Adaptive Management for Environmental Aspects of Dredging and Reclamation projects: Reactive and Pro-active

A CEDA Environment Commission Working Group

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Managing Environmental Aspects of Dredging Works

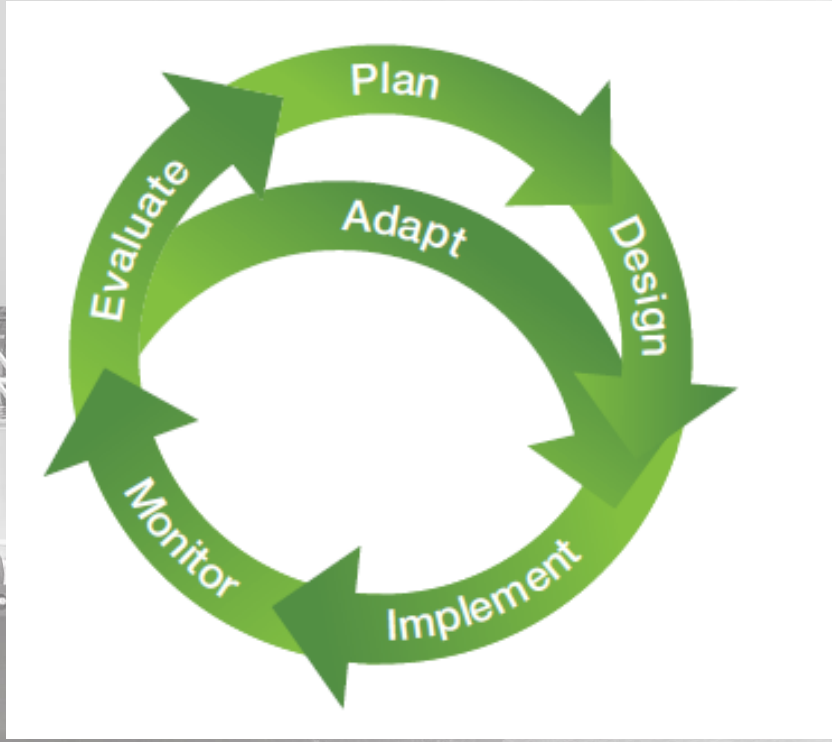
Image from CEDA (2020). Assessing and Evaluating Environmental Turbidity Limits for Dredging

- Before Execution:
  - Environmental Impact Assessment Studies
    - Baseline studies (measurements and models)
    - Scenario studies (models)
- During Execution:
  - Environmental Monitoring & Impact Management
    - EMMP (Environmental Monitoring and Management Plan)
    - Adaptive / Proactive Management of the Impacts
    - Compliance check
- After Execution:
  - Environmental Monitoring

An information paper on Adaptive Management, why?

- AM facilitates environmental risk reduction, and increasing sustainability
- Am helps to explore environmental opportunities (e.g. NBS)
- Following the more generic/Introductory AM paper from 2015
- Survey showed limited awareness of recent advances, e.g. Pro-Active AM, Strategic AM, …
- To provide insights on benefits of (pro-active) AM, for:
  - Developers
  - Authorities
  - Contractors
  - Non-governmental organisations
  - Consultants.

Adaptive Management (AM)



Fischenich & Vogt (2012)

- Classic AM cycle:
  - Plan
  - Design
  - Implement
  - Monitor
  - Evaluate
  - Adapt

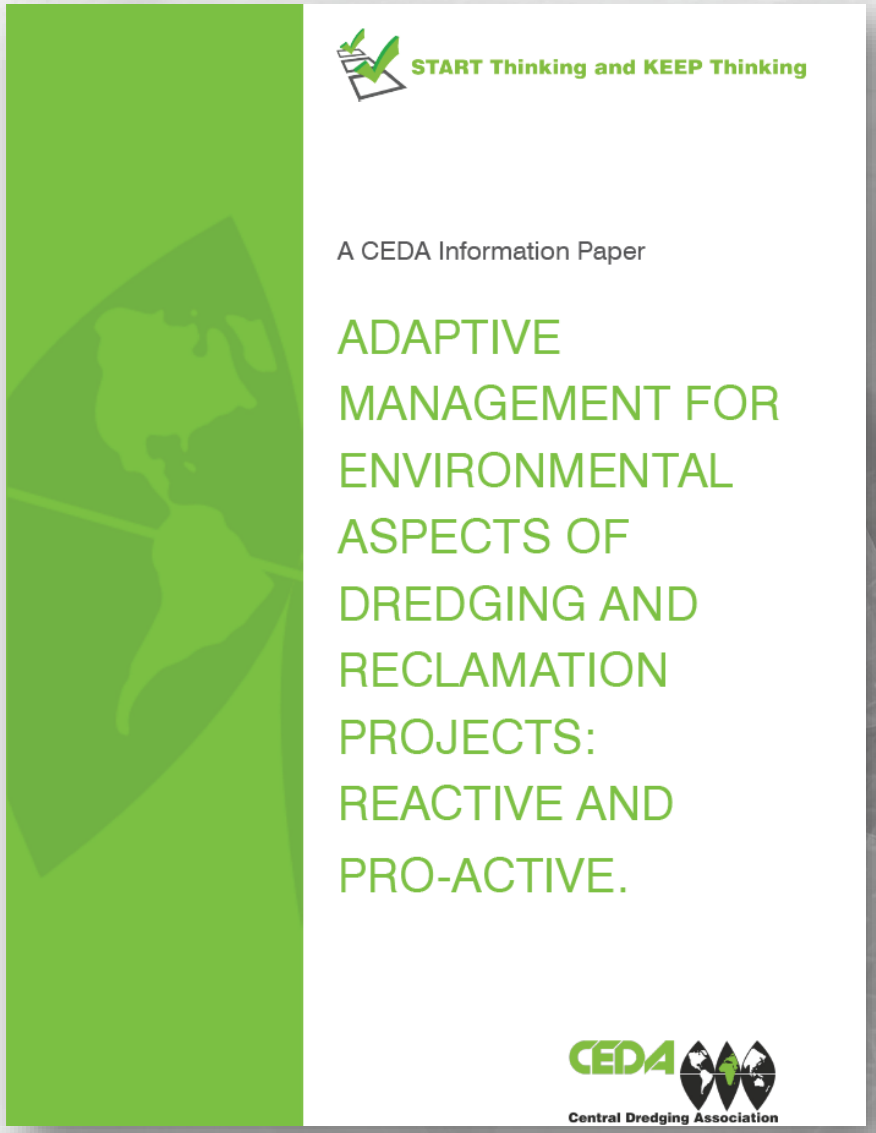
= at project level

= reactive

- Market survey on awareness of AM in the industry:
  - 70% is aware of AM
  - 45% has experience with AM

Content of the paper

- Types of AM
- Awareness of AM in the industry
- Existing tools and platforms
  - Monitoring techniques
  - Numerical models
  - Online platforms & DSS
- AM best practice
- Pro-Active AM (PAM)
  - What is PAM?
  - Benefits of PAM!
  - Requirement to operate PAM
- Strategic AM (SAM)
- Legal framework
- Obstacles and how to overcome them
- Case Studies



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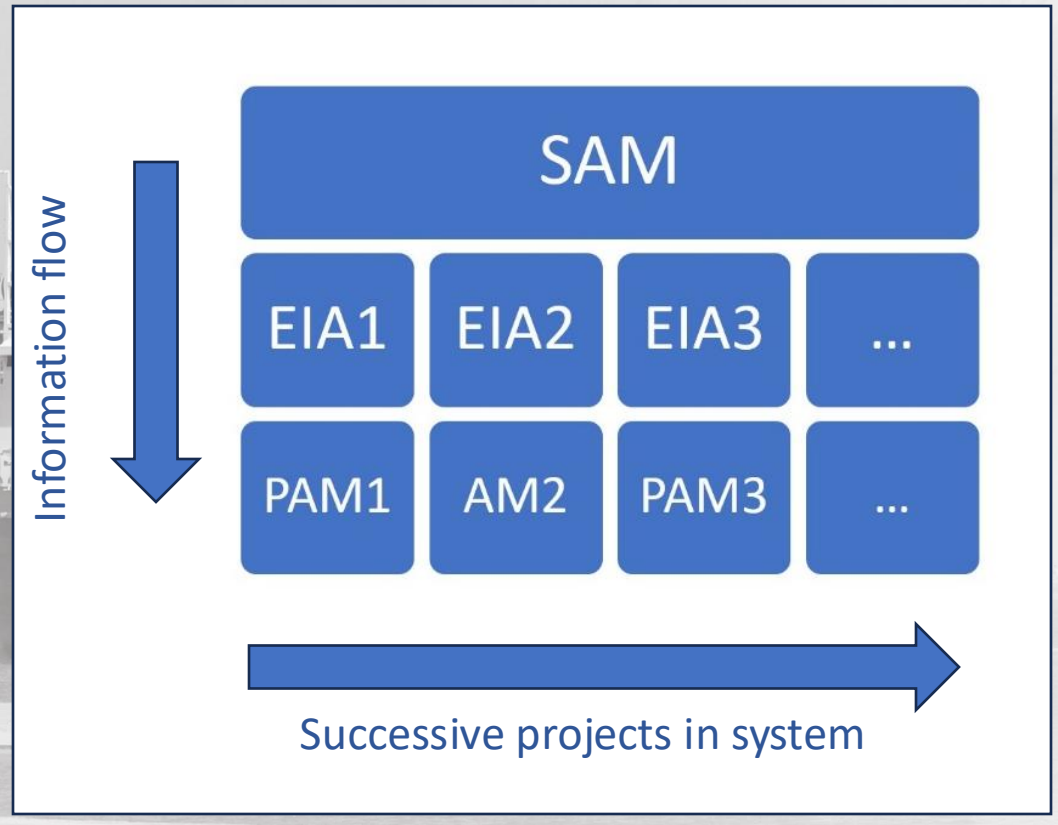
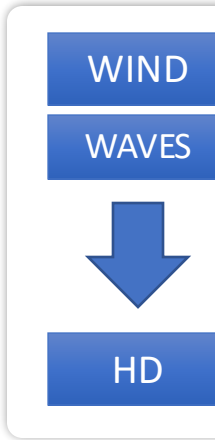
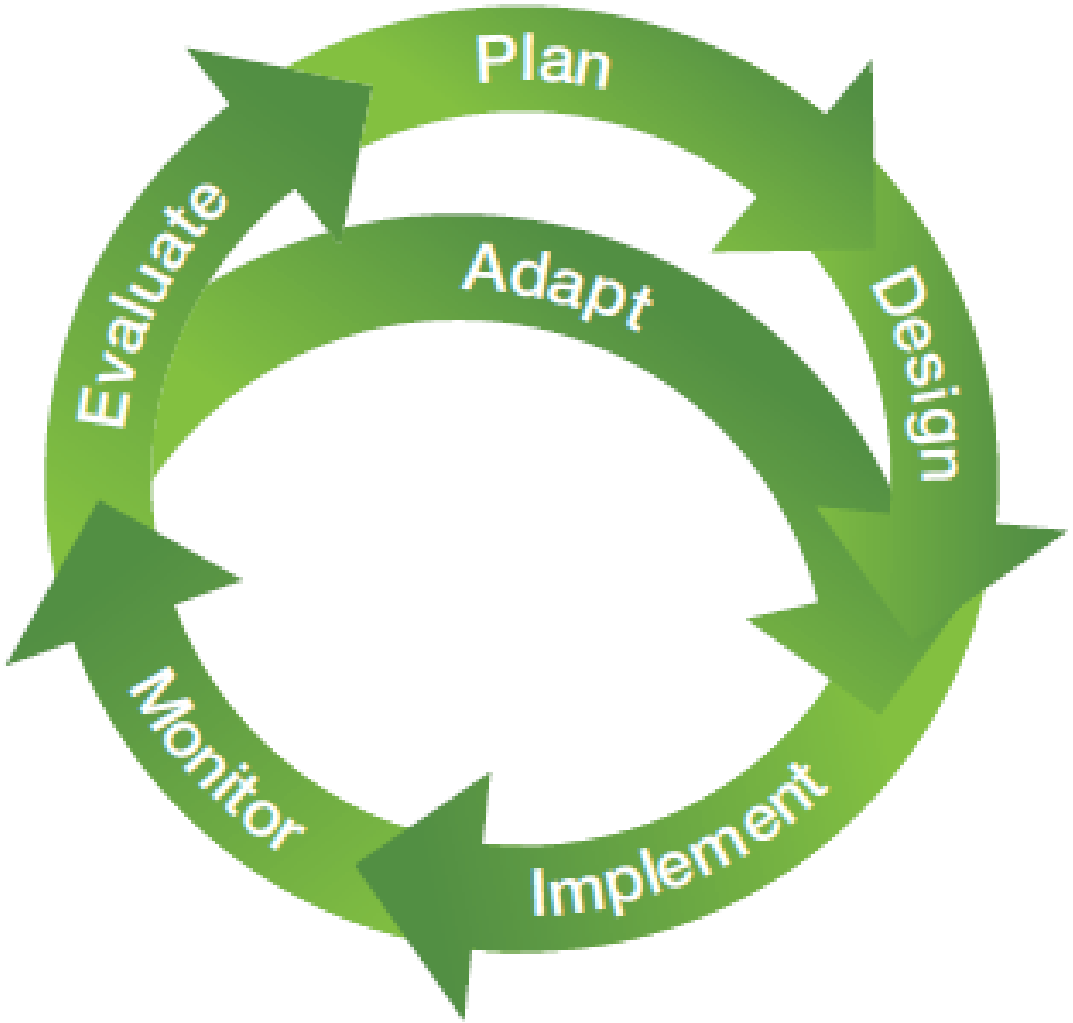


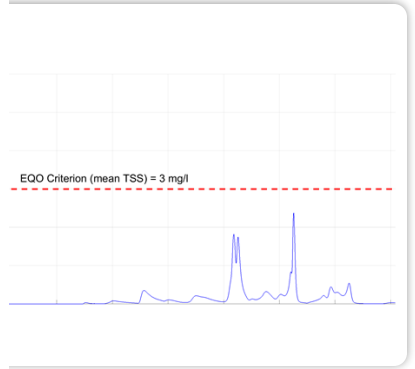
Paper proposes three types of AM

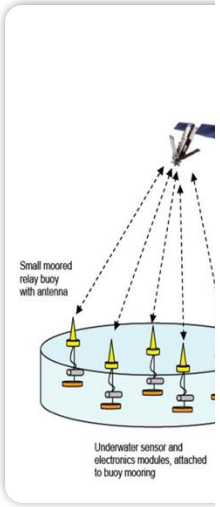
1. Reactive/classic (AM):
   - During execution
   - Based on monitoring
   - Management actions: at breach of environment indicators
2. Pro-Active AM (PAM):
   - During project planning & execution
   - Compliance based on design and forecasting
   - Adapt when breaches are forecasted
3. Strategic AM (SAM):
   - As strategy at system level (>1 project in port, estuary, coastline)
   - Input for Environmental Impact Assessments (EIA)
   - Understand effectiveness of management actions in (P)AM on a broader temporal and spatial scale

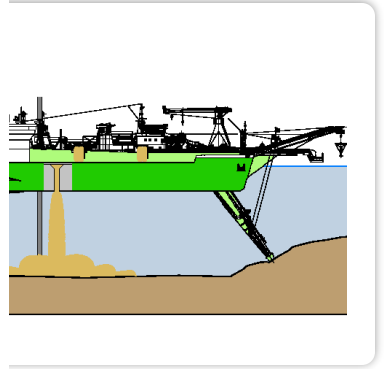
Pro-Active Adaptive M'gt: modified feedback loop



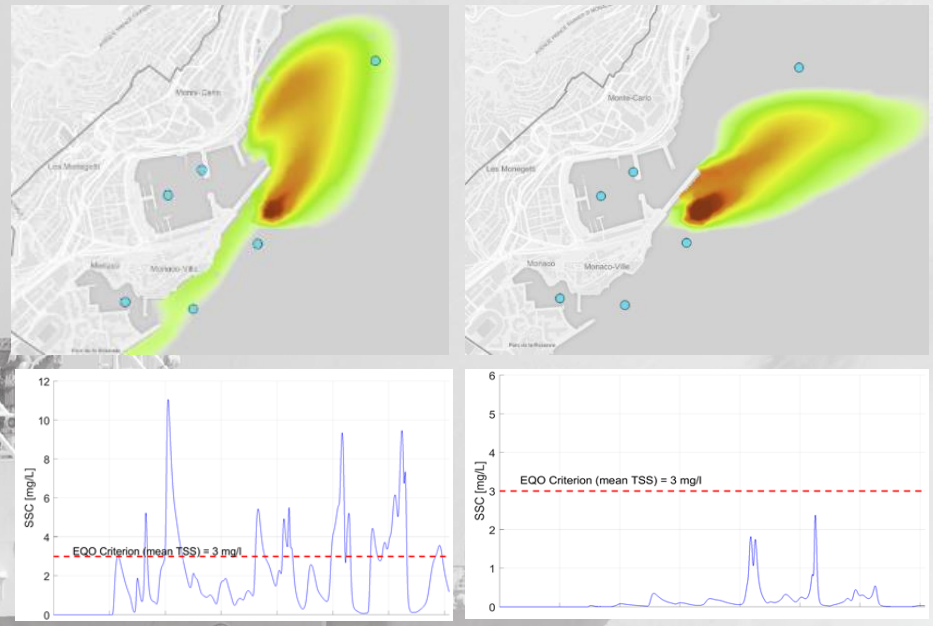








Pro-Active AM: benefits (1)



- **Proactive Approach:**
  - Methodology and planning adjustments before starting a project phase
  - Minimizing non-compliance risks during execution
- **Cost Reduction:**
  - Avoiding strict mitigation measures and standby equipment costs
  - Economical tool, compensating for the initial investment during project execution
- **Flexibility:**
  - Full exploration of opportunities and implementation schedule flexibility
  - Enhancing project adaptability to changing conditions
- **Risk Reduction:**
  - Reduce shutdown and reputation risks by selecting optimal scenarios based on available data, particularly in projects with strict compliance limits.
- **Stakeholder Confidence:**
  - PAM builds confidence among contractors, employers, and stakeholders in project compliance and control,
  - Potentially mitigating opposition.
- **Forecast Quality Monitoring:**
  - Monitored in real-time by comparing past predictions with observed parameters
  - Utilizing ensemble forecasts to establish uncertainty bands.

Pro-Active AM: benefits (2)

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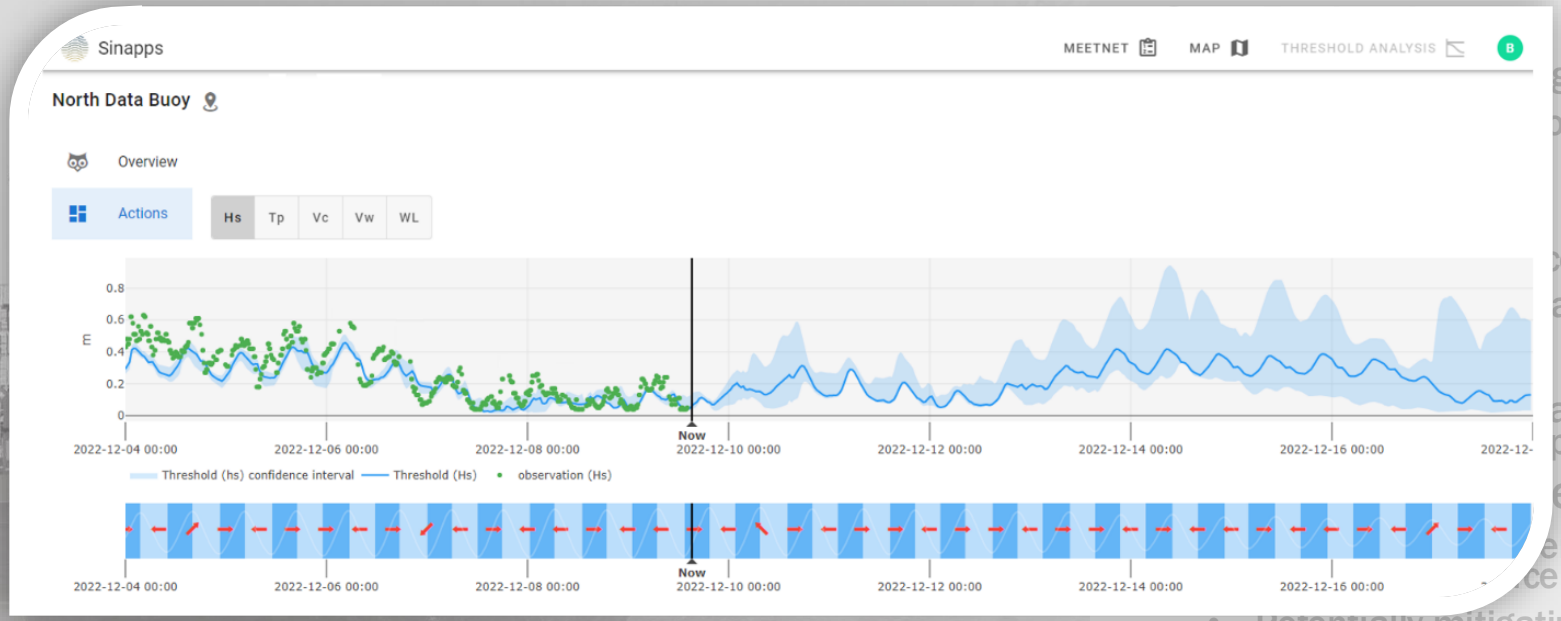

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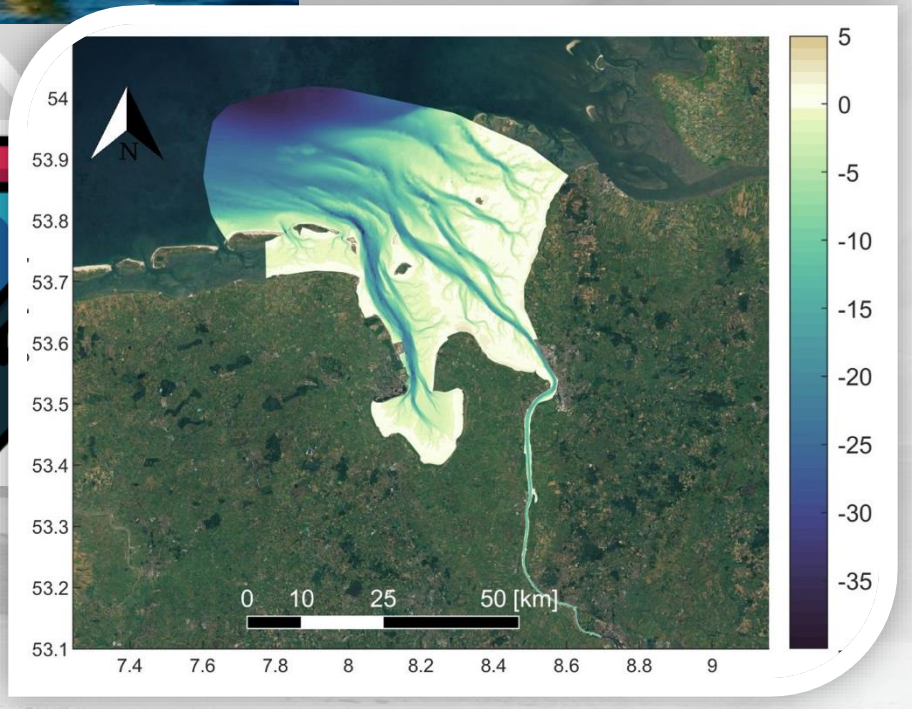
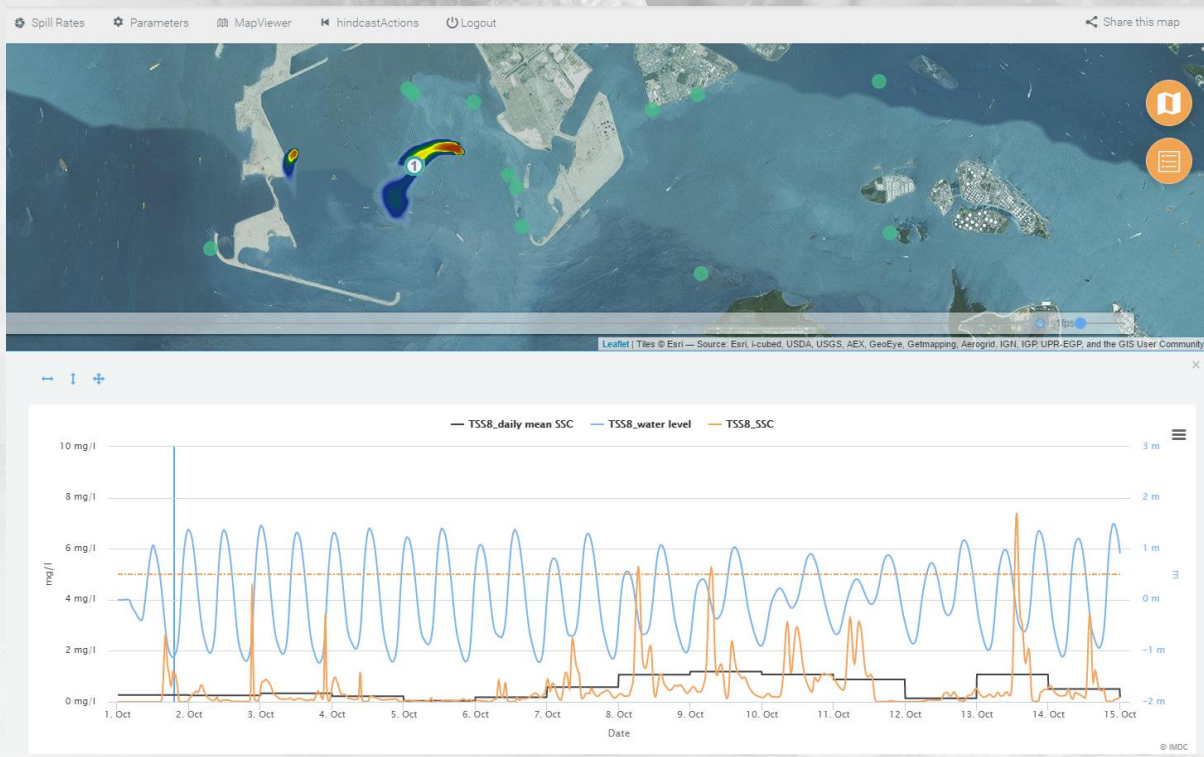
Pro-Active AM: Requirements

- Knowledge on project ecosystem, sediment dynamics
- Real-time and online monitoring
- Opportunity scenarios (library)
- Forecasting system with numerical model
- Graphical interaction platform & sharing proces

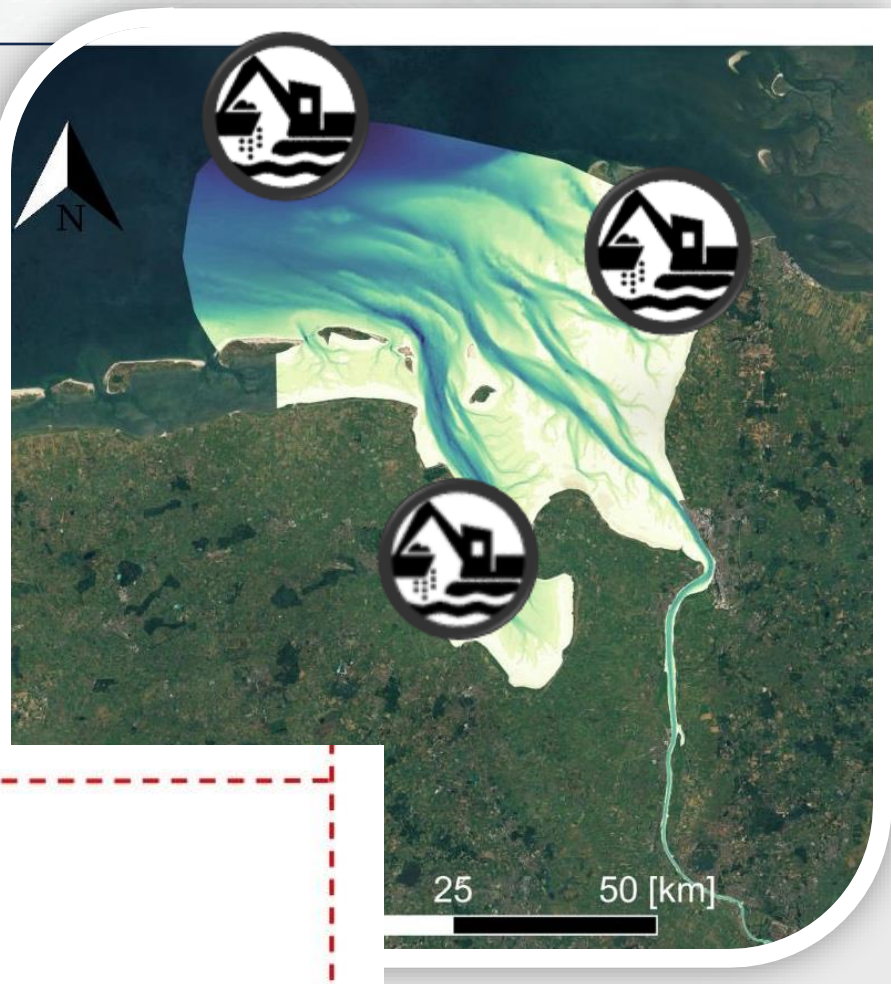


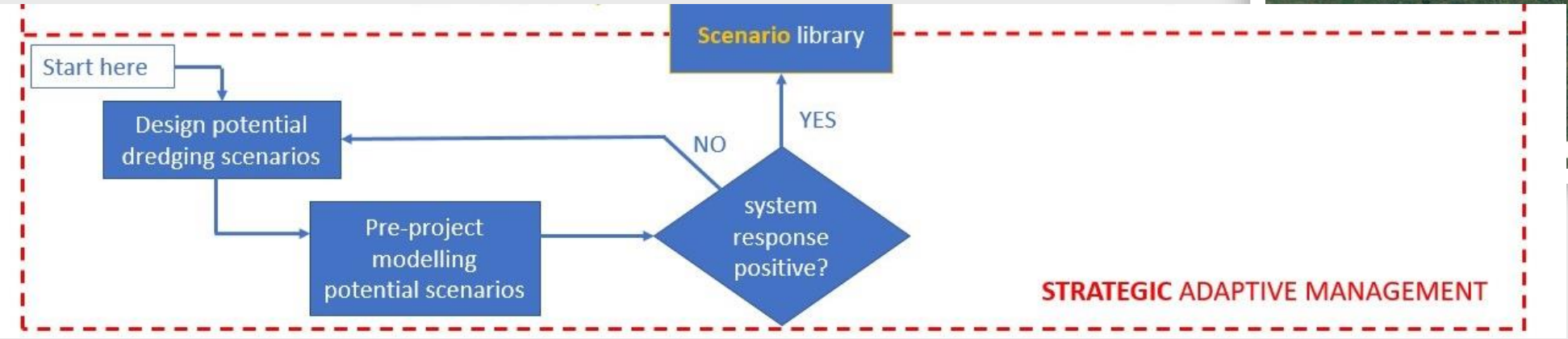


Strategic Adaptive Mg't (SAM) (1)

- SAM Application in Environmental Management:
  - More sustainable dredging strategies, at environmental system level, e.g. fairway maintenance
  - Cumulative effects
  - Applicable to various environmental management domains beyond sediment management.
- SAM in Sediment Management:
  - Strategy to adapt sediment management to hydromorphological changes,
  - A proper base for beneficial (re)use of dredged materials in different applications (e.g. CEDA, 2019),
- Promote understanding of the effectiveness of strategies & scenarios

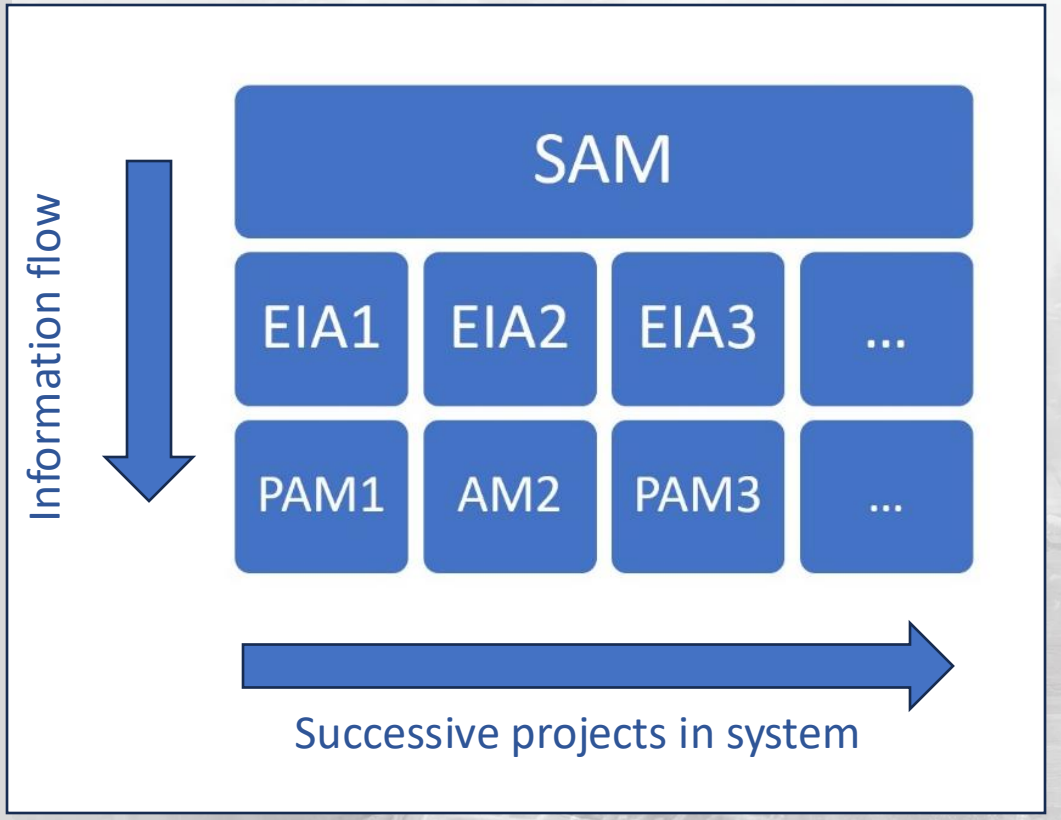
→ Library of effective and acceptable scenarios



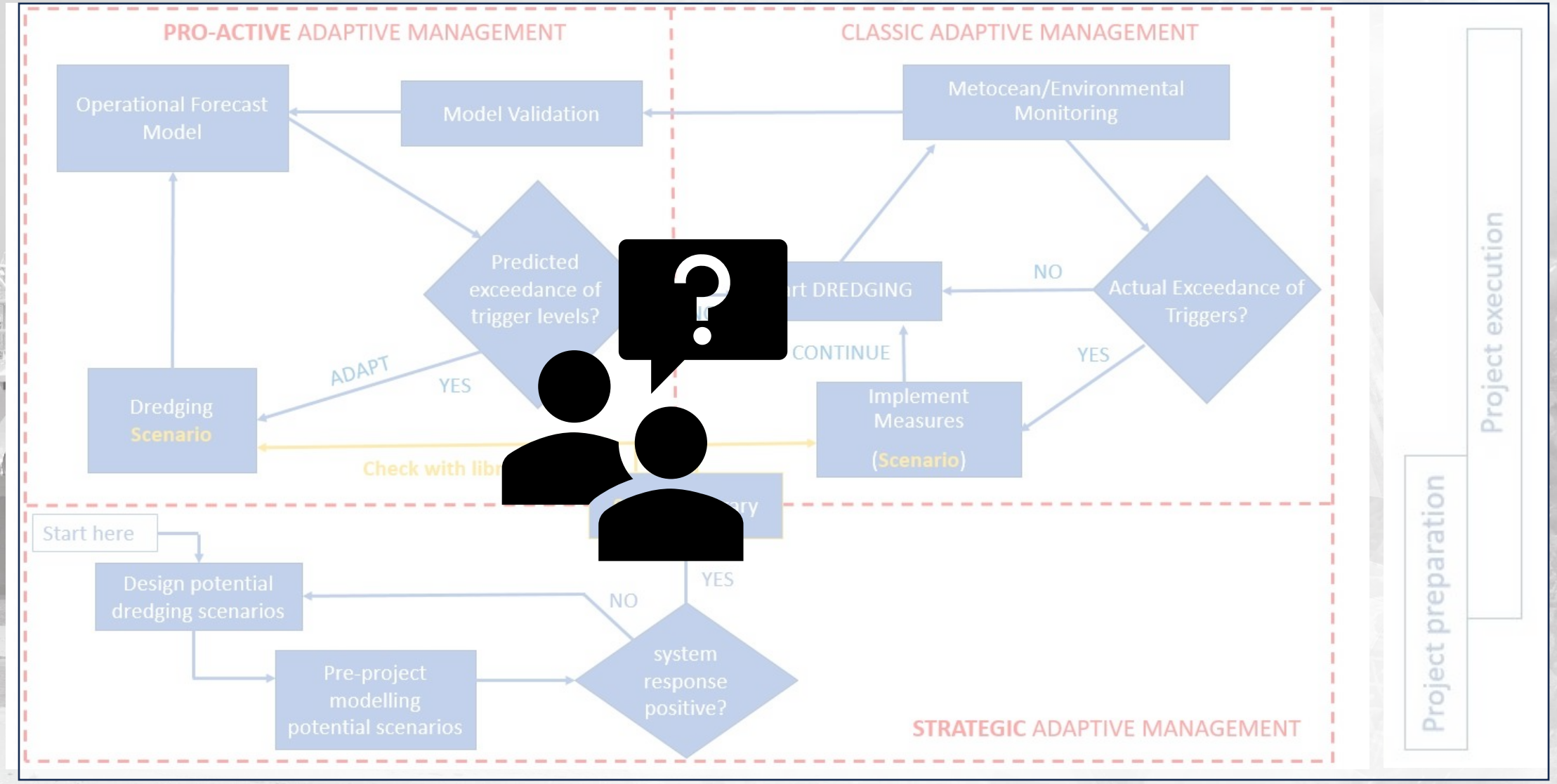


Strategic Adaptive Mg't (SAM) (2)

- Scope:
  - Embeds dredging projects into environmental management on larger spatial and temporal scales.
  - Based on ecological, economic goals, monitoring, modeling, and readjustment of management options.
- Examples of SAM in Practice:
  - Flexible dredging activities based on environmental conditions like oxygen levels.
  - Variable disposal site selection considering e.g. sediment quality and hydromorphological conditions.
- Importance of Adaptive Management Strategy:
  - Vital when changing boundary conditions hinder long-term planning of maintenance activities.
  - Ensures economic efficiency, minimizes environmental impact, and addresses technical and legal constraints.



Adaptive Management: flow charts



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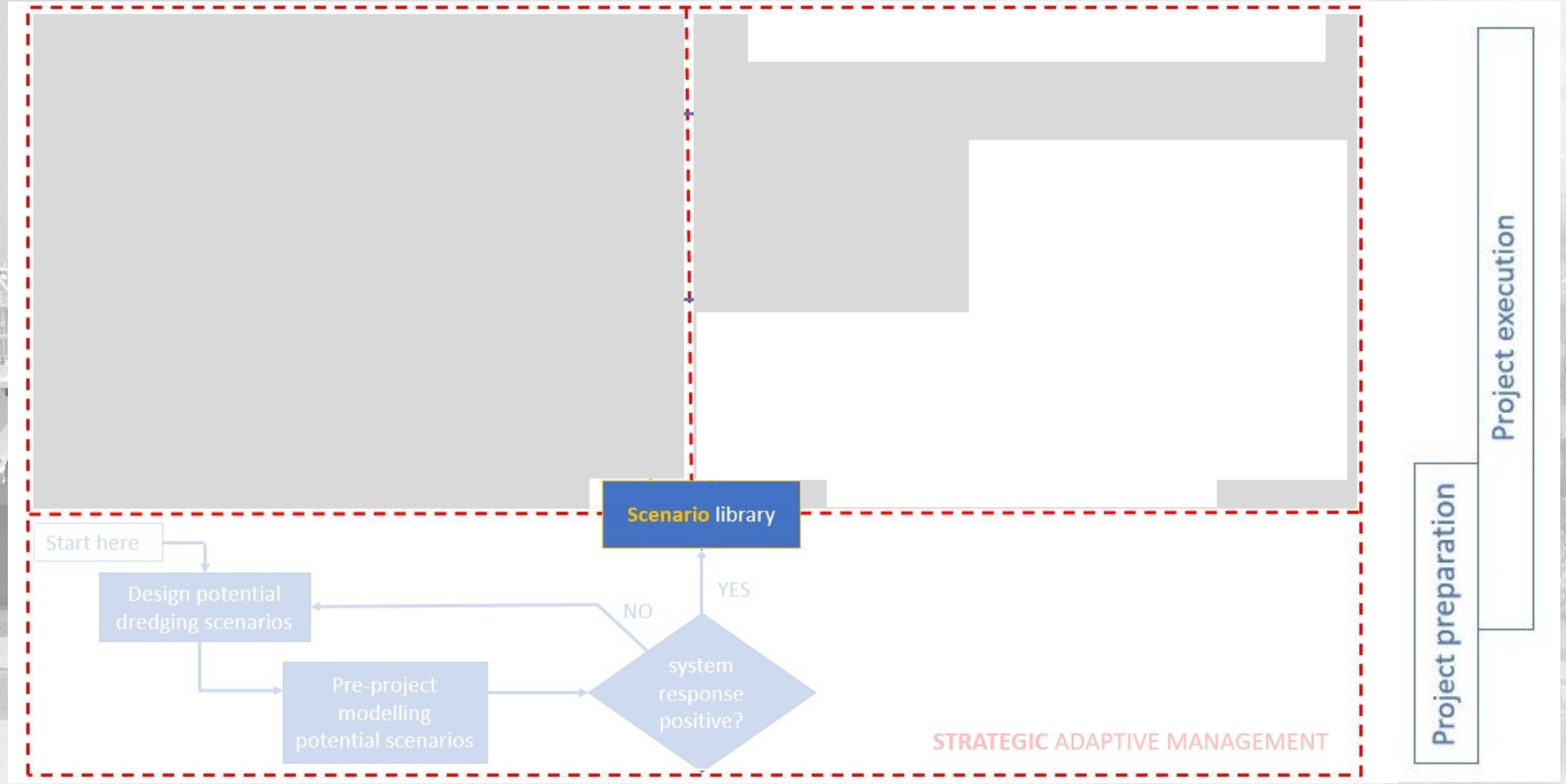
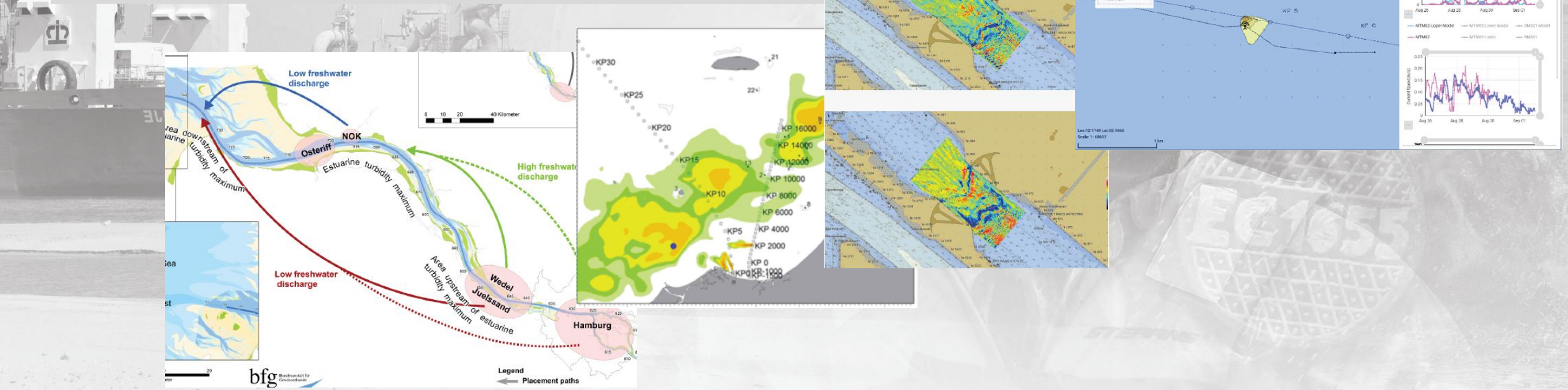


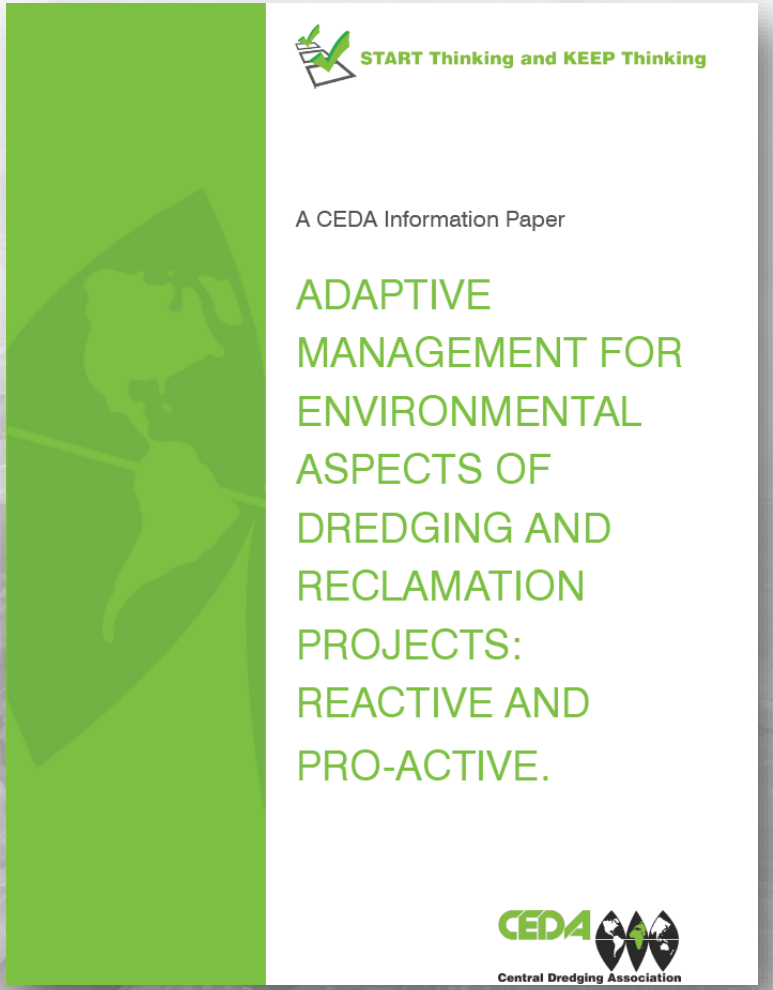
Case Studies

- Application of PAM in pipeline trench dredging and backfilling in Baltic Sea
- Application of PAM in the approach to channel dredging in Western Australia
- Elbe Estuary maintenance dredging
- Maintenance dredging near a storm surge barrier



Conclusions

- Awareness of Pro-Active Adaptive Management (PAM) is significantly lower.
- Paper increase information on PAM, also for developers/project owners.
- Paper provides tools and prerequisites for PAM.
- Concept of Strategic Adaptive Management
- Need for guidelines to embed PAM early?



Access the paper now on CEDA website !!

https://dredging.org/news/556/ceda-releases-new-information-paper-on-environmental-adaptive-management

Questions ?