CLIMATE ADAPTATION TOOL FOR PORTS

PIANC WORKING GROUP 178 AND ITS PRACTICAL TOOLKIT

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Ports and waterways around the world are some of the first recipients to experience the effects of climate change. Port facilities are exposed to increases in air and water temperatures, rising sea levels, and changes in parameters such as seasonal precipitation, wind and wave conditions. Most are also seeing more frequent and severe extreme weather events such as storms, heatwaves and droughts.

NEED FOR GUIDANCE

The implications are serious; ports are suffering direct structural damage to quay walls and cargo yards, companies are experiencing unscheduled delays, disrupted turnaround times and even closures. Operational systems are also under additional stress; for instance, after Hurricane Sandy on the east coast of the USA in 2013, the Port of New York and New Jersey was closed for a week while the re-opening of cargo terminals and support facilities was further delayed because of power failures and damage to ancillary equipment. Extended drought conditions on the River Rhine in Germany – a result of the long heatwave in Summer 2018, low rainfall and reduced supply from glaciers – led to restrictions on river shipping throughout the remainder of the year, in many cases making river sections impassable and cutting-off freight suppliers from their markets.

Even if the world moves quickly to decarbonise, we will still be locked-in to decades of climate change impacts. This presents a significant risk to port businesses, operations and activities and ultimately safety and the integrity of infrastructure. The repercussions will be felt in local, national and global economies. Waterborne transport infrastructure and its connecting interfaces can also be adversely affected. What is clear is that port authorities, terminal and waterway operators and asset owners need to take urgent action to strengthen resilience and adapt to these changes.

THE METHODOLOGICAL FRAMEWORK

Guidance has been prepared by international experts on PIANC's Working Group 178 which has focussed on planning for climate change adaptation in operational seaports, inland waterways and navigation infrastructure. Some references are made to greenfield sites, but the emphasis of the Guidance is on helping those responsible for strengthening resilience in existing facilities.

The Guidance discusses the potential consequences of climate change and some of the challenges to be addressed if ports and waterways are to adapt effectively.

It then introduces a four-stage methodological framework to help port and waterway owners and operators plan for improved resilience (see figure 1).

Stage 1 describes a range of foundational actions that will assist both those tackling climate adaptation planning for the first time or those wanting to refresh an existing programme of activities. The Guidance encourages the user to establish the ultimate objective and key goals, and the time horizons over which these need to be achieved. The port will need to take its list of critical assets, operations and systems and establish the climate impacts to which each is susceptible.

An often-overlooked part of climate resilience programmes is the extent to which interested and diverse stakeholders can contribute immense value through sharing local knowledge and lessons learned from their experiences in and around the port. The identification of relevant internal and external stakeholders and making sure they are properly engaged and play a proper role in the process is vital. The Working Group heard great examples of participation by harbourmasters and pilots, who have deep knowledge of long-term weather patterns and local hydrodynamics through to landowners on adjacent properties to the port, who had a better understanding of surface water flows and sedimentation problems associated with heavy storms.

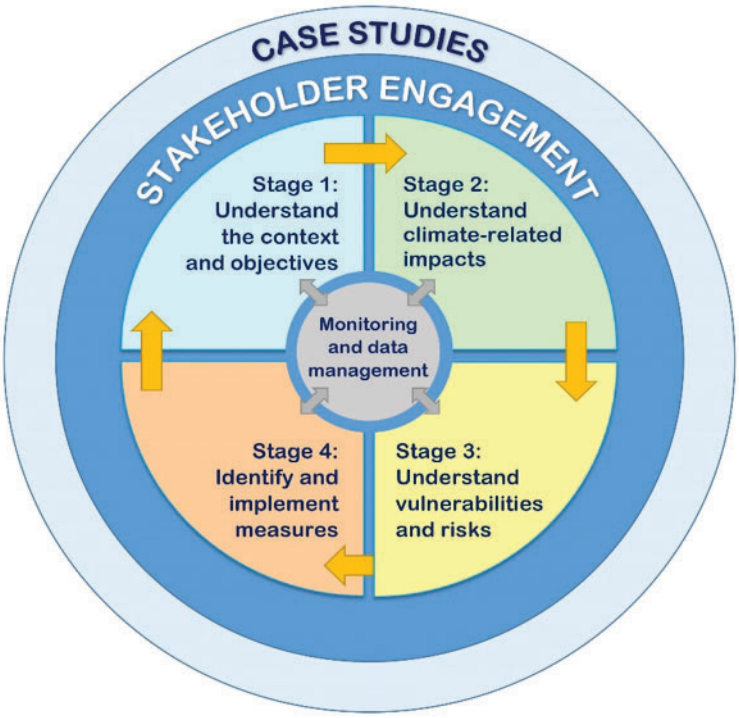

Figure 1 - The four stages in the climate adaptation planning process

One of the biggest reasons for delaying acting on climate adaptation is the sheer complexity and scale of the challenge to understand the science of climate change. In Stage 2, the Guidance therefore sets out to help the user better understand how future changes in the climate will affect many of the critical maritime and inland infrastructure assets identified in the Stage 1 inventory. By researching key data sources available for relevant geographies, and signposted online, the user will be able to user identify which climate parameters and processes are most relevant to their port.

Impact	Air temperature	Water temerature	Precipitation	Storminess	Sea level rise
Flooding due to overwhelmed drainage systems or high groundwater levels			✓	✓	
Overtopping due to high river flows, high tides or storm surges			✓	✓	✓
High in-channel flow velocities or changes in sea state			✓	✓	✓
Low river flow conditions, drought or reduced water supply			✓		
Changes in bathymetry, or sediment or debris transport			✓	✓	✓
River, sea or bank erosion			✓	✓	✓
Fog or orther reduced visitbility issues	✓	✓	✓		
Wind speed, strength, direction, duration	✓			✓	
Extreme cold, ice or icing	✓	✓			
Extreme heat or humidity	✓				
Changes in water chemistry		✓			
Changes in biological character	✓	✓			

Table 1 - Examples of relevant parameters/processes based on impact susceptibility

The Guidance assists the user in helping to understand how the selected parameters are projected to change under different climate change scenarios, as developed by the Intergovernmental Panel on Climate Change. These are the Representative Concentration Pathways' (RCPs), i.e., greenhouse gas concentration trajectories, labelled 2.6, 4.5, 6.0, and 8.5 W/m^2 in line with a possible range of anthropogenic radiative forcing values in the year 2100.

Stage 2 establishes existing baseline data, including information on extreme events, collated for each relevant climate parameter or process. Ongoing programmes of monitoring should now have been instigated to enhance local knowledge or fill gaps in data (while acknowledging and documenting residual gaps). Climate changes scenarios have been selected in line with the planning horizons adopted for the adaptation planning exercise and projections collated for relevant parameters and processes. Both slow onset changes and expected changes in the frequency or severity of extreme meteorological, oceanographic or hydrological events are covered.

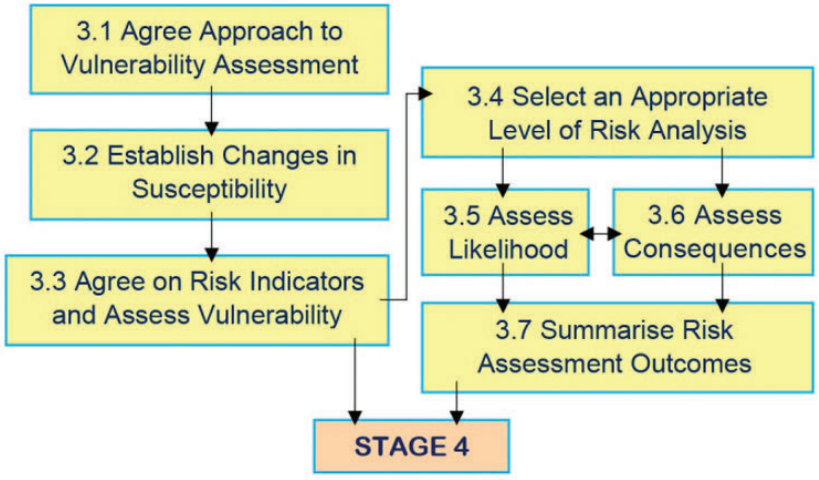

Figure 2 - Summary of the Stage 3 risk assessment in the climate change adaptation planning process

Most port organisations will have an established risk management framework for assessing its risks, usually for Health & Safety purposes. Stage 3 of the Guidance builds on the information (on assets) and understanding (of climate parameters) gained in the earlier stages to help identify and assess potential risks associated with climate change. The specific advice on quantifying risk focusses on understanding how climate change is likely to affect existing risks or introduce new ones. This will help highlight future changes in the vulnerability of critical assets, operations or systems.

Impact		Measure	Conditions triggering action
Sea level rise leading to increasingly frequent flooding of one of two general cargo berthing and loading areas in the port	1	Prepare contingency plan for alternative berthing arrangments	Immediate (no regret)
	2	Instigate monitoring of asset condition	Funding is secured
	3	Decision on retrofit of elevated quay superstructure vs. replacement asset	Monitoring of local sea level rise rates or asset deterioration or both, indicate the acceptable threshold will be exceeded within three years
Increased frequency of extreme wave and wind conditions exacerbating erosion of the mangrove swamp that provides the port with natural protection from storms	1	Develop and implement community engagement programme on role of mangroves as buffer; lobby for strengthened legal protection of remaining vegetated shorelines	Immediate (no regret)
	2	Instigate research and trials into appropriate mangrove planting and breakwater construction techniques	Funding is secured
	3	Design and implement mangrove planting strategy	Research outcomes are available; funding is secured
	4	Design and construct new breakwater (e.g. using brushwood or dredged material filled geo-tubes)	Monitoring of changes in wind and wave conditions, erosion rates and/or the sufficiency of the area of mangrove successfully re-established indicate that action will be needed within two years

Table 2 - Examples of phased measures in adaptation pathways

After agreeing the approach to the vulnerability assessment and confirming changes in susceptibility, the user will be able to identify risk indicators and highlight vulnerable assets, operations and elements of systems (for each climate change scenario).

The final Stage 4 sets out a series of steps to identify, screen and, where relevant, evaluate, possible adaptation and resilience options. These options comprise discrete measures or groups of measures to deal with the risks identified in Stage 3. Adaptation pathways describe a sequence of actions (tangible measures, modifications or other interventions) to be implemented in response to changes in meteorological, hydrographic and/or oceanographic conditions.

The overall approach to climate change adaptation can be presented as an adaptation strategy. The implementation of measures on the adaptation pathways, and their subsequent performance in meeting the objectives of the strategy, are informed by monitoring. Ongoing stakeholder engagement activities will help ensure all concerns and key issues connected to a port's activities are included.

Sixteen international good practice case studies are appended to the guidance, along with various templates to be used for data collection and record-keeping. The Guidance provides methodological support to the recent PIANC 'Declaration on Climate Change', and also enables the wider navigation infrastructure community to take timely action to strengthen resilience. This fulfils an action in the adaptation strand of the 'Navigating a Changing Climate' partnership's Action Plan, to develop and deliver technical guidance on climate change adaptation.

The increased frequency of extreme weather in the last 40 years is forcing ports to step-up their plans to minimise the impacts and cope with the aftermath of those events. The Guidance is the first of its kind to develop an approach to planning for climate adaption in ports. It provides an extensive toolbox of adaptation options but helps the user evaluate the effectiveness of different options in typical climate change scenarios. This will not only aid decision-making but will raise awareness across the maritime sector to prioritise adaptation.

ABOUT THE AUTHORS

Charles Haine works on integrating sustainability features into maritime projects, including masterplanning, due diligence, optioneering, consents and helping ports decarbonise and become future ready. He is a frequent speaker at industry conferences such as GreenPorts Congress, TOC Europe and at AIVP Port-City Conferences.

Jan Brooke provides independent environmental and climate change advice to port and waterway operators. In addition to chairing PIANC's Permanent Task Group on Climate Change, Jan is the UK representative on PIANC's EnviCom, on whose behalf she contributed to Working Group 178.

ABOUT THE ORGANIZATIONS

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Established in 1885, PIANC's mission today is to provide expert guidance and technical advice by bringing together the best international experts, both public and private, on technical, economic and environmental issues pertaining to waterborne transport infrastructure.

ENQUIRIES

FURTHER LINKS/DOWNLOAD
THE GUIDANCE HERE:
https://www.pianc.org/publications/envicom/wg178