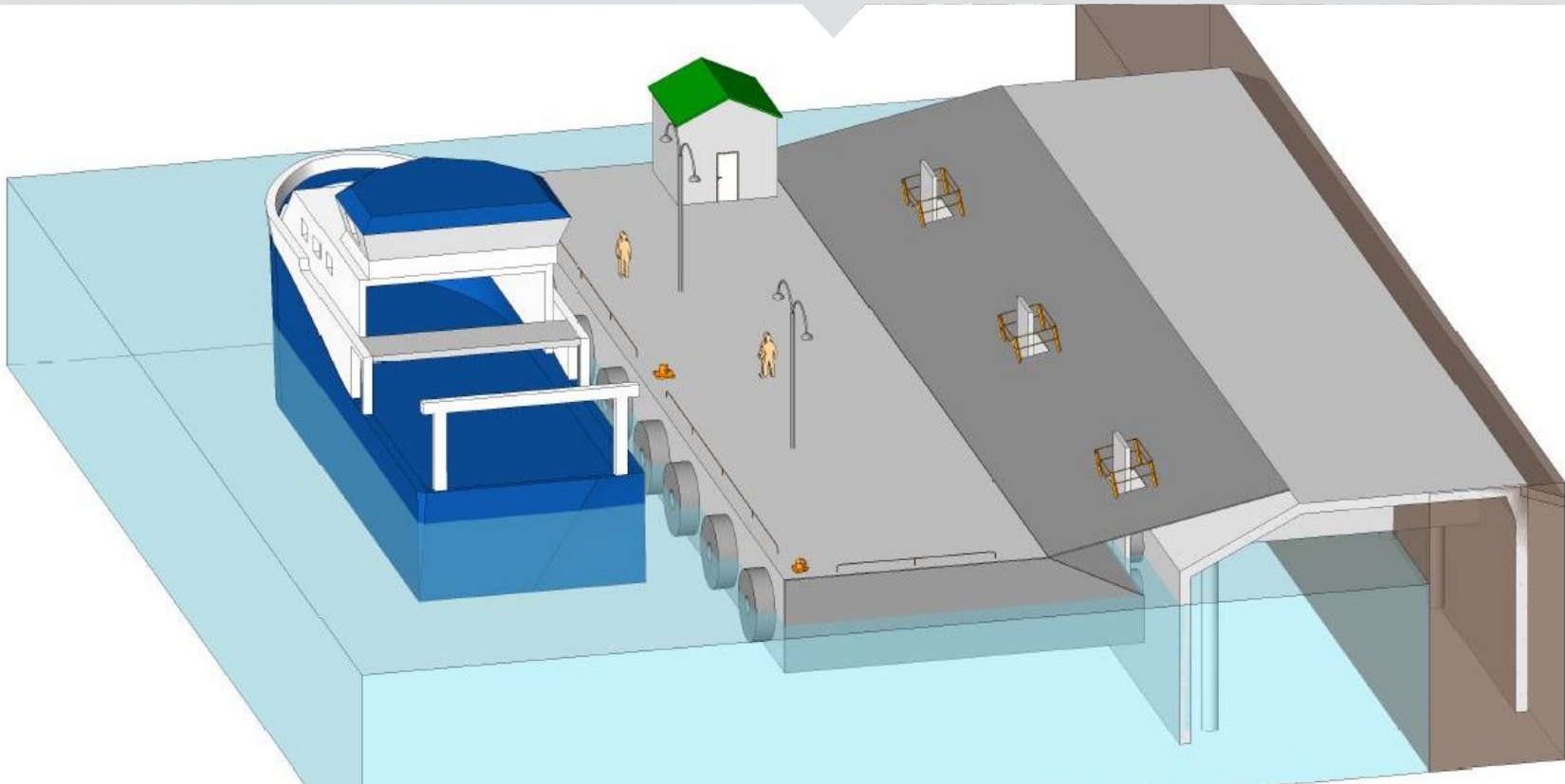


PIANC WG 178: Adaptation to climate change for waterborne transport infrastructure

TOOLBOX OF MEASURES

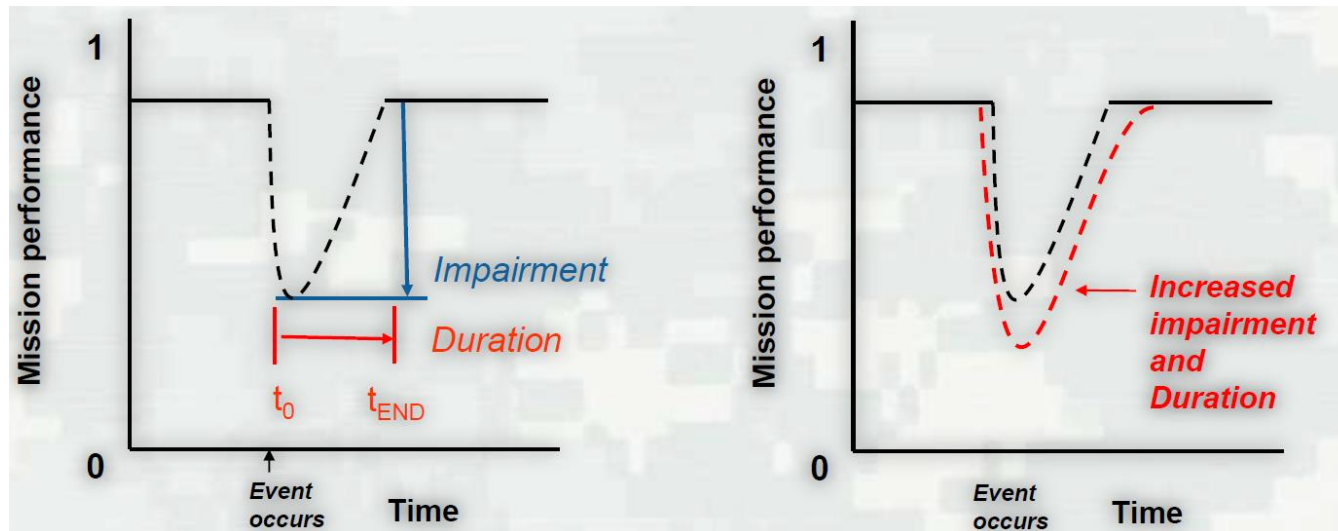


Important considerations in adaptation decision-making taking into account uncertainty

- take care to avoid maladaptation - inflexible solutions that cannot be modified if climate variables do not change in the manner projected at the time of design
- promote resilience – plan for disruption; absorb the impact and rapidly recover afterwards; adapt to changing conditions
- understand where there is existing adaptive capacity – existing redundancy or resilience within the system
- explore adaptive management options – infrastructure solutions that retain maximum flexibility in the face of uncertainty through an incremental project implementation process; responsive solutions
- investigate the low-hanging fruit – ‘quick win’ solutions that can sometimes deliver significant improvements in resilience cost effectively and with little extra effort
- focus on no or low regret measures – adaptation solutions that will provide benefits under any foreseeable climate scenario including present day climate

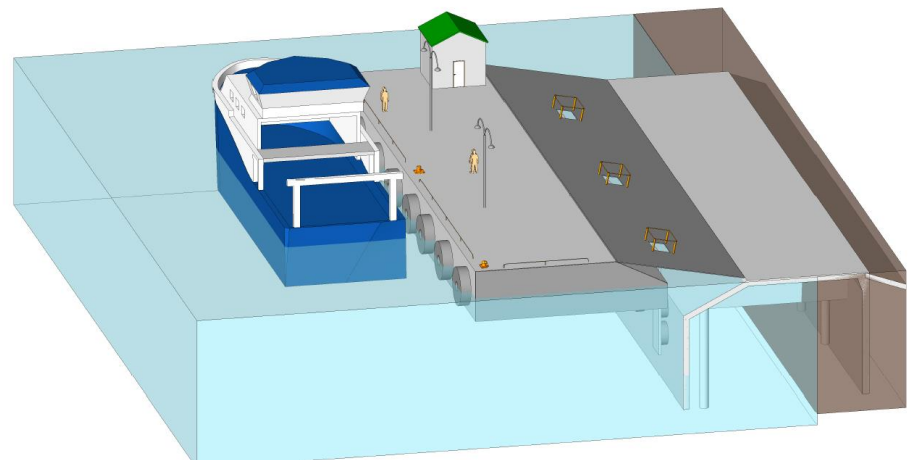
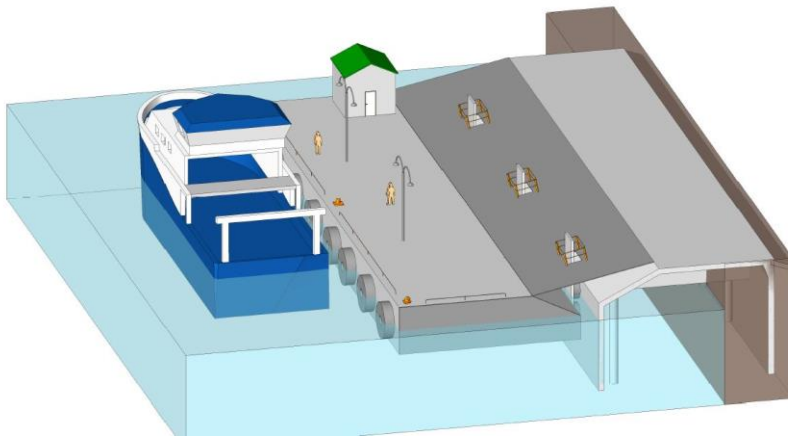
Key messages for new infrastructure design

- Those designing or retrofitting waterborne transport infrastructure will have to contend with significant uncertainty relating not only to local rates of change in key climatic variables but also to the increasing frequency and intensity of extreme events.
- Infrastructure assets will need to be designed to include the capability for upgrading or future modification as climate changes. Resilience and flexibility will be important prerequisites.
- The consequences of failure will also need to be understood and accommodated within the design: incident management plans will need to be developed.



Additional key messages for adapting existing infrastructure

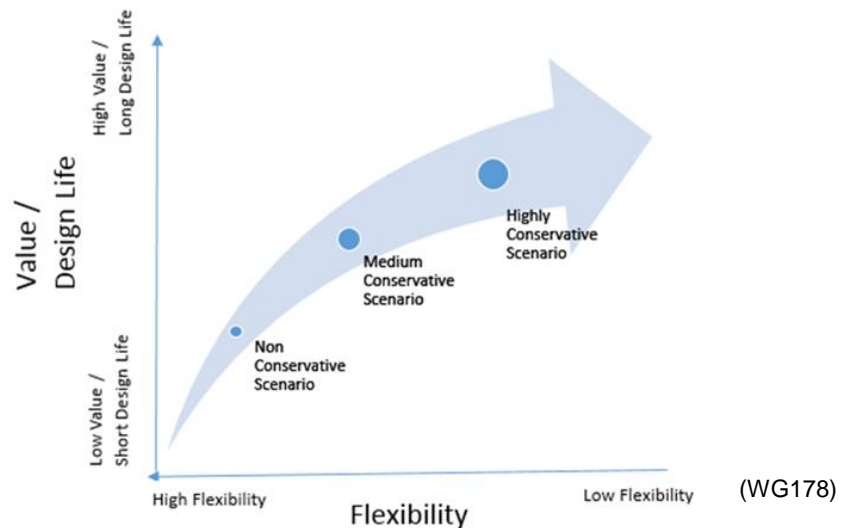
- Two further factors will influence decision making when adapting or strengthening the resilience of existing infrastructure:
 - retrofitting can be costly and complex: the residual life of the asset will be relevant in deciding how and when to adapt
 - understanding whether and where adaptive capacity already exists within the system will also be a critical determinant



(Norconsult – Floating quay concept design)

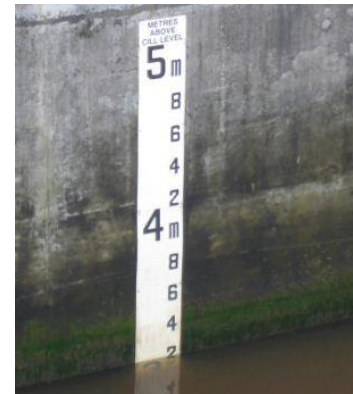
So, what does all this mean for developing a toolbox of measures?

- Need to think about existing as well as new infrastructure
- Need structural and non-structural measures: planning-based solutions, education, and operational or maintenance changes can all provide 'quick wins'
- Need short term or interim as well as long term measures
- Need flexible, adaptive solutions that respond to monitoring: monitoring is key!
- Need low as well as high tech solutions
- Need low as well as high cost solutions



Monitoring

- Site-specific monitoring in conjunction with climate change adaptation of port planning and port operation is key and refers mainly to the following aspects:
 - Monitoring of meteorological and hydrological phenomena
 - Monitoring of climate related structural damages and operational obstacles
 - Monitoring of the climate change adaptation process in the harbour itself
- All data is valuable, not only state of the art measuring stations.
 - Logg-keeping of occurances of climatic phenomena, e.g. Fogg, high water level, high wind and/or waves, debris in harbour etc
 - Low key measuring devices
 - Logg-keeping of damage and obstacles



Categories of adaptation measures included in WG 178 toolbox

Category	Sub-category
Physical (structural)	Engineered measures (including conventional hard engineering; soft engineering and nature- or ecosystem-based solutions; or hybrid solutions) Technological measures (including physical system or process solutions) Service-based measures
Social (people)	Educational measures Information-related measures Behavioural measures
Institutional (governance)	Economic measures Laws and regulations Government policy and programmes

Source: IPCC AR5 report

What does this mean in practice?

Indicative combinations of adaptation and resilience measures

Impact	Measure 1	Measure 2	Measure 3
<i>Sea level rise leading to increased flooding of certain berths</i>	Modify berthing arrangements or schedules to avoid high water or berths at higher elevation	Monitor performance to know when adaptive capacity is exceeded	Depending on residual life of berth, retrofit or replace with elevated structure

Impact	Measure 1	Measure 2	Measure 3
<i>Increased frequency of extreme wave and wind conditions exacerbating erosion</i>	Strengthen legal protection for remaining vegetated shorelines to reduce impact of other pressures	Educate local communities in role of marsh or mangroves	Plan and implement habitat restoration and re-planting projects; create breakwaters (e.g. using dredged material filled geo-tubes)

Impact	Measure 1	Measure 2	Measure 3
<i>Increased storm frequency impacting breakwater integrity</i>	Retrofit the asset to provide maximum affordable protection	Prepare a disaster risk reduction plan	Educate workforce and local community about the risks and the risk reduction plan

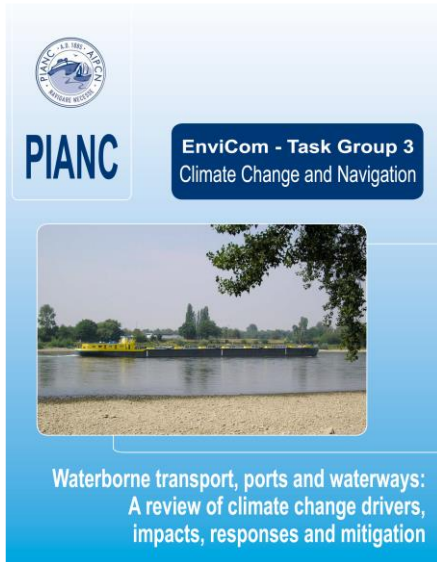
What does this mean in practice?

Indicative combinations of adaptation and resilience measures

Impact	Measure 1	Measure 2	Measure 3
<i>Excessive weed growth associated with increased water temperature</i>	Increase frequency of cutting and clearance activities	Research into biological or nature-based control options	If no biological control option is identified, invest in cutting machine with higher capacity

Impact	Measure 1	Measure 2	Measure 3
<i>Accumulation of debris in harbour following extreme rainfall events</i>	Better maintain or upgrade existing drainage system, trash screens, etc.	Education of communities living upstream in catchment about consequence of dumping garbage in river	Investigate use, costs, benefits of temporary booms and/or invest in specialised debris removal equipment

Some final comments



Coming update of: PIANC Task Group 3 Report Climate Change and Navigation

This report gives a summary of the latest climate change knowledge and how the waterborne transport industry may be impacted. WG178 refers to this report as a source of large scale climate change data.

New website launched 11.11.16:
Think Climate Coalition:

Navigating a Changing Climate Initiative

navclimate.pianc.org/



Thank you, any questions?