50 Years Of Excellence

The International Maritime Transport and Logistics Conference

"MARLOG 12"

Sustainable & Innovative Technologies

Towards a Resilient Future

12 - 14 March, 2023 Alexandria - EGYPT

2023 12 Marlog

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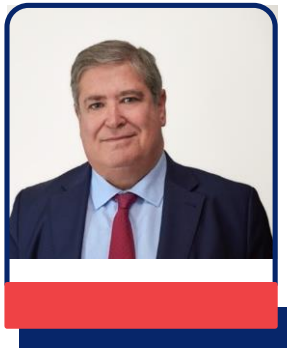


Francisco Esteban Lefler

President of PIANC

The World Association for Waterborne Transport Infrastructure

Dealing with Uncertainty for a Resilient Navigation Infrastructure

Executive Committee of PIANC

PIANC IS

A worldwide network of professionals,

Providing expert advice on cost-effective and sustainable waterborne infrastructure,

And the leading partner for governments and the private sector in the design, development and maintenance of ports, waterways and coastal areas

…

SINCE 1885!


Maritime Navigation Commission

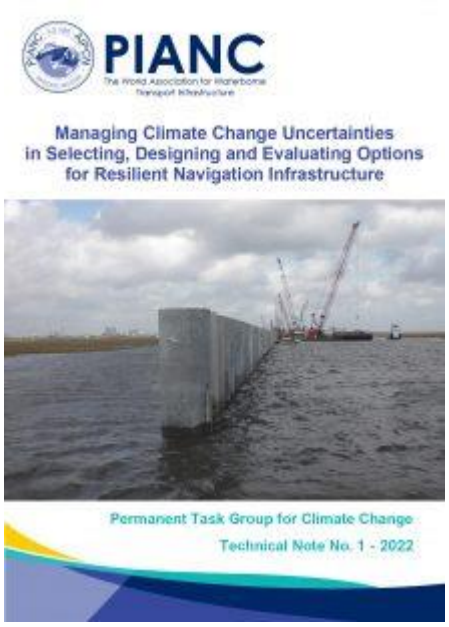

Inland Navigation Commission

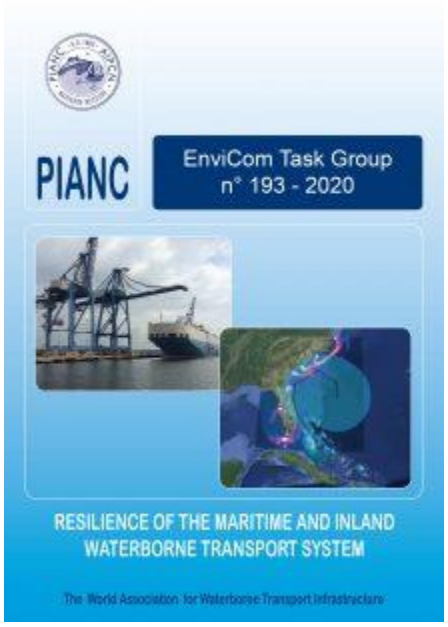

Environmental Commission

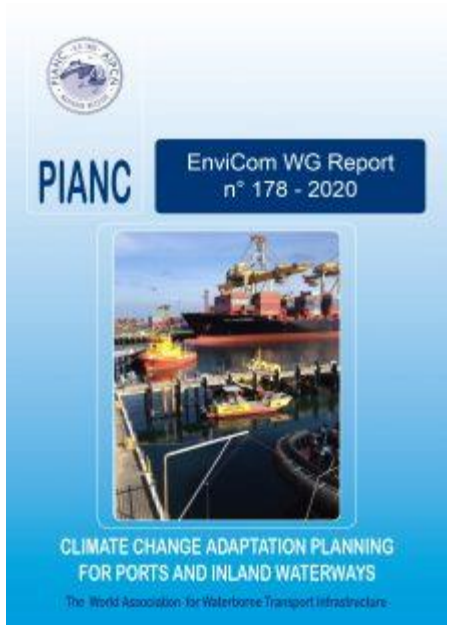

Recreational Navigation Commission

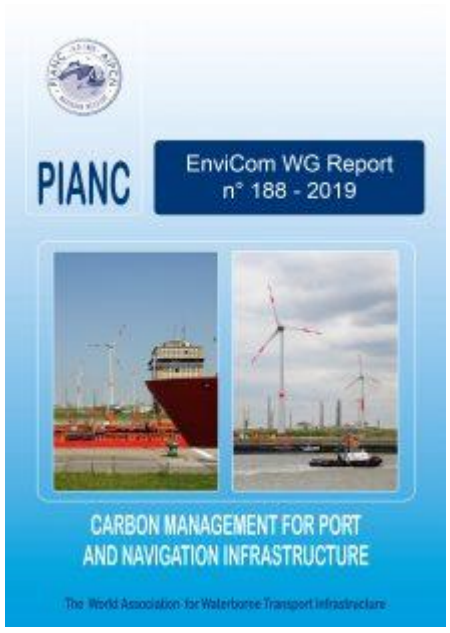
OUR MEMBERSHIP

Latest PIANC Reports on resilience and climate change

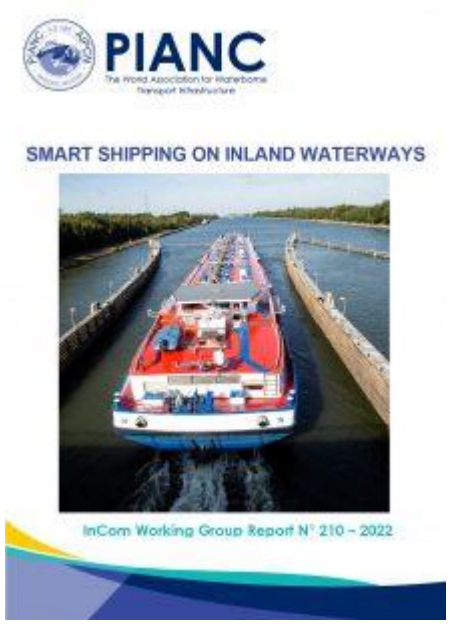






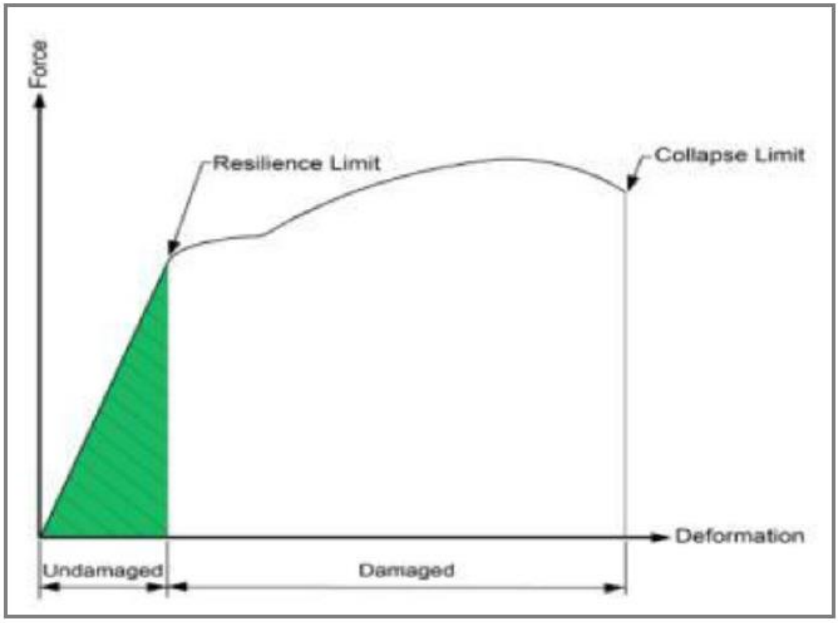


Some of latest PIANC Reports



RESILIENCE – The concept

- The word is everywhere: polysemic
- First uses:
  - Mechanics of materials
  - Psychology
  - Environmental sciences: resilience of ecosystems
- Later:
  - Applies to everything
- Connected to
  - Sustainability
  - Climate Change:
    - Mitigation
    - Adaptation



RESILIENCE – The concept –A few definitions

- United Nations Office of Disaster Risk reduction 2009

  The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

  Resilience means the ability to “resile from” or “spring back from” a shock. The resilience of a community in respect to potential hazard events is determined by the degree to which the community has the necessary resources and is capable of organizing itself both prior to and during times of need.

- US National Academy of Science (2012)

  The ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events

- PIANC INCOM WG 137-2014 Navigation Structures their role within flood defence systems - Resilience and performance under overloading conditions

  Capability of a component, unit or system to:

  a. Withstand ocasional small overloads (minimal deformation, damage or cumulative degradation) which recovers state and function after overloading event.

  b. Sustain loads greater than the design load achieving gradual failure modes rather than sudden failure.

RESILIENCE – Elements in the MIWTS

- Resilience components in the MITWS:
  - Infrastructure:
    - Port and waterway infrastructure
    - Infrastructure beyond the system's boundaries
  - Operations and logistics: multimodal system
  - Regulations, policies and governance
  - Communication systems
- Stages to consider:
  - **Preparing and anticipating**
  - **Withstanding damages and losses**
  - **Absorbing impacts**
  - **Recovering fast**
  - **Adapting for the future**
- Bounce forward

*For the MIWTS, **resilience** means continuing an acceptable level of operations with minimal disruption in service through short- and long-term environmental and human-related disturbances and stressors.*

UNCERTAINTY – Time Scale of stressors (I)

- Long term:
  - Climate change and sea level rise
  - Population dynamics
  - Economic and social evolution
  - Evolution of demand
  - Congestion:
    - Navigation channels and waterways
    - Ports
    - Land transport
  - Availability of energy and water
  - Aging infrastructure
  - …

Long term:
Transition to a new dynamic equilibrium
Short term:
Events after which the target is resuming operations

UNCERTAINTY – Time Scale of stressors (II)

- Short term - DISRUPTIONS
  - Storms, floods, hurricanes and extreme meteorological events
  - Earthquakes
  - Tsunami
  - Pandemics
  - Spills and environmental disasters
  - Accidents
  - Economic crisis
  - Anthropic events: war, terrorist attacks, cyberattacks…
  - …

Some few examples:

- Hurricane Katrina
- Financial crisis 2008
- Volcano at Iceland
- East Japan Earthquake and Tsunami
- Hurricane Sandy
- Covid 19
- Suez Canal Blockage
- War in Ukraine

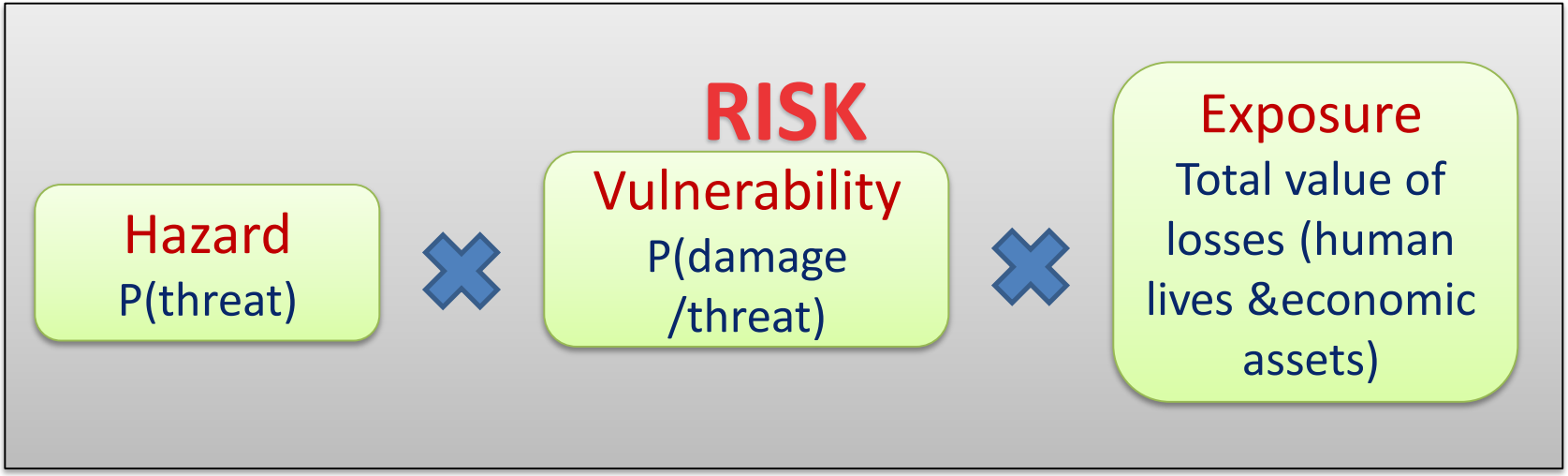
Features of time scales

- Long term:
  - Uncertainty of the models:
    - Climate models at the long term
    - Effect of reduction of carbon emissions
    - From global models to local conditions
    - Social and economic changes
  - Need to integrate in resilience conception:
    - ADAPTATION
    - MONITORING
    - FORECASTING
- Short term (disruptions)
  - Low probability – high impact scenarios (black swans)
  - Prepare for the unprecedented: frequency & intensity extreme events
  - Add sensitivity analysis to representative conditions
  - Non-stationary distributions of climate parameters

NaCC survey 2019-2020:

- 53% responding ports reported more frequent extreme events.
- 41% reported exceptional, unprecedented or out-of-the- ordinary events in previous 5 years

Tool: Risk analysis



- Probabilistic tools
- Consideration of **cascading failures**

THE PORT COMMUNITY (I)

MANY AGENTS WITH COMMON AND OPPOSED INTERESTS: NEED OF A COORDINATION FRAMEWORK: SHARED UNDERSTANDING

Relations between agents depend on the governance model of the port:

- Public Service
- Tool port
- Landlord
- Fully privatized

- Institutional:
  - Port Authority
  - Governmental, regional and local agencies
  - Supra-national regulators (IMO…)
  - Customs

THE PORT COMMUNITY (II)

- Port agents
  - Terminal operators and concessionaries
  - Providers of port services: pilotage, towing, stevedors,…
  - Shipping lines and agents
  - Land transport agencies and companies (rail and road)

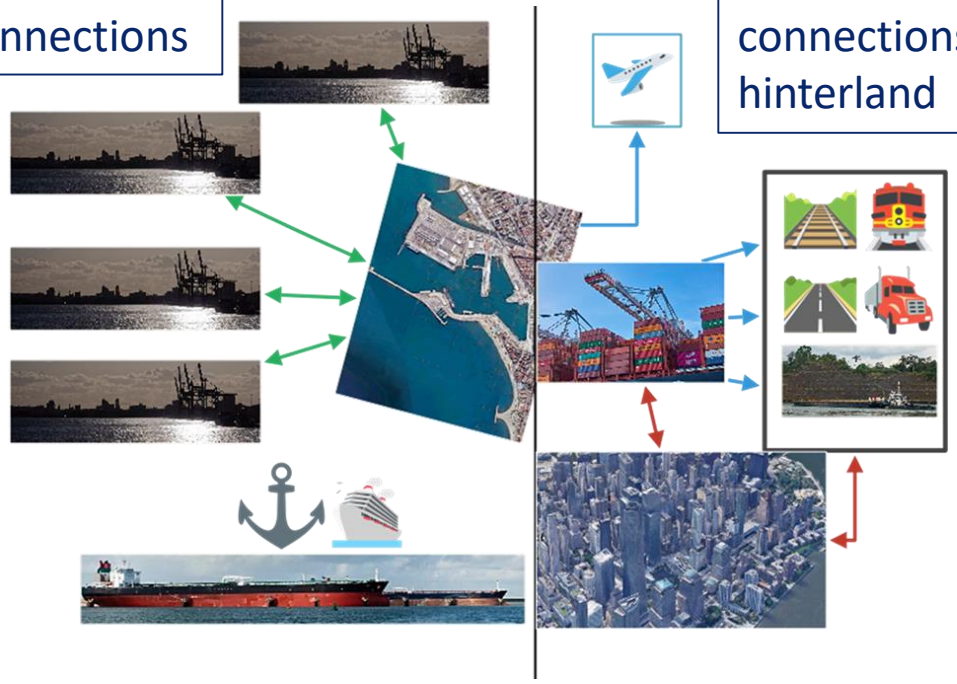
- External stakeholders
  - Cargo providers
  - Logistic agents:
    - Warehouse owners
    - Industry
  - Energy providers
  - Utilities
  - Financial agents
  - **THE LOCAL COMMUNITIES – Need for transparency**

THE PORT CONNECTIVITY

Maritime connections

Land connections: hinterland

Logistic chain or logistic web?



Connectivity is not only physical: data & communications

Connectivity is strength and vulnerability

ADDRESSING UNCERTAINTY AND RESILIENCE

- The role of infrastructure:
  - Physical support
  - Limit of port productivity and performance
- Address:
  - Regulations, policy and governance
  - Communications and information systems
  - Natural and built physical infrastructure
  - Multimodal system (logistic connections)
- Measures:
  - Holistic adaptive actions:
    - Structural (engineered)
    - Non-structural: governance-operational
    - Set up a cooperative framework
  - Connect with sustainability
  - Accommodate uncertainty in assessment methods

PLANNING FOR RESILIENCE

- Plan for all stages
- Combine engineered and operational resilience
  - Zero damage policies are usually unaffordable
- Strengthened resilience:
  - Physical: redundancy in engineering design
  - Non-structural measures:
    - Map vulnerable areas and assets
    - Prepare contingency plans
    - Identify thresholds for action
    - Early Warning Systems
    - Improve adaptive capacity
  - Plan for consequences of failure
  - Design for progressive and controlled failure, avoiding catastrophic failure
  - Introduce deliberate weak points easily replaceable

Resilience of the MIWTS includes four stages: preparing, withstanding damages and absorbing impacts, recovering, and adapting.

Resilience:

- Ability and process, not an outcome
- Dynamic concept

ADAPTIVE PLANNING

- Combine short-term interim interventions with development of long-term responses
- Avoid maladaptation
- Changes in operations, management, management or behaviour. Even institutional changes can be considered at the long-term.
- Use of nature-based solutions
- Set economic, financial and business continuity lessons, including response to cascading impacts
- Decisions informed by:
  - Monitoring
  - Follow-up of thresholds
- Plan and design flexible and adaptable structures that can be modified and strengthened as conditions change

RESILIENCE MANAGEMENT

- Data management for decision making:
  - Understand trends and compare with planning and design criteria
  - Monitor condition and performance of physical assets, including response to extreme events
  - Post-event data analysis
  - Record:
    - Costs
    - Disruptions and downtimes
    - Financial and economic benefits of intervention
  - Follow-up effectiveness of implemented measures
  - Select and apply Climate Change Scenarios, understanding climate data uncertainties

INVESTING ON RESILIENCE (I)

- Select assessment methods that recognise and accommodate resilience
- Financing institutions and banks require today as a pre-requisite considering climate change and resilience in infrastructure and operational design.
- Incremental cost of resilience and adaptation to climate change need to be justified
- Considerations:
  - Include and understand cost of inaction
  - Do not rely only on past data in the risk analysis
  - Include financial and business implications
  - Use a holistic approach, avoiding integration of analysis of elements
  - Be aware of uncertainty on the time for return of investment in resilience
  - Selected discount rates rates have a large influence on the result:
    - High rates can lead to maladaptation

INVESTING ON RESILIENCE (II)

- Risk of conventional cost-benefit/NPV methods:
  - May not reflect well the complexity of decisions
  - Need to capture less-quantifiable social and environmental costs and benefits
- Take into consideration implementation time and lifespan of measures in a changing environment
- Potential of shared costs and benefits:
  - Upstream and downstream of the logistic network
  - Transboundary effect
- Consider commercial and competitive value of investment in resilience and adaptation to Climate Change
- Combine efforts of all the Port Community and Stakeholders

RESILIENCE ASSESSMENT

- Assess the criticality of all components, subsystems and systems to set a resilience hierarchy. **Consider added value of systems**
- Define key elements of resilience (consider low vulnerability and/or redundance)
- Set thresholds based on acceptable levels of risk.
- Consider with detail the cycle with special incidence on time for recovery of the functions
- Include post-event data analysis in future adaptation plans.
- Integrate the full supply chain-network in resilience analysis
- Workshops and exercises

Parameters of Resilience Assessments:

1. ***Critical Function*** *– component function essential to system performance*
2. ***Threshold*** *– level of acceptable performance*
3. ***Time*** *– stages of event cycle, including impact, recovery, and adaptation*
4. ***Memory*** *– understanding past performance and progressive change in the system*

Resilience audit of existing infrastructure and operations

THE FUTURE: OPPORTUNITIES AND NEW TECHNOLOGIES

- Integration of resilience and adaption in management, operations and engineering
- Connectivity:
  - Reduce risks by increased and coordinated cybersecurity
  - Use Big Bata IoT, blockchain and IA to strengthen resilience
- Optimise total investment on resilience and adaptation throughout the network according to a reasonable risk assessment
- **OPPORTUNITIES OF DIGITAL TWINS FOR:**
  - **INCREASED RESILIENCE**
  - **ADAPTATION TO CLIMATE CHANGE**

PIANC Mediterranean Days | 25 - 26 October 2023

& Ports of the Future | 24 - 25 October 2023

In Sète (Occitanie, France)

You can find the complete call for abstracts on the French PIANC website at http://aipcn.fr/.

Submission of a 400-words abstract, to be sent to aipcn-france.dtecemf@cerema.fr until 15 March 2023.

PIANC INTERNATIONAL EVENTS:

PIANC-COPEDEC Conferences - Manila, Philippines – October 9-13 2023

https://www.pianc.org/pianc-copedec-conferences

Thank you for your attention

PIANC HQ
Blvd. du Roi Albert II, 20-B3
1000 Brussels (Belgium)
E-mail: info@pianc.org

www.pianc.org