share knowledge on resilience building for disaster management and identified ways to achieve increased coordination and cooperation in different regions. It was organized by PIARC and REAAA

This session commenced with an overview of REAAA activities. In particular, the REAAA Climate Change, Resilience and Disaster Management Working Committee aims to:

- Address issues of concern to REAAA member countries in the area of infrastructure resilience to climate change and disaster management
- Act as a liaison between the REAAA member countries and PIARC Committees

These REAAA activities are aligned with PIARC’s policy to:

- Encourage the collaboration with regional road association
- Share knowledge: World-wide knowledge and overcomes on coordination and cooperation
- Identify the challenges today to enhance coordination and cooperation in disaster management.

REAAA is committed to the topics of climate change, resilience and disaster management. The Working Committee covering these topics has developed a number of reports over the last 10 years. These include:

- REAAA Scanning Tour on Infrastructure Resilience in South Korea and Japan, in 2017
- Briefing note on the International Climate Change, Resilience and Disaster Management Seminar in Yogyakarta, Indonesia jointly coordinated by PIARC and REAAA, in 2022
- REAAA Newsletter, April 2025 on Climate Change Impacts on Road Engineering Management. This Newsletter included 3 reports on planning for resilience, designing for resilience and technologies and tools.



Figure 3.1.1 REAAA’s Work on Resilience and Disaster Management

3.2. EXPRESSWAY CLOSURE RESTRICTION BEFORE DISASTER WITH CONSIDERING INTENSITY AND CUMULATIVE VOLUME OF RAINFALL



MITSUISHI, Akira

Chief General Manager, International Department, East Nippon Expressway Co., Ltd., Tokyo, Japan (NEXCO East)

The presentation emphasized the critical role of early warning systems in Japan to prevent human casualties from landslides triggered by heavy rains. It began with a historical overview, citing a slope failure in 1968 caused by typhoon-induced heavy rain exceeding 100mm/hr. This tragic event resulted in the deaths of 104 out of 107 passengers while two buses fell into a river. This incident prompted the development and implementation of early warning systems on Japan’s national highways and expressways.

The concept of early warning in Japan involves proactively regulating and closing road sections before a disaster occurs to ensure the safety of road users. This approach is complemented by adequate slope protection work. Weather stations are installed along roadways to monitor real-time weather conditions, enabling road operators to conduct patrolling and road closures at the appropriate times and locations.

Two methods are employed in Japan for early warning: the accumulated rainfall method and the combination of accumulated rainfall and hourly rainfall. The accumulated rainfall method is easier to operate but does not account for heavy rainfall in short periods. The combination method is more reliable as it considers both accumulated rainfall and rain intensity, although it requires a suitable monitoring system and human resources.


The closure thresholds are continuously reviewed based on factors such as return period rainfall, traffic volume, age of the slope, history of slope disasters, and long-term rainfall forecasts by the Japan Meteorological Agency. The baseline rainfall is typically based on a 5-6-year return period, with adjustments made for traffic volume and other factors.

In conclusion, the early warning system have proven to be a practical and effective measure to save lives from landslides caused by heavy rain. The early warning systems should be implemented alongside appropriate slope protection measures. Closure thresholds should be regularly updated to reflect current slope conditions and climate change.



Figure 3.2.1 Early warning and road closure criteria for heavy rain

3.3. RAPID IMPACT ASSESSMENT - THE UK JOURNEY TO EMBED RESILIENCE ACROSS A NATION



LAMB, John

Leader, Working Group 3, TC1.5, PIARC

UK Board Chair, Adaptation, Biodiversity & Climate Board, UK

The United Kingdom (UK) has experienced a series of extreme weather events, such as floods, landslides and infrastructure failures that severely impacted its highway networks and forced communities into prolonged detours. In response, the UK has developed a transformative approach, known as Rapid Impact Assessment (RIA), a new approach to emergency management and infrastructure resilience.

The presentation outlined the development and implementation of RIA methodologies as a critical component of the UK’s national resilience strategies. RIA enables rapid evaluation of disaster impacts and supports targeted, timely responses to stabilize and restore highway assets.

The presentation emphasized the following six key domains of resilience:

Robustness: Infrastructure should be strong enough to resist damage from disasters.

Reliability: Road systems should keep working well under different conditions.

Redundancy: Backup routes and systems should be available when primary ones fail.

Resourcefulness: Emergency teams should be able to use people, tools, and information effectively during emergencies.

Rapidity: Quick action is important to minimize damage and start recovery fast.

Recovery: Post-disaster rebuilding should improve infrastructure strength and resilience.

The key features and benefits of RIA are that it:

- Provides structured, evidence-based data to support transparent and accountable decision-making.
- Enables real-time assessment of infrastructure conditions to identify the most affected areas.

- Guides resource prioritization, such as deploying temporary bridge supports or initiating early repairs.
- Acts as a first step before advanced technical assessments (e.g., drones, satellite imaging).
- Facilitates cross-agency coordination and mutual aid across government boundaries.

To promote and implement RIA nationwide, the UK Government is launching a series of national roadshows across England, Scotland, Wales, and Northern Ireland. These events aim to:

- Raise awareness of RIA’s importance.
- Share best practices and training.
- Foster collaboration among emergency planners, engineers, and local officials.
- Engage all 200+ local highway authorities and National Highways in adopting RIA.
- Encourage a cultural shift from reactive disaster response to proactive resilience planning.

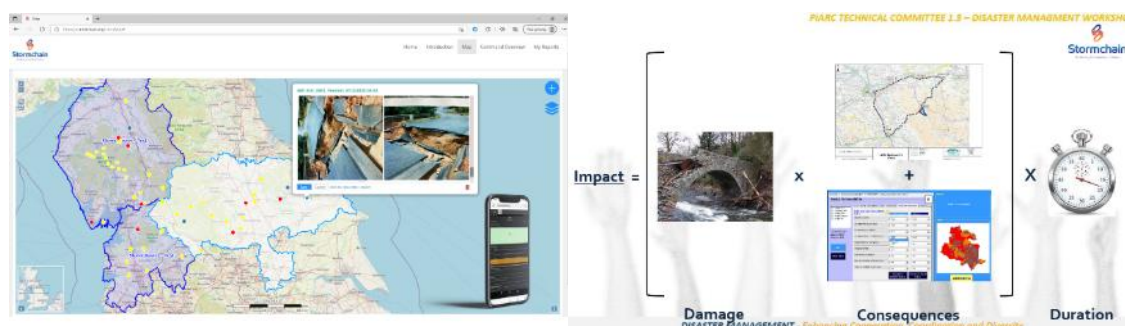



Figure 3.3.1 Images of Rapid Impact Assessment

3.4. THE USE OF ALERTING SYSTEMS AND TECHNOLOGY TO ENHANCE PREPAREDNESS AND COORDINATED RESPONSES TO NATURAL HAZARDS



MACBETH, Willis

Member, Climate Change, Resilience and Disaster Management Working Committee, REAAA

Principal Engineer - Asset & Network Performance, WSP NZ Ltd. NZL

The presentation discussed remote monitoring technologies used for road asset management. These technologies transmit critical information and alerts to asset owners, making it suitable for known problem sites. With advancements in communication technology, critical information can now be transmitted globally in real-time. Examples of remote monitoring technology include extensometers to measure slope failures, tilt meters to measure the rotation of retaining walls, and flow gauges used on slope drainage. Additionally, cameras and computer vision are employed to detect floods and analyze images using AI and machine learning.

Satellite monitoring using InSAR was introduced, this is a satellite remote sensing technology that detects ground deformation and relative elevation changes. A proof of concept using InSAR showed successful network-wide landslide monitoring, and there are plans to use this technology across New Zealand's state highway network. The benefits of InSAR include continuous monitoring

and early warning, as well as cost-effective coverage of entire networks rather than individual sites. It can detect small surface movements over time, aiding in predicting landslides.

Post-disaster response tools were also examined, such as Survey 123 and GIS, which were used for triaging bridge collapses and significant damage during the 2023 cyclone. These tools help prioritize responses and coordinate with key stakeholders, road controlling authorities, and the public.

Case studies were presented related to the Canary Early Alerting System, which includes modules for bridge scour risk, road slip risk, and bridge seismic risk. The bridge scour risk module forecasts rainfall using available and observed data, maps catchments, and predicts potential issues. The road slip risk module uses cumulative rainfall and intensity to predict damage. The bridge seismic risk module integrates live earthquake data with bridge assets to correlate expected damage.

Another case study involved the SH6 Epitaph Slip Monitoring and Response, where UAVs, 3D models, and remote monitoring were used to respond to a significant landslide that cut off the state highway for about two weeks in November 2024. The tools and technology used in this response included various extensometers, cameras, flow gauges, and rainfall gauges. The remote monitoring, especially the camera, helped validate information in real-time, aiding decision-making and communication with stakeholders.

In summary, the speaker emphasized the importance of alerting systems and new technologies in improving readiness and ensuring coordinated responses to natural disasters. The integration of technology enhances response capabilities and improves resilience and safety outcomes. The presentation is concluded by highlighting the future use of machine learning and AI to better predict and prepare for network failures.

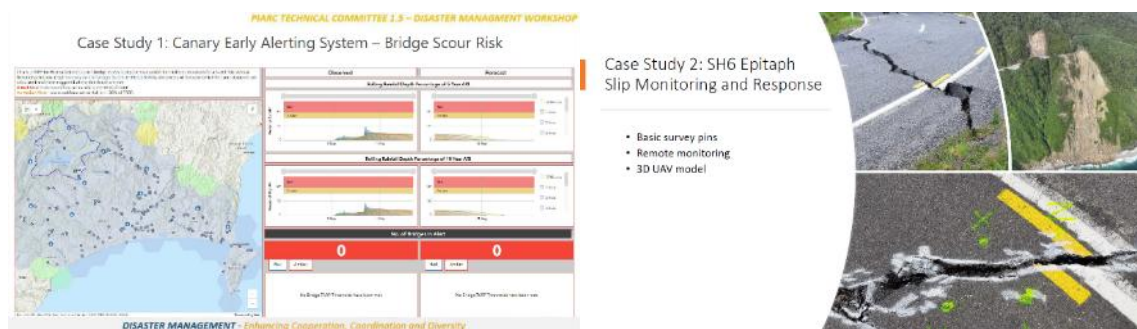


Figure 3.4.1 Case studies of the use of alerting systems and technologies

3.5. IMPACT OF EXTREME WEATHER EVENTS ACROSS BORDERING COUNTRIES



SIMELANE, Kwanele

Member, Working Group 3, TC1.5, PIARC

Project Manager, South African National Roads Agency, ZAF

Road networks are essential for modern society. They support the movement of people and goods, help economies grow, and reduce poverty in both urban and rural areas. When roads, bridges, and culverts are damaged, especially during disasters, it can lead to serious problems such as traffic delays, loss of access to key economic routes, interrupted development, and even loss of life.

In recent years, extreme weather events have become more frequent and severe, both globally and in Southern Africa. Between 2010 and 2020, countries like South Africa, Mozambique, Zimbabwe, Botswana, and Namibia have experienced strong storms, heavy rains, and floods that caused major damage to transport systems. These disasters often happen without warning and stop people and goods from moving safely and quickly.

This presentation explored the escalating risk of extreme weather impacts on road infrastructure in South Africa and the broader Southern African region. It highlighted the essential role of roads in economic development, social cohesion and demonstrated how climate-related disasters increasingly jeopardize these functions. This presentation also illustrated the scale of the problem and advocated for a proactive, regionally coordinated approach to resilience planning, infrastructure adaptation, and disaster risk reduction.

The major challenges in disaster response and infrastructure management were identified as follows:

- **Poor Historical Data Collection and Management:** South Africa has experienced over 150 extreme weather events, yet many of these incidents were not adequately recorded or analyzed. Without good data, it's hard to learn from past disasters, predict future risks, or plan better responses. This also makes it difficult for different agencies to work together effectively.
- **No Dedicated National Disaster Funding:** While current legislation allows for post-disaster recovery and rehabilitation funding, there is no dedicated budget specifically allocated for disaster preparedness or rapid response at the national level. This reactive funding model delays critical interventions and limits the ability to act swiftly during emergencies, while making the situation worse.
- **Lack of Clear Funding Mechanisms for Provinces:** Provincial and municipal governments are responsible for managing local infrastructure and responding to disasters. However, here are no clear rules or funding systems to support them. This leads to confusion and uneven responses, leaving some areas without the resources they need.

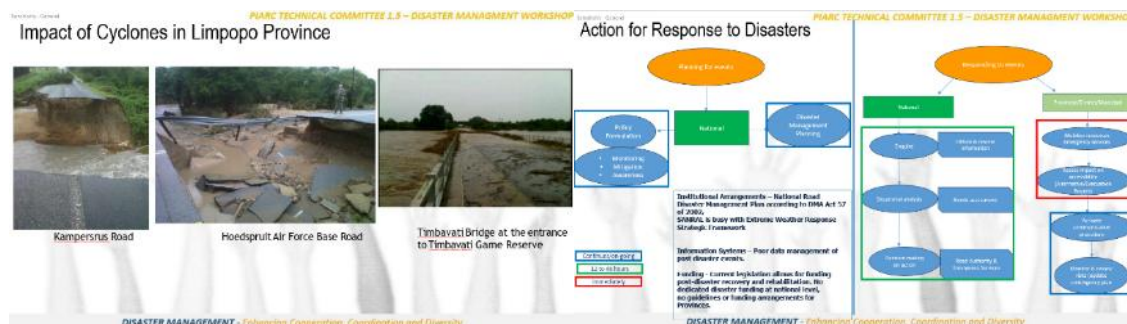


Figure 3.5.1 Impact of extreme weather events across bordering countries and response actions

3.6. INITIATIVES TO STRENGTHEN DISASTER RESPONSE CAPABILITIES ON EXPRESSWAYS (QUICK RECOVERY IN ACCESSIBILITY IN THE EVENT OF A DISASTER)



FUJIWARA, Hiroshi

Manager, General Management Division Expressway Operation
Department West Nippon Expressway Co., Ltd Japan

The presentation provided an overview of the expressway network, highlighting the length of service and average daily traffic operated by NEXCO EAST, NEXCO CENTRAL, and NEXCO WEST. These services set the stage for understanding the scale and importance of the expressway network in Japan.

The presentation discussed major earthquakes and heavy rains that have occurred in West Japan in recent years. It emphasized the seismic activity in the region and the increasing frequency of torrential rain disasters due to climate change. Specific events such as the 2018 West Japan Torrential Rainfall, the 2024 10th Typhoon “Shanshan,” and various significant earthquakes were mentioned to illustrate the types of disasters that impact the expressway network.

The core of the presentation focused on the missions and roles during the initial response to disasters. The primary mission is saving human life, by securing access for emergency services within 24 hours. The secondary mission is the early recovery of economic activity, supporting the activities of police departments, fire departments, the Self-Defense Forces, and medical services within 72 hours. The goal is to secure access for emergency transport for logistics within 72 hours and open the expressway to the public within one week.

Following this, the presentation addressed issues and solutions for securing access for emergency transport within 24 hours. Solutions included data collection using PDA, sharing video surveillance by the Self-Defense Forces, and joint training with similar organizations. These measures aim to quickly and comprehensively assess damage and restore access.

The following section continued with issues and solutions for ensuring the passage to the public within one week. Solutions involve acquiring detailed survey data by a Laser Profiler Survey, detailed investigation and recovery planning by internal and external experts and securing two lanes for provisional operation using the width of four lanes until full restoration. The presentation emphasized the importance of informing the public about temporary operations and promoting public awareness.

Finally, the presentation concluded by reflecting on lessons learned from past disasters and the continued improvement of operations. It highlighted the importance of conducting joint drills with stakeholders, updating communication protocols, and refining emergency response and recovery plans.

This outline provided a comprehensive overview of the initiatives to strengthen disaster response capabilities on expressways. It focuses on the expressway network, recent disasters, initial response missions, and solutions for securing access and ensuring passage to the public.

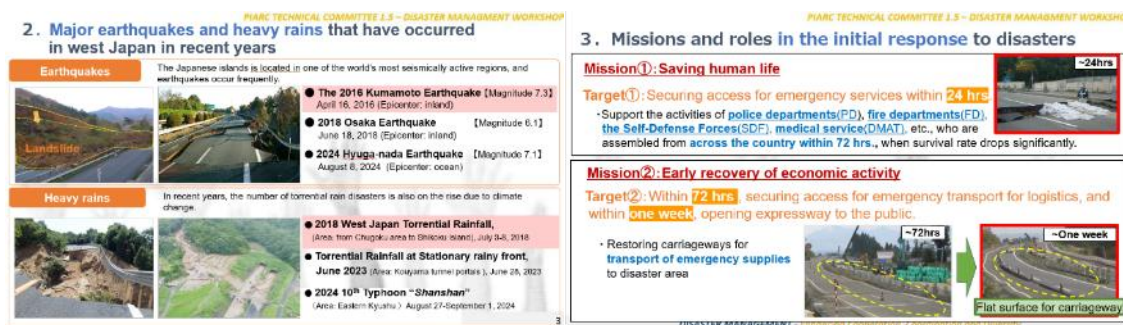



Figure 3.6.1 Missions and roles in the initial response to disasters

3.7. COORDINATION AND COOPERATION OF NATURE-BASED SOLUTIONS FOR RESILIENT AND SUSTAINABLE SLOPES IN THAILAND



SAWANGSURIYA, Auckpath

Member, Climate Change, Resilience and Disaster Management Working Committee, REAAA

Senior Professional Civil Engineer, Department of Highways, THA



JOTISANKASA, Apiniti

Member, Climate Change, Resilience and Disaster Management Working Committee, REAAA

Associate Professor, Kasetsart University, THA

Thailand’s highway infrastructures have faced significant challenges related to slope instability, especially in mountainous regions and areas affected by heavy monsoonal rainfall. Traditional engineering solutions such as retaining walls, soil nailing, and drainage systems have proved effective but are often costly, environmentally intrusive, and limited in scalability. In response, Thailand has actively explored Nature-based Solutions (NbS) as a sustainable, cost-effective alternative to enhancing slope resilience.

Since 1993, under the guidance of the Royal Initiative Project, the use of vetiver grass has been promoted nationwide to prevent soil erosion and improve slope stability. This presentation provides an overview of the development and implementation of NbS for slope stabilization, particularly within the context of disaster risk reduction and environmentally responsible infrastructure development.

Through a series of case studies, the presenters demonstrated how ecological techniques can be integrated with engineering practices to create effective, low-impact solutions. These approaches not only address geotechnical challenges, but also support ecosystem restoration and long-term environmental sustainability.

A key focus of the presentation was the importance of multi-stakeholder coordination and collaboration—involving government agencies, academic institutions, and local communities—in scaling up and institutionalizing NbS across the country.

Thailand is planning to expand nature-based solutions into broader urban and environmental planning through:

- Sponge City Concepts: Green roofs, rain gardens, permeable pavements, and stormwater storage systems
- Bio-Circular-Green Economy: Promoting sustainable infrastructure practices in highway maintenance and development.

In conclusion, the presenters advocated for wider adoption of NbS as a climate-resilient, cost-effective, and ecologically sound approach to managing slope-related risks. The Thai experience demonstrates that blending traditional knowledge, innovative science, and policy support can lead to scalable solutions for sustainable infrastructure across diverse landscapes.



Figure 3.7.1 Nature-based Solutions for slope stability

3.8. US COORDINATION AMONG FEDERAL, STATE & MUNICIPALITIES TO BUILD TRANSPORTATION RESILIENCE



ENGELBRECHT, Christopher

English Speaking Secretary, TC1.5, PIARC

Director Safety and Emergency Management Division Missouri Department of Transportation, USA

In the face of growing threats from natural disasters and climate change, strengthening the resilience of transportation systems has become a national priority for the United States. In 2024 alone, the country experienced 27 disaster events, each causing over \$1 billion USD in damage. While such disasters cannot be entirely avoided, their impacts can be significantly reduced through proactive planning, strategic investment, and effective coordination.

This presentation highlighted the critical role of integrated action among federal, state, and municipal governments in improving the resilience of U.S. transportation infrastructure. It focused on three major challenges that currently hinder efficient disaster management and infrastructure recovery:

- Challenge 1: Fragmented Coordination Across Regions

Disaster response is often hampered by inconsistent policies and siloed operations across different jurisdictions. States and municipalities frequently work under their own strategies, leading to duplicated efforts, delays, and higher recovery costs.

Recommendations:

- Develop standardized national frameworks and mutual aid agreements
- Establish a unified command structure with trained, empowered decision-makers.
- Challenge 2: Inefficiencies in Communication and Data Sharing

Timely, accurate information is essential for effective disaster management. However, many agencies still rely on outdated communication tools, slowing response efforts.

Recommendations:

- Invest in interoperable communication platforms and real-time data sharing systems.
- Implement rapid impact assessment tools to support faster response and resource deployment.
- Challenge 3: Funding concerns and Program Inconsistencies

Multiple federal programs—such as FHWA’s Emergency Relief (ER) and FEMA’s Public Assistance (PA) - often differ in eligibility, reimbursement, and processing, creating confusion for state and local responders.

Recommendations:

- Align and streamline funding programs.
- Prepare project designs and cost estimates in advance for high-risk infrastructure.

In conclusion, overcoming these challenges requires a comprehensive and coordinated national strategy. The speaker proposes four key actions:

- National Standardization – Establish clear protocols for disaster response while allowing flexibility at the local level
- Funding Coordination – Align programs to reduce complexity and speed up recovery
- Technology Integration – Use predictive models and real-time assessment tools to improve decision-making
- Public-Private Partnerships – Involve private sector expertise and innovation in resilience planning and infrastructure development

A resilient transportation network is essential not only for emergency response and supply chain continuity, but also for long-term national economic stability and community well-being. Forward-thinking action will ensure the U.S. transportation system is well-prepared for future disasters.

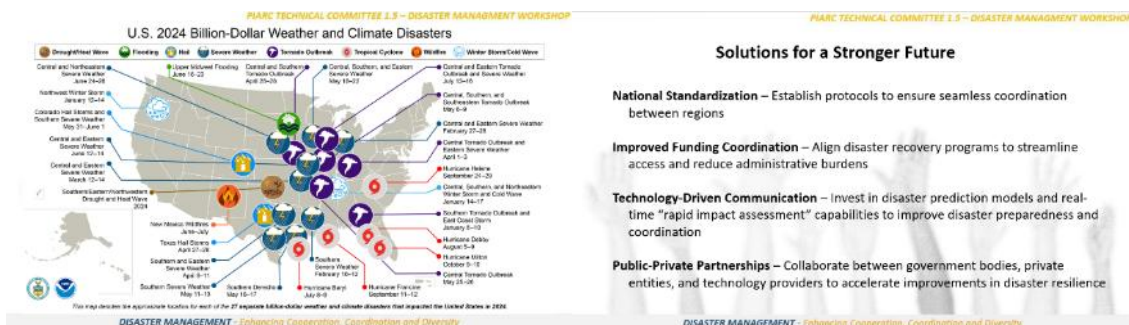


Figure 3.8.1 Solutions for more resilient transportation systems

4. DISCUSSION

The discussion was moderated by Caroline Evans, Australia.



4.1. MAIN CHALLENGES IN ACHIEVING CONSENSUS ACROSS MANY STAKEHOLDERS FOR DISASTER MANAGEMENT



John LAMB responded that one of the key roles of professionals in disaster management is to prepare for the worst-case scenarios – not for normal days.

Kwanele SIMELANE emphasized that securing resources and funding is one of the most critical components for effective disaster emergency response. Christopher ENGELBRECHT also supported Kwanele SIMELANE's view, reinforcing the importance of financial and logistical preparedness.

Akira MITSUSHI pointed out that in terms of stakeholder consensus, the level of cooperation among different stakeholders varies depending on the severity and location of road damage. Central government ministries and local governments needed to work together to restore damaged roads.



Hiroshi FUJIWARA emphasized the importance of establishing an emergency response system, as rapid coordination is essential during a disaster. Joint training should be conducted during normal times to ensure preparedness ahead of disasters.

Willis MACBETH acknowledged that, given the diverse needs in disaster response, engineers often focus on physical assets when providing technical solutions. However, he emphasized the importance of balancing funds between assets and the needs of communities, which is essential to ensure more inclusive and effective disaster recovery.

Auckpath SAWANGSURIYA explained that even when consensus is achieved, coordinating disaster response among national, regional and local levels remains a major challenge. This is especially true in low-income areas, Here there can be less response specifically in low income areas with limited capacities, and slower response times. This significantly hinders effective emergency management. In Thailand, even when consensus and agreements have been achieved, the responsible authorities and agencies still require enforcement mechanisms to effectively drive the policies and managements and to timely take action across their direct jurisdictions.



4.2. NEW TRENDS OF COORDINATION AND COOPERATION TAKE PLACES IN YOUR COUNTRIES

Christopher ENGELBRECHT highlighted two key points: first, that relevant stakeholders engage in active dialogue and collaborate effectively; and second, that the collection and sharing of disaster-related data are critical to enable a well-coordinated response.



Kwanele SIMELANE also emphasized two key aspects in the case of South Africa: first, the importance of sharing emergency management knowledge through workshops, training programs, and other capacity-building activities; and second, the need to collect and analyze data from past disasters to improve future preparedness and response strategies.



John LAMB explained that a major trend in UK is organizing workshops that involve all relevant agencies. These workshops often include activities such as observing local geology and micro-level conditions to understand localized risks. In the UK, the government has required 150 authorities to report on their plans and actions for addressing climate change.

4.3. HOW ARE WEATHER FORECASTS USED FOR DISASTER MANAGEMENT OPERATIONS?

Akira MITSUISHI explained that weather data along road routes are provided by private companies for a fee. These have been actively utilized for micro-level road disaster management.



Willis MACBETH added that the active use of AIPs (Area Information Platforms) integrated with weather forecast data is particularly useful for obtaining regional-level information, as weather forecast data is generally provided on a regional scale.

4.4. INFORMATION AND COMMUNICATION ARE KEY: HOW IS REAL-TIME DATA SHARED, AND WHAT ARE CHALLENGES?

John LAMB emphasized the importance of a flexible response and the ability to rapidly understand the disaster situation, including identifying urgent needs and mobilizing required actions. This rapid situational awareness is essential for stabilizing critical assets.



Hiroshi FUJIWARA highlighted the practical importance of preparing contact lists in advance. In emergency situations, having immediate access to key personnel across agencies and sectors significantly enhances coordination and speeds up decision-making.

5. CONCLUSIONS

- The impact of extreme weather events can have a profound effect on any country and region. This is not just a problem for each country or region, but a challenge that needs to be addressed on a global scale. PIARC members need to look beyond their borders to share best practices on mitigating the effects of extreme weather events and building resilience.
- An active dialogue and collaboration among stakeholders, capacity-building activities, and the use of weather data for disaster management is essential. The importance of real-time data sharing and rapid situational awareness was also emphasized, along with the need for immediate access to key personnel during emergencies.
- Key points included the importance of preparing for worst-case scenarios, securing resources and funding, and ensuring cooperation among various stakeholders. The discussion also highlighted the need for financial and logistical preparedness, establishing emergency response systems, and balancing funds between physical assets and community needs.
- Supporting the adoption of consistent Rapid Impact Assessment methods and technologies will increase the road sector's ability to understand and quantify disaster impacts locally, nationally and internationally. By applying a defensible process, this can be used to inform recovery and adaptation priorities in ways that advance international Disaster Risk Reduction (DRR) goals.

6. RECOMMENDATIONS

6.1. RECOMMENDATIONS FOR DECISION MAKERS

Coordinated, forward-looking strategy: We are facing an increasing number of threats from extreme weather. Furthermore, inadequate data, funding gaps and unclear support systems hinder effective disaster response. A coordinated, forward-looking strategy is vital to protect critical infrastructure and ensure sustained development.

Coordinated response actions: Quick responses are needed to ensure the re-opening of disaster impacted roads. Key actions involve access restoration, life-saving coordination, and continuous improvement—combining advanced tools, stakeholder drills, and public communication to safeguard mobility during disasters.

Coordinated governance : To build a disaster-ready transportation system, we must embrace coordinated governance, modern technology, and streamlined funding. Unified action across all levels of government is key to ensuring resilient infrastructure and national preparedness.

Rapid Impact Assessment: A proactive, data-driven approach that strengthens disaster readiness, speeds recovery, and promotes nationwide collaboration for safer, more adaptive infrastructure.

6.2. TECHNICAL ASPECTS

Advanced technology: New technologies like remote sensing, AI, and early warning systems are transforming road asset management. These technologies enable faster disaster response, enhanced resilience, and smarter infrastructure planning.

Nature-Based Solutions: For sustainable disaster resilience, we should consider Nature-based Solutions—like vetiver grass and ecological engineering such as sustainable, scalable alternatives to traditional infrastructure. With strong collaboration and policy support, these methods offer a resilient path toward environmentally responsible development.

Monitoring and proactive road closure: Real-time monitoring and proactive road closures have proven vital in protecting lives. Ongoing refinement of thresholds ensures these systems adapt to evolving weather patterns and slope conditions.

6.3. RECOMMENDATIONS FOR PIARC

A hybrid format workshop: This workshop session emphasized the importance of the hybrid format. Beyond-border activities are essential, especially in the event of unforeseen extreme weather events. This hybrid formatted workshop created opportunities for face-to-face

information sharing and virtual participation. This format also enhanced the collaboration between international road organizations, such as PIARC, and REAAA.

Information sharing with LMICs: It is essential to develop consistent metrics and methodologies for tracking the impacts and remediation costs of extreme weather, to support adaptation efforts. This workshop provided a platform to maximize knowledge sharing and best practice solutions from around the world. These outcomes can be used to enhance practices in LMICs. .



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