The concept and process of Adaptive Delta Management (ADM) and Bangladesh Delta Plan 2100

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Outline

- Background and evolution of ADM
- ADM concepts and principles
- Operational tools and methods
- Challenges and way forward

Key concepts

- Objective: what do we want to enhance in our system; what is the problem we want to solve?
- Scenarios: which are the potential (external) conditions under which the objective has to be reached?
- Actions or measures: what can we do to reach our objectives?
- Tipping points: under what conditions do the actions perform unsatisfactory?
- Pathways: what combinations of actions bring us to our objective?

Background of ADM

- Adaptive Management (AM)
  - in the US in the 1990s to support **natural resource management** policy
  - based on **learning** from the outcomes of management actions, **accommodating** change, and thereby **improving** management.
- AM ensures that
  - (i) **uncertainty** is acknowledged and 'information gaps' are identified,
  - (ii) there are good **prospects for learning** and experimenting in order to **narrow down information gaps** over time, and
  - (iii) the socio-economic and physical changes warrant to **adjust management directions** (interventions) as a consequence of lessons learnt.
- Growing interest in AM in river restoration/flood management programs:
  - Mississippi River Basin, Colorado River and Colombia River Basin.
  - **Thames Estuary project (TE2100)** and the **Dutch Delta Program**.

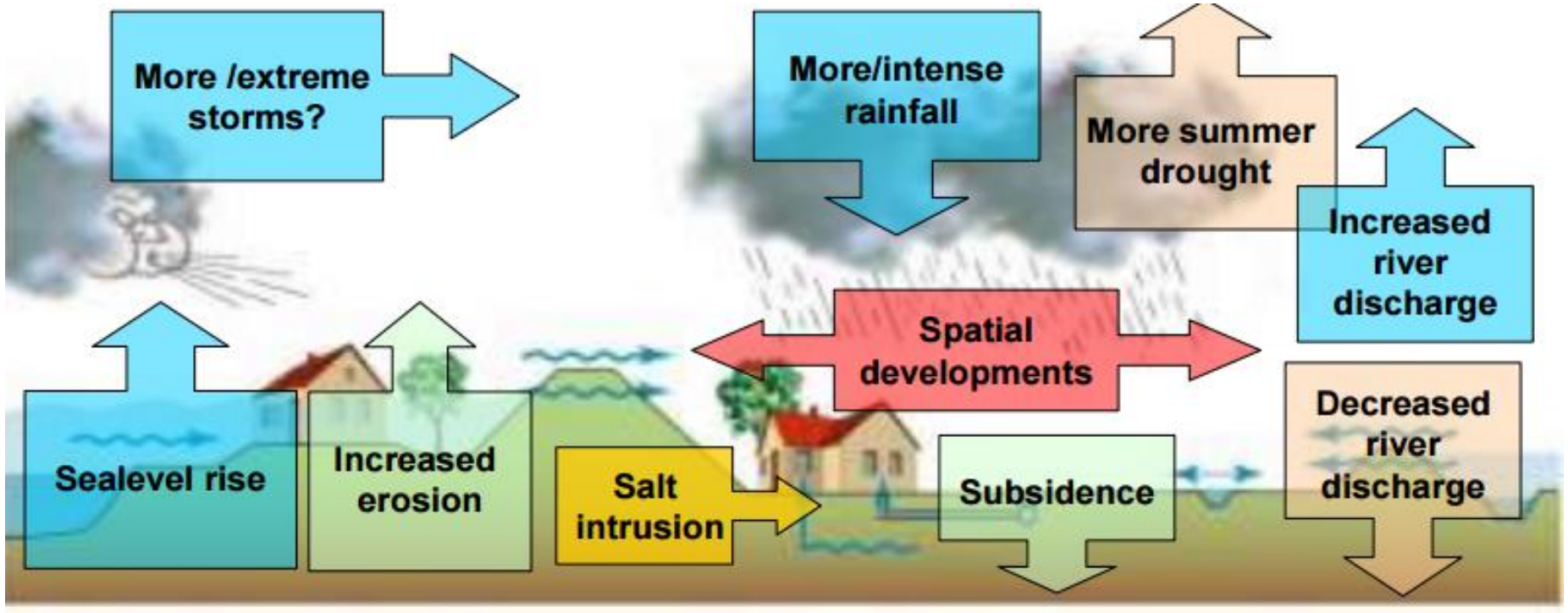
Background of ADM

- **Challenges** of AM implementation and sustainability:
  - **institutional constraints** and lack of **leadership** in implementation
  - lack of stable (long-term) **funding and resources**
  - reluctance to admit and **embrace uncertainties** (beyond 'traditional' practices) in making policy choices
- To overcome these challenges, **three enabling elements** are necessary:
  - (i) a system approach,
  - (ii) participatory decision making, and
  - (iii) learning and experimentation (flexibility and adaptability).
- In addition, **continuity in implementation** has to be provided by **institutional arrangements** on leadership, funding and legal aspects.

Background of ADM

- **TE2100:**
  - started in 2003, one of the first to propose an **adaptive approach** to manage flood risk based on the principles of AM
  - aims to **protect London and Thames Estuary** from tidal flooding and proposes a series of possible interventions until 2100
  - has been instrumental for decision makers to understand the **options and 'decision pathways'**
- **Dutch Delta Program:**
  - inspired by TE2100 adaptive approach, adopted **Adaptive Delta Management** (ADM) to deal with the difficulties of anticipating **climate change and socio-economic developments**
  - in the initial years (2010-2014) delivered **five** major '**delta decisions**' and **six regional adaptive strategies**
  - in the **coming decades** the emphasis will shift towards further **elaboration** of the **adaptive strategies** and **implementation** of the measures

Background of ADM : Delta Challenges



- Globally, Delta Countries face common **problems** and **challenges**
- Need a **holistic** and **adaptive 'no regret'** plan to **deal with the challenges** for achieving **sustainable development**

Adaptive Delta Management

… a structured, **iterative process** of **robust decision making** in the face of **uncertainty**, with an aim to reduce uncertainty over time via system **monitoring**.

Uncertainty: a matter of probabilities?

Certainty: This is a situation wherein the outcome that will occur is known; i.e. the probability of that the outcome will occur is 100% (=deterministic).

Courtesy: W Veerbeek, IHE Delft 2016

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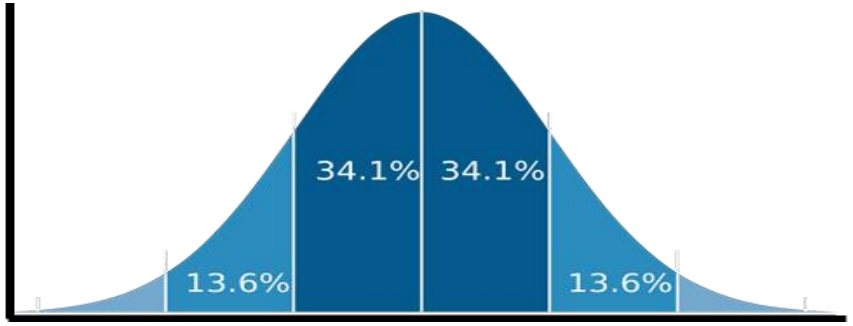
Risk: This is a situation wherein all possible outcomes and the probability of occurrence are known , even as one does not know which outcome shall surely occur.

Probability distribution



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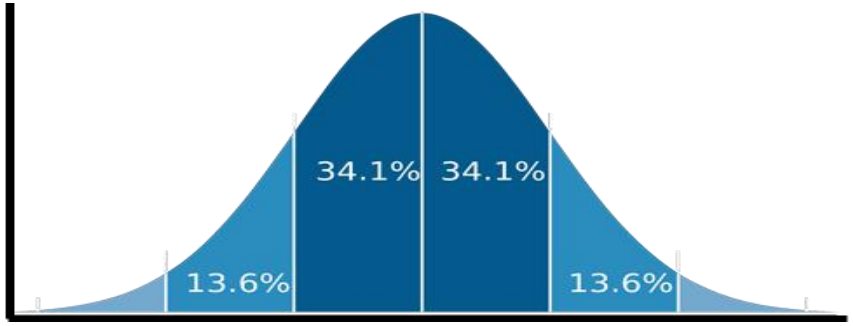
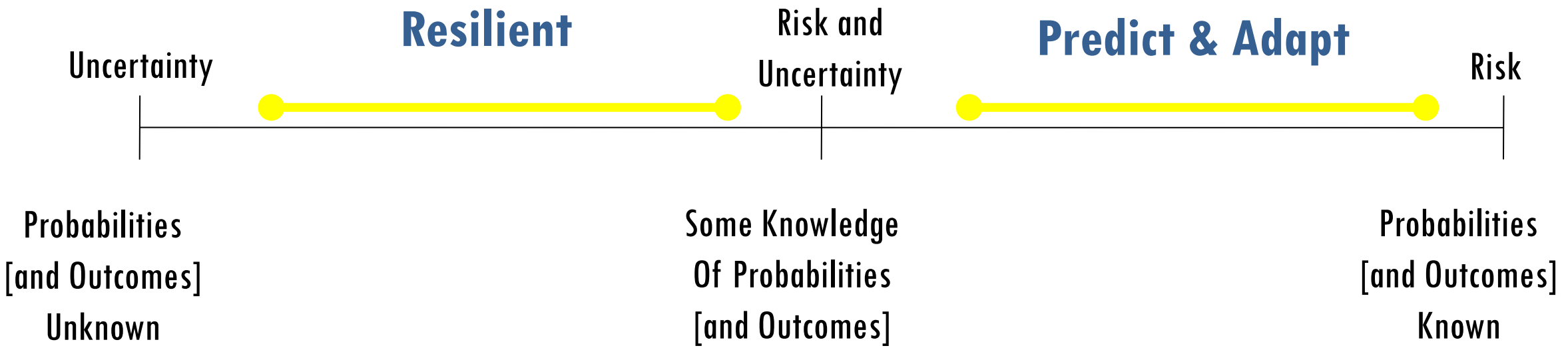
Positioning Risk & Uncertainty





Courtesy: W Veerbeek, IHE Delft 2016

Adaptive Delta Management

- Accepts that the **future is deeply uncertain**

  e.g., Climate change, Socio-economic development, Urbanization, Vulnerability, Social norms and acceptance

- Instead of making a '**best**' prediction and **developing a plan** for that future,

  ADM asks:

  What *could* happen in the ***future***, and what can we do ***now*** to achieve our goals, regardless of how the future unfolds?

Dealing with uncertainties is the key issue:
✓ 'what to do and when to do it?'
✓ 'not too much, not too little'
✓ 'not too early, not too late'

Courtesy: Wil Thissen, TU Delft

Adaptive Delta Management

- **Deals with uncertainties** in a transparent and sensible way **to support decision making** with regard to water policy, planning and infrastructural investments
- Connects **short-term targets** and **long-term objectives**
- Combines **water management** with plans for **regional development**
- Builds further upon **IWRM experience** in developing and developed countries
- Looks for policies/strategies that will perform well under a wide variety of futures (‘**robust policies**’)

Paradigm shift

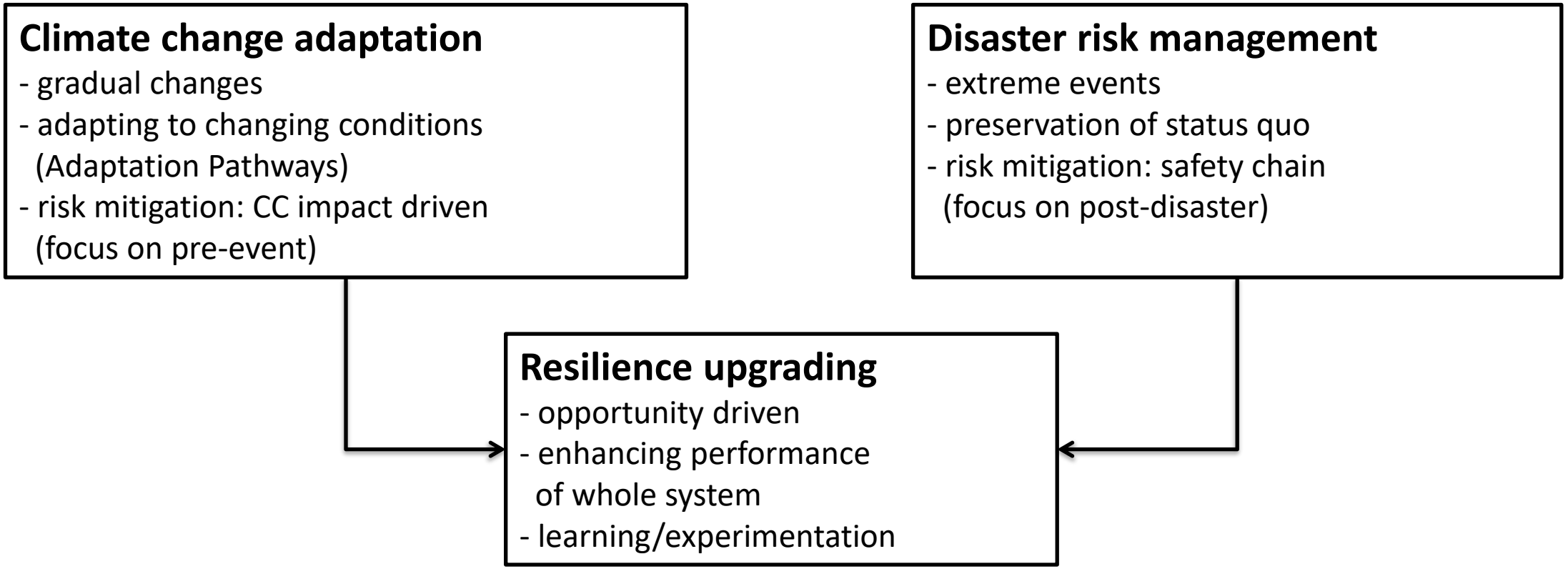
Sustainable delta?

Shifts needed:

- from stand alone to **embedded/integrated**
- from (climate) risk reduction to **resilience upgrading**
- from top down to **bottom up**
- from additional to **mainstream**

(adapted from: IHE Delft 2016)

Paradigm shift



(adapted from: IHE Delft, 2016)

Paradigm shift

Actions needed:

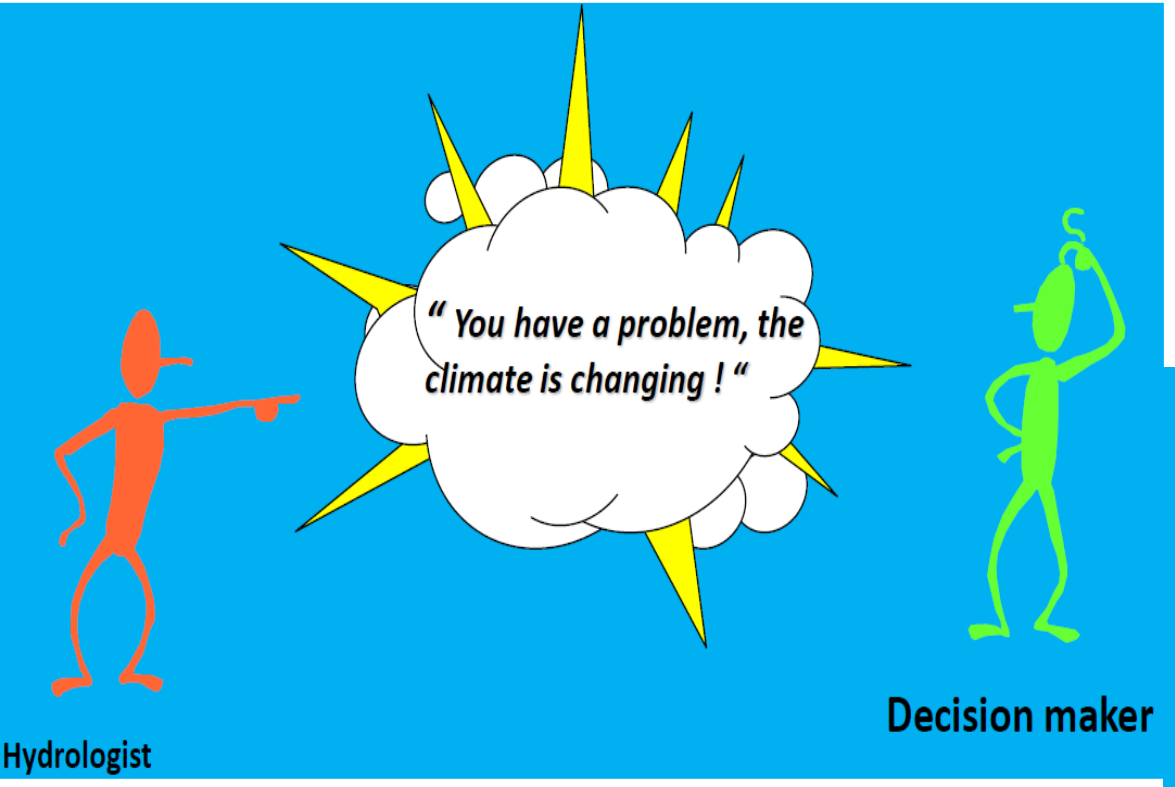
- identify core issues (long-term vision)
- appropriate planning and legal frameworks, approaches and tools
- enhance capacity to develop and implement plans
- practical time horizons for plans

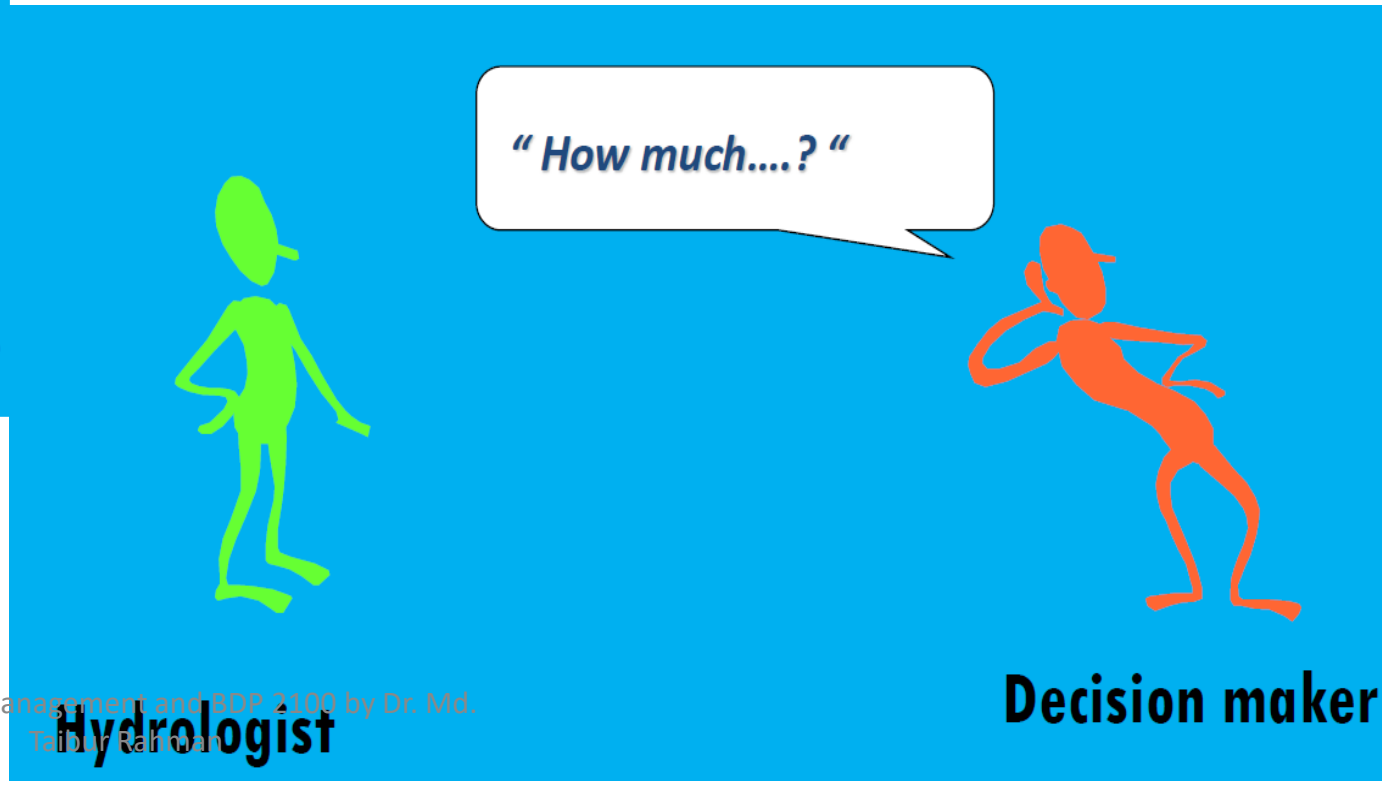
(adapted from: IHE Delft, 2016)

Delta Planning: the requirements

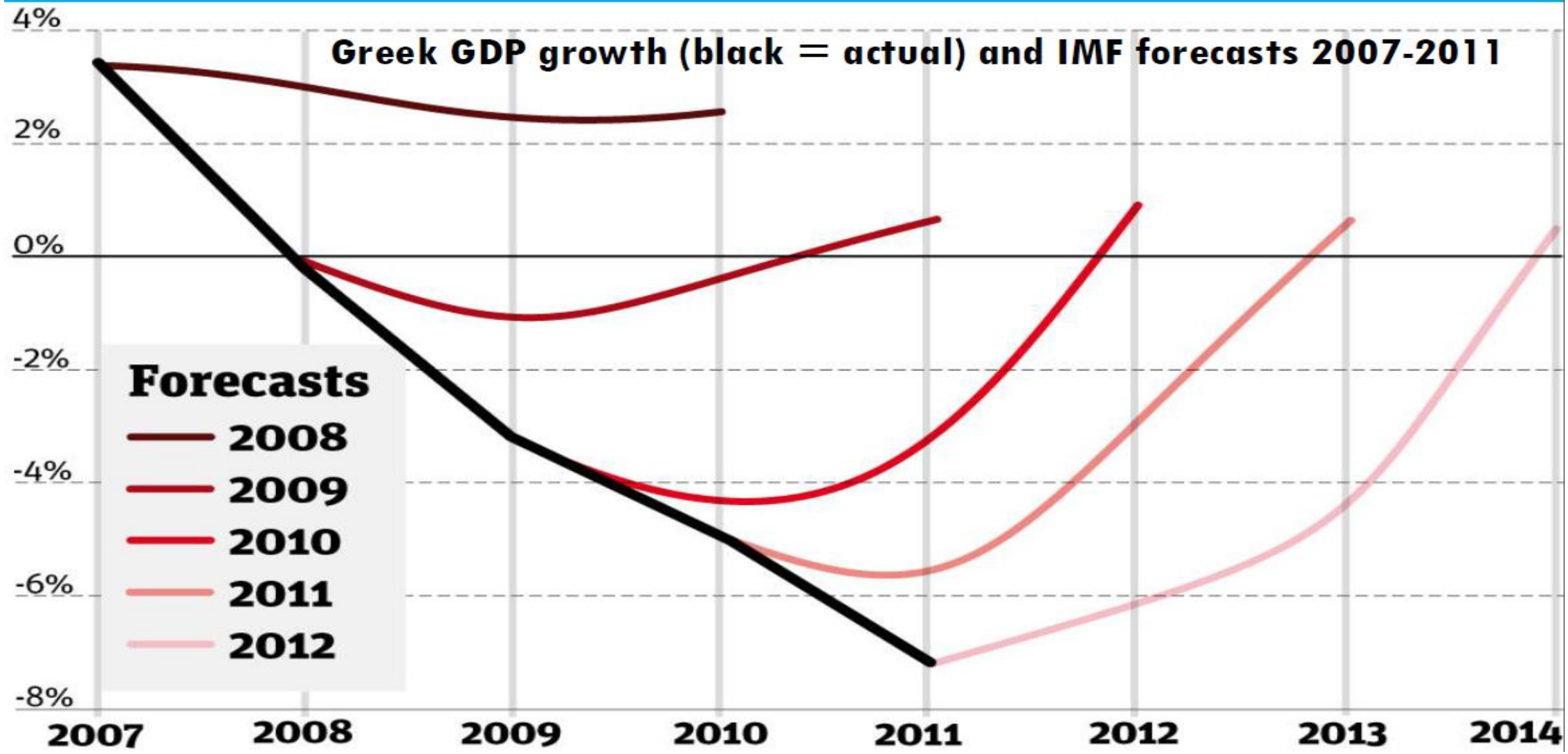
- No-Regret: Need to prevent making ‘mistakes’ that need considerable resources and time to fix in future;
- Handle increased societal complexity and development speed;
- Integrate short-term and long-term planning; operational and strategic level

Approach: what future brings…?

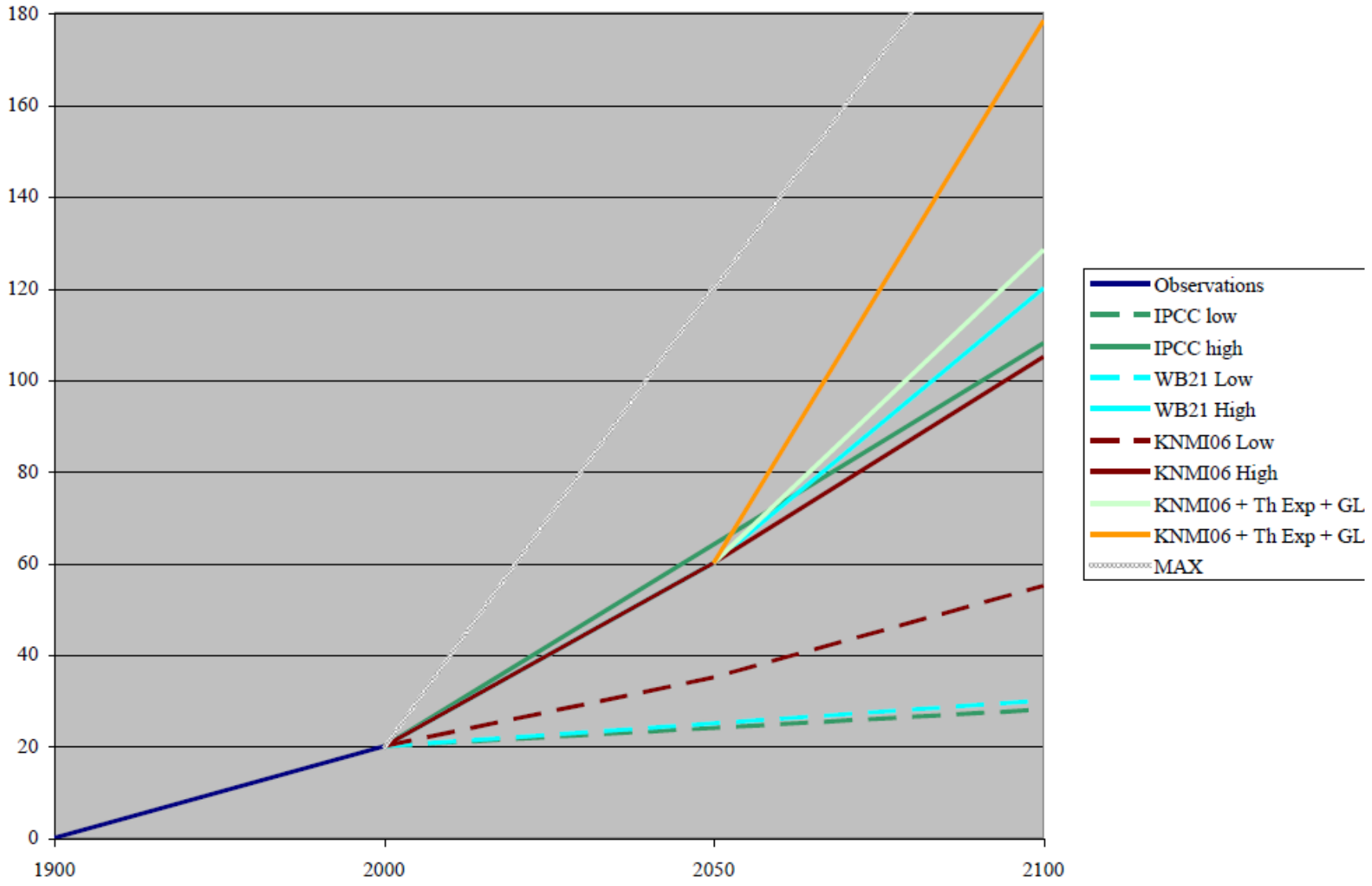




We are notoriously bad in predicting the future



So many possibilities: Sea level rise



Coping with uncertainty

Strategy 1: Prepare for the worst

- Resource intensive;
- Might have strong impact (spatial, social);
- Residual risk

Strategy 2: Wait for scientific certainty/consensus

- Maybe too late for timely readjustment (implementation period);
- Maybe new insights will NOT increase confidence bounds;
- Risk might be increasing due to anthropogenic changes

But how well can such an approach cope with uncertainty?

Adaptive Planning

Adaptive Planning Types:

- Assumption-Based Planning : sensitivity analysis of “load-bearing” assumptions;
- Robust Decision Making: identifying policies that deliver under different scenarios;
- Adaptive Policy Making: Continuous adjustment;
- Adaptation Tipping Points and Adaptation Pathways: Identifying exceedance and shifting policies to meet objectives under different scenarios;
- Dynamic Adaptive Policy Pathways: APM+ATP+AP

All Adaptive Planning methods use scenarios to explore different futures.

Scenarios: storylines about the future

Scenarios:

- Are **NOT** future predictions and are not use to create predictions;
- Are **NOT** future goals, outlooks or targets;
- Are **NOT** necessarily extrapolations of current trends;

- Are **quantitatively or qualitatively** described possible future developments;
- Incorporate various degrees of uncertainty;
- Are mutually exclusive;
- Include independent developments;
- Can be data (model) driven, narrative driven, event driven;
- Should include a sets of states (indicators) that make the scenarios tangible;
- Are somewhat bounded in their range (reflexivity);

Adaptive Planning: Robust decision making

Robust Decision Making

Developing policies/strategies/measures that are effective under **different scenarios**;

- No regret strategies/measures: measures that work in different future **scenarios***
- Low regret strategies/measures: based on ranking (performance criteria; assessment framework)

*A **scenario** is a "possible future"

Adaptive Planning: Adaptation Tipping Points & Adaptation Pathways

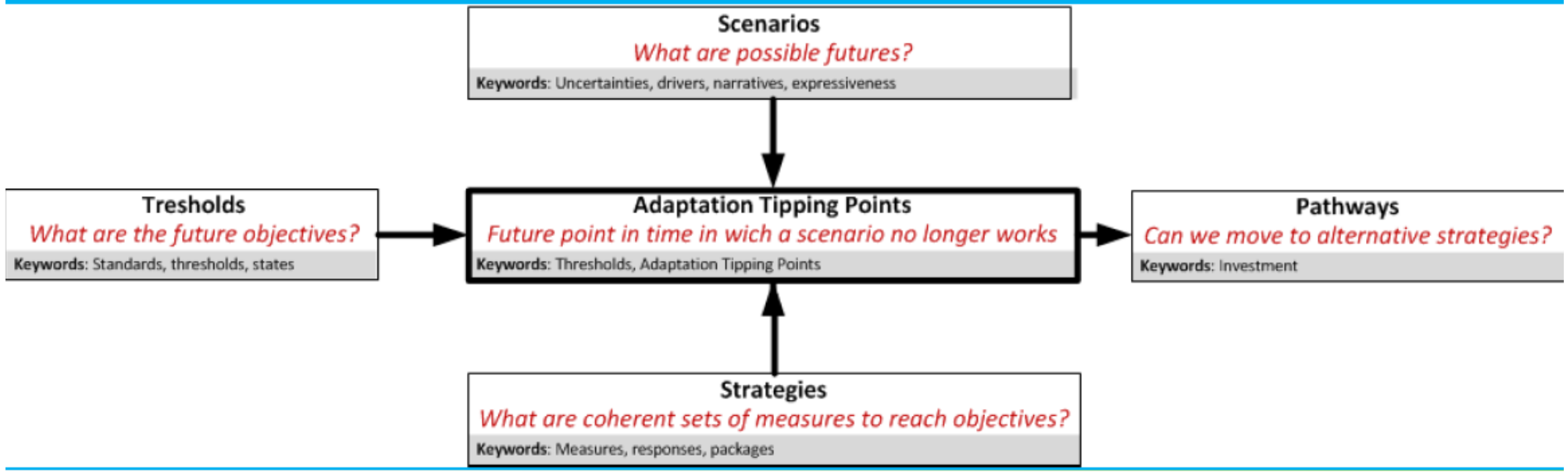
Thresholds: future objectives (standards);

Scenarios: Possible futures (exogenous);

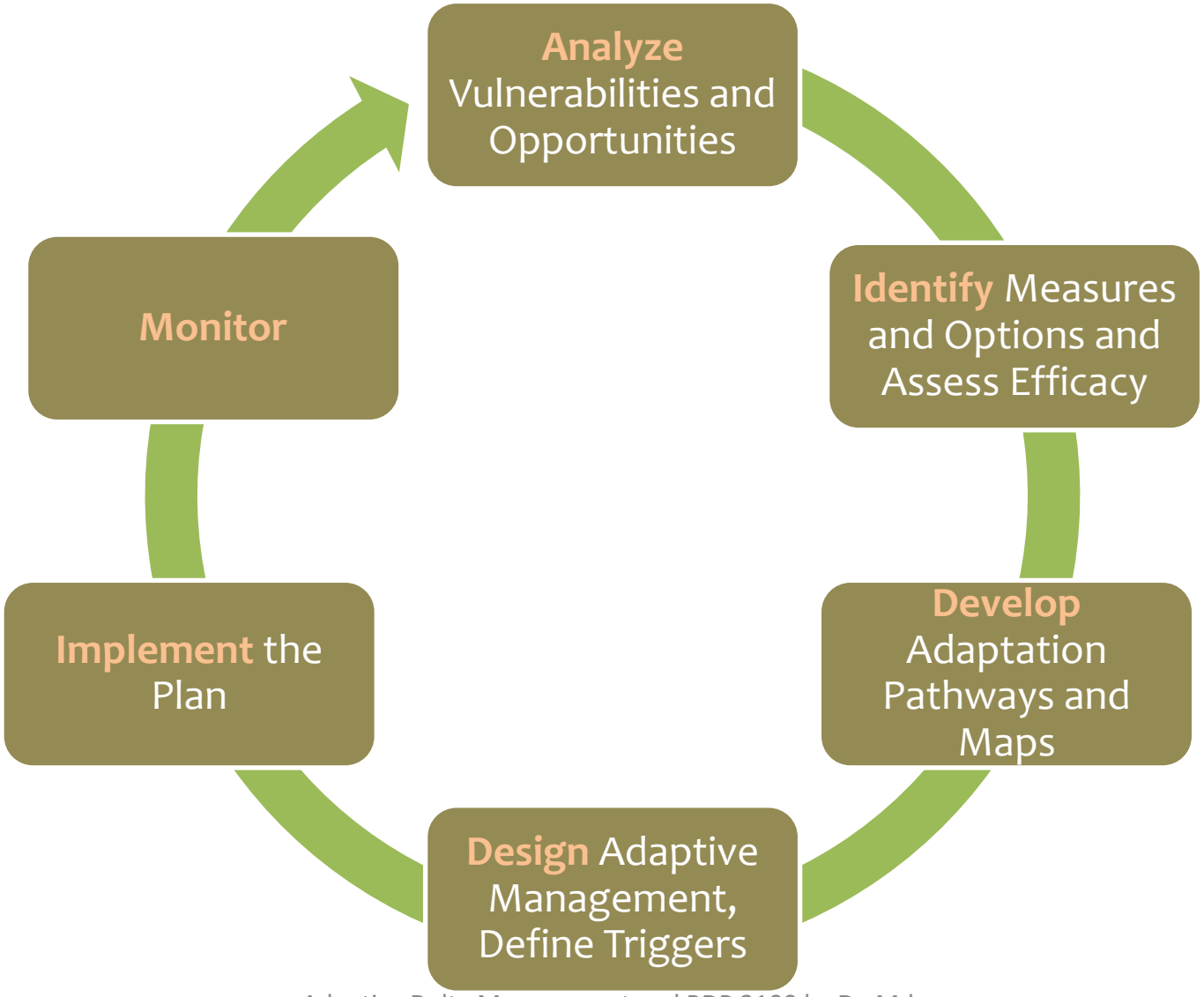
Strategies: Sets of measures

ATPs: future points in time when a strategy exceeds threshold for a given scenario

APs: possible transitions in strategies to ATPs that are further in future



Adaptive Delta Management Cycle



(adapted from Haasnoot et al., 2013)

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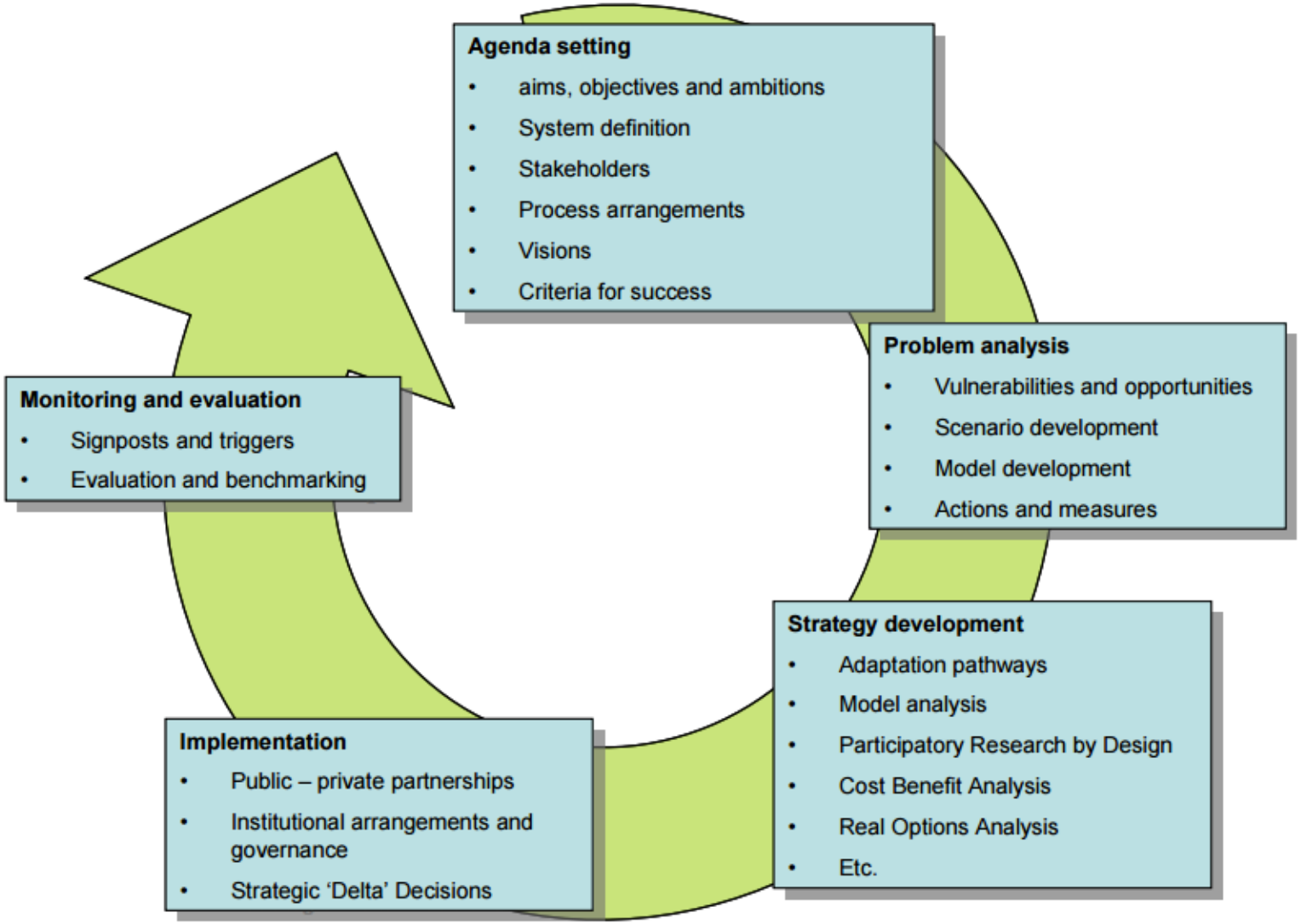


ADM can be seen as a cyclic process; each step contains new elements, such as long term scenario building, adaptation pathway development, signposts, triggers, etc.

An approach for Adaptive Delta Management

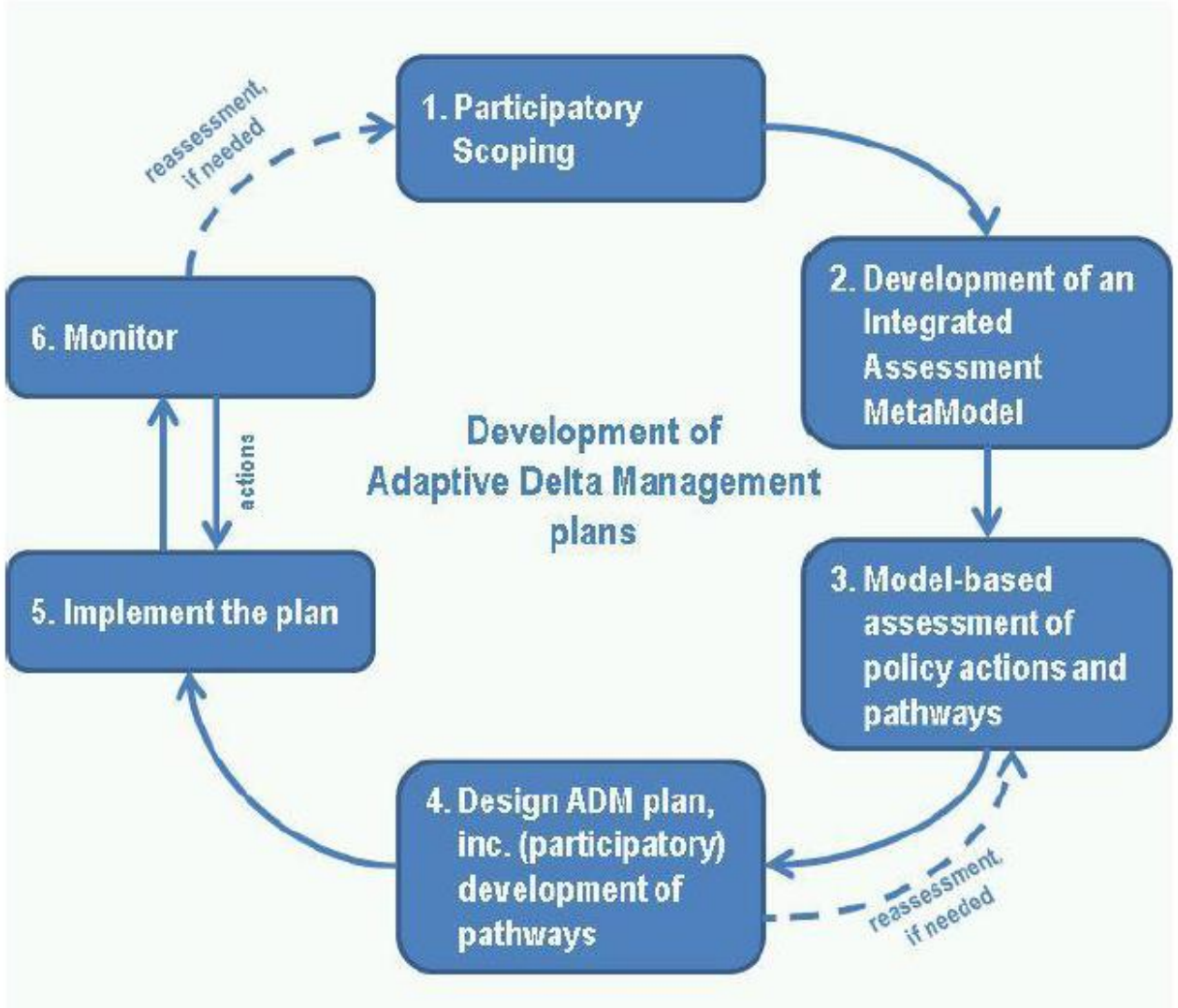
Dynamic Adaptive Policy Pathways (DAPP)

Adaptation is a path - The **end point** is not only determined by what is known or **anticipated** at present, but also by what will be experienced and learned when the **future unfolds**, and by the **policy responses** to events.

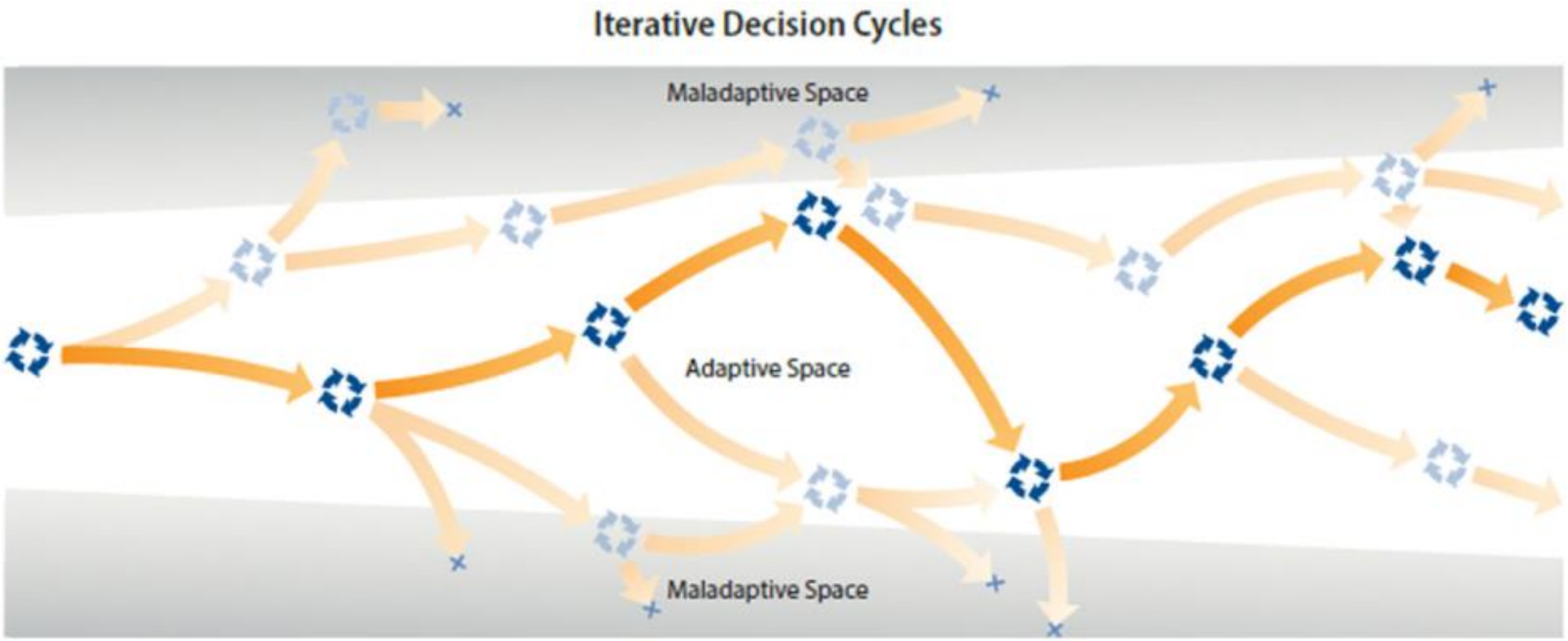
Different paths leading to the **same destination**

The Dynamic Adaptive Policy Pathways approach (adapted from Haasnoot et al., 2013)

Dynamic Adaptive Policy Pathways



The Dynamic Adaptive Policy Pathways approach (simplified from Haasnoot et al., 2013)

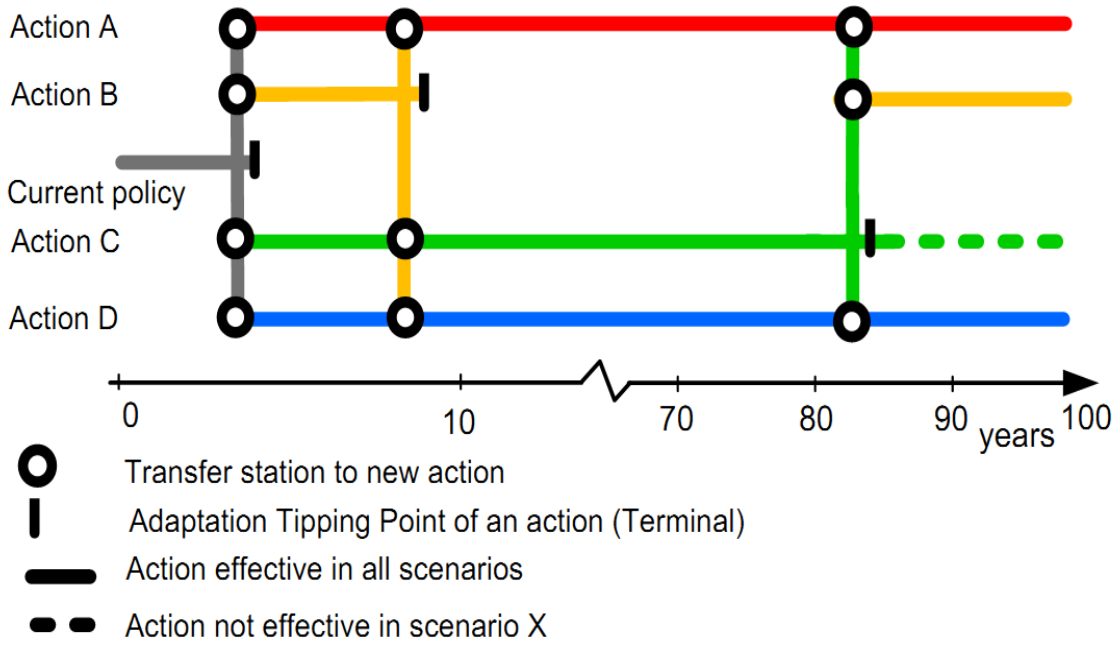


Wise et al. (2014) Glob. Env. Change. 10.1016/j.gloenvcha.2013.12.002

Adaptation pathways describe a **sequence of policy actions or investments** in institutions and infrastructure over time to achieve a set of pre-specified **objectives** under uncertain changing conditions,

and are part of a **policy** and planning **framework** (e.g. DAPP*) that ensures **evaluation** of costs and benefits and **monitoring** to track both implementation and changing conditions.

*Haasnoot et al. (2013) Glob. Env. Change. 10.1016/j.gloenvcha.2012.12.006



Adaptation Pathways Map

	Path actions	Relative Costs	Target effects	Side effects
1		+++	+	0
2		+++++	0	0
3		+++	0	0
4		+++	0	0
5		0	0	-
6		++++	0	-
7		+++	0	-
8		+	+	- - -
9		++	+	- - -

Scorecard pathways

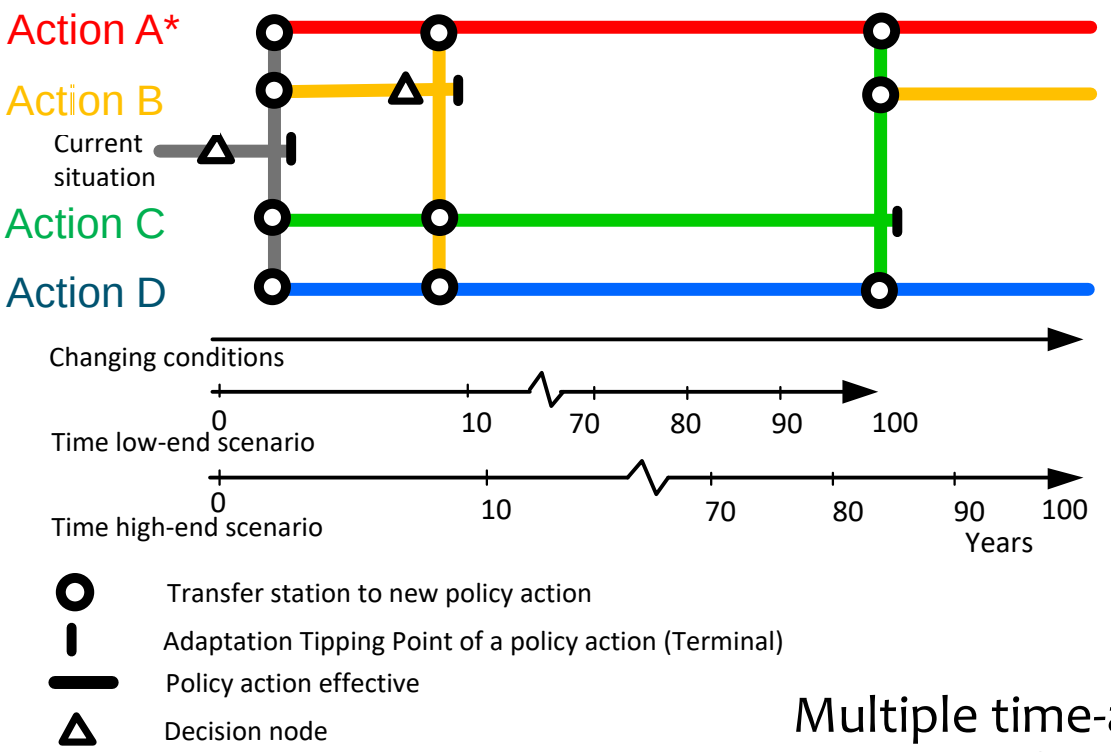
Adaptation **Tipping Points**: conditions at which a policy begins to perform unacceptably

Adaptation **Pathways**: a sequence of policy actions

Haasnoot et al. (2013). 10.1016/j.gloenvcha.2012.12.006

An adaptation pathways map shows **different possible sequences of investment decisions.** A scorecard helps to evaluate the pathways and potential decisions.

Adaptation Pathways Map



Costs and benefits of pathways

Time horizon 20 years

Time horizon 50 years

Time horizon 100 years

Pathway	Costs	Benefits	Co-benefits
1	+++	+	0
2	+++++	0	0
3	+++	0	0
4	+++	0	0
5	0	0	-
6	++++	0	-
7	+++	0	-
8	+	+	- - -
9	++	+	- - -

Pathways that are not necessary in low-end scenario

Multiple time-axes show uncertainty in moment of ATP

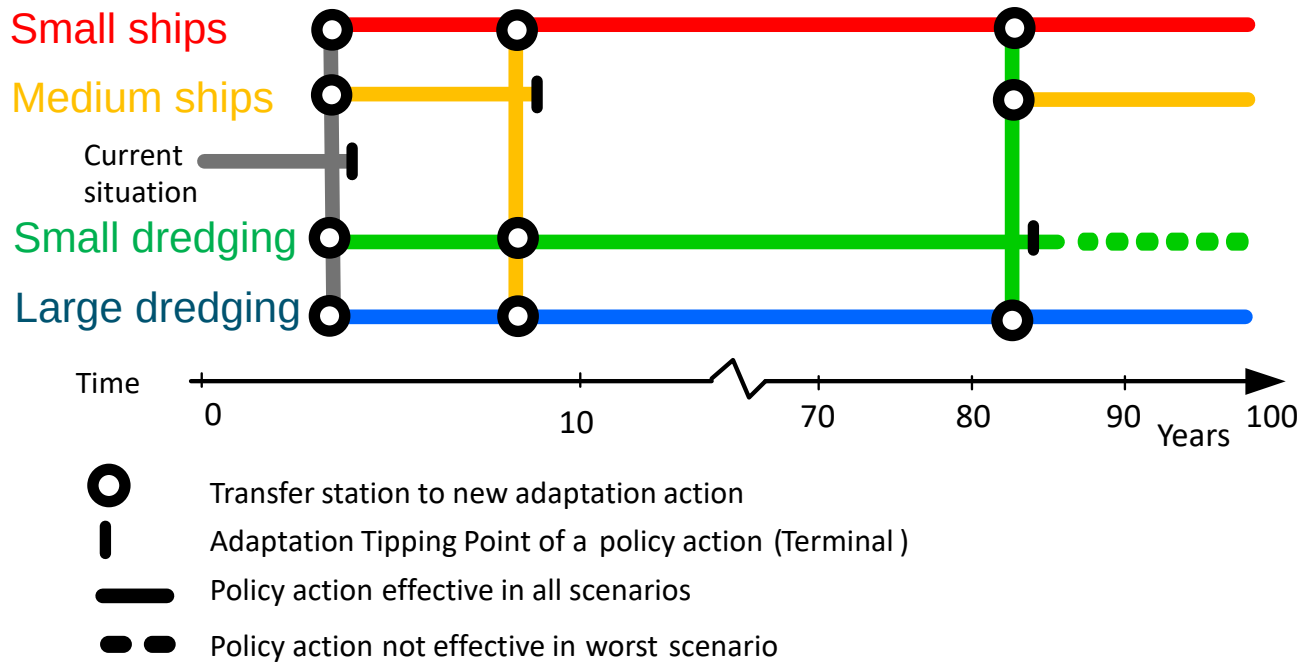
* single action or portfolio of actions

Adaptive Delta Management and BDP 2100 by Dr. Md. Tanvir Rahman

Haasnoot et al. (2012). Clim. Change.; Haasnoot et al. (2013) Glob. Env. Change. 10.1016/j.gloenvcha.2012.12.006

Example: Adaptation Pathways

How to keep a river navigable in a changing environment that may result in lower water levels in the river?



Scorecard for Pathways

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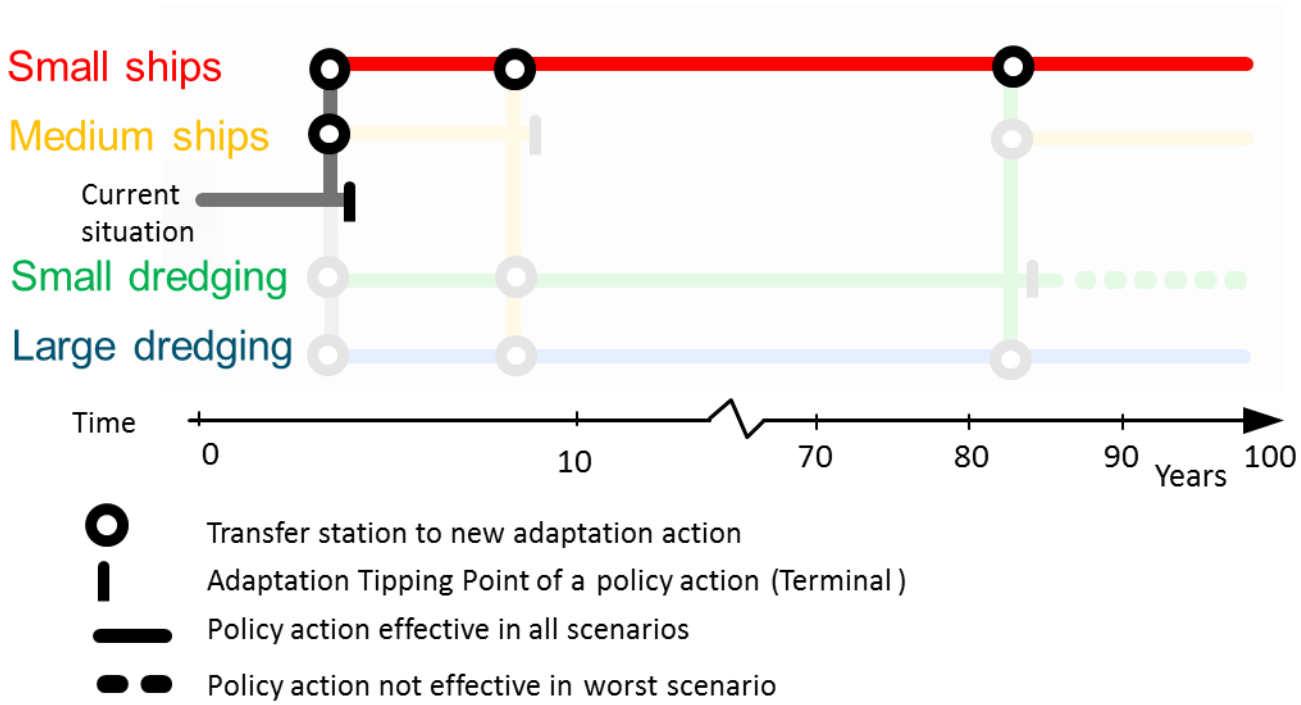

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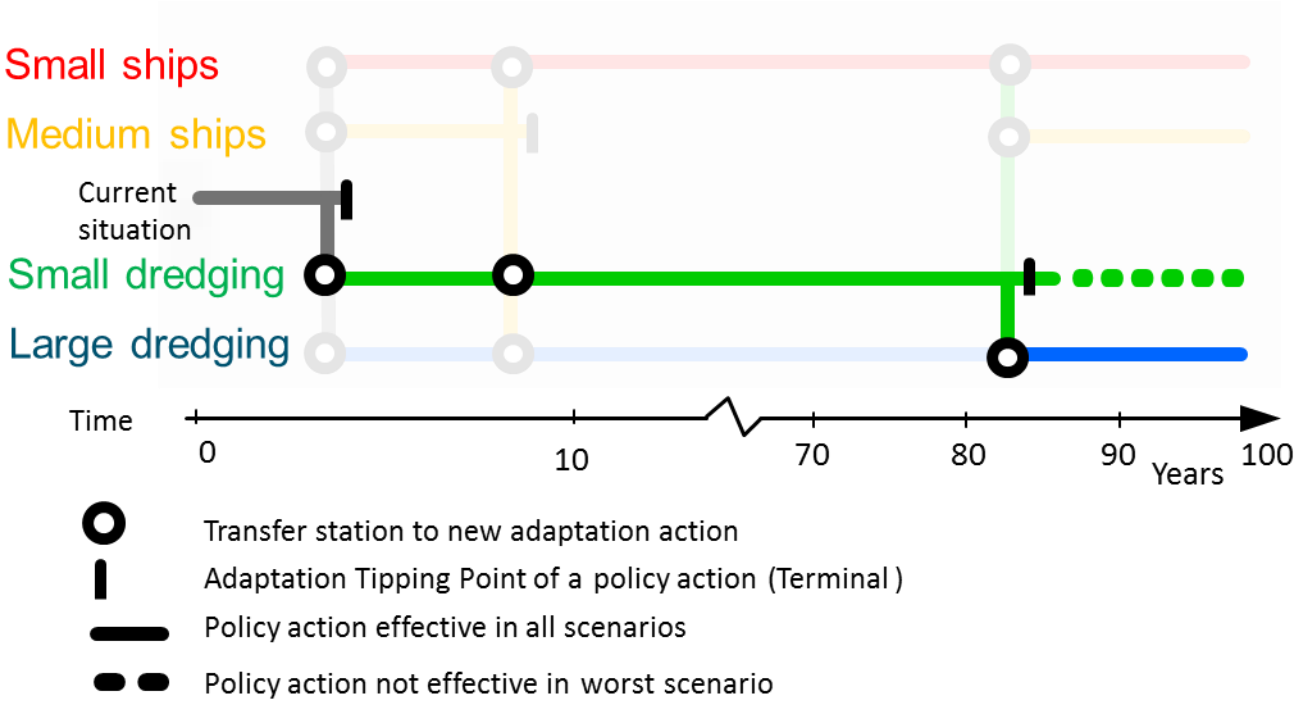

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9		++	+	- - -

Adaptive Plan: small scale dredging, then switch to large scale dredging.
Implement corrective actions to mitigate negative side effects.
Monitor river discharges and transport developments.

Haasnoot et al. (2012). Clim. Change.; Haasnoot et al. (2013) Glob. Env. Change. 10.1016/j.gloenvcha.2012.12.006

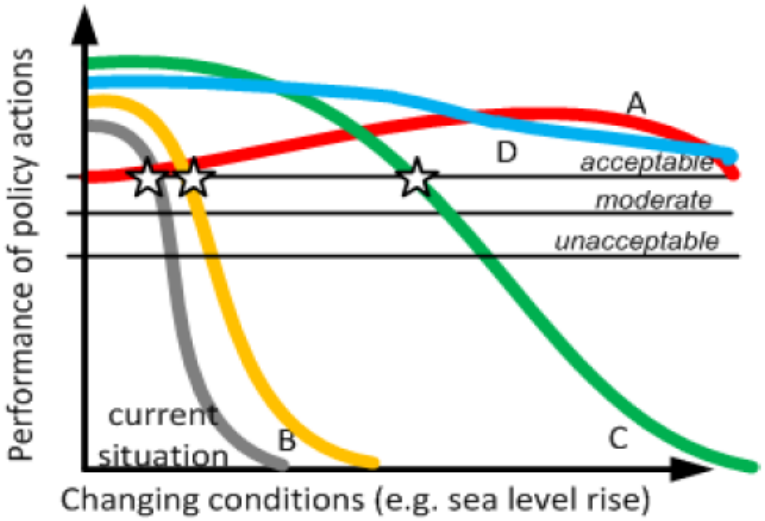
adaptive plan = short term actions + long term options + monitoring

Approaches to identify adaptation tipping points

1. Bottom-up vulnerability assessment (ATP)

Under what conditions does the system perform unacceptably?

What are unacceptable outcome thresholds?



- Expert judgement
- Model-based assessment (sensitivity analysis)
- Use scenarios to assess timing of ATP

Not easy to answer. Especially if you do not have a model.
"From the past we know that we can cope with…."

Approaches to make pathways

2. Develop pathways at once:

Kwakkel et al 2014

a) Computer-assisted: robust optimization or agent-based

b) Focus group discussion with stakeholders

Barnet 2014,
Vizinho in prep,
Haasnoot 2013

c) Serious game

Short-term actions

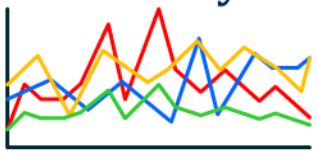
Mid-term option

Long-term options

Describe storyline incl. socio-economic and environmental conditions, and triggers of actions

Models can support the development of an adaptive plan and management

Ensemble (transient) scenarios or sensitivity analysis



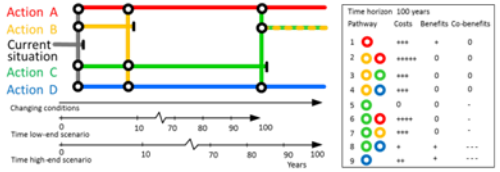
Set of actions and pathways

Action A Action C

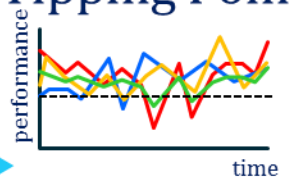
Action B Action D

Collaborative model-based development

Adaptation pathways



Adaptation Tipping Points



Participatory/qualitative Workshop & storylines

Three model requirements
for decision support of delta planning and management under uncertainty

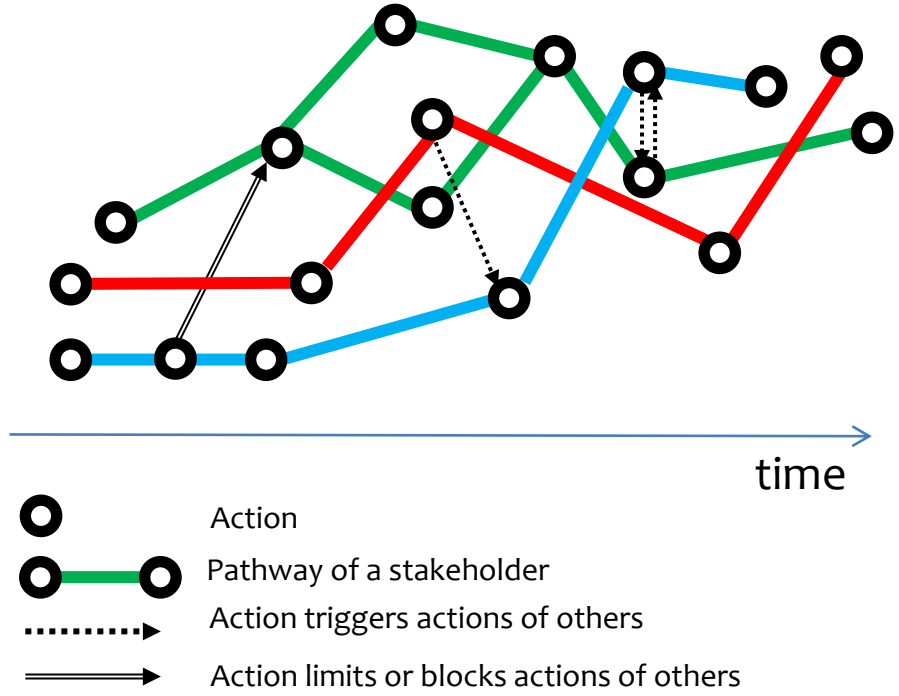
1. **Fast**: explore uncertainties and many actions over time

2. **Integrated:** multiple functions and stakeholders that interact

Haasnoot et al. (2014) Env Mod & Soft. 10.1016/j.envsoft.2014.05.020

Three model requirements
for decision support of delta planning and management under uncertainty

3. **Dynamic**: interactions are not static - over time the environment and stakeholders interact. There is coevolution.



A **Fast**, **Integrated** and **Dynamic** model could be a **theory-driven metamodel** as developed for the Netherlands (Haasnoot et al. 2014, Fit for purpose. EMS)

However, in the Netherlands a lot of **data and models** are available and the **delta** is much **less dynamic** than in Bangladesh.

The practical challenges for ADM in Bangladesh are:

- **Data/model scarcity**: system knowledge, data availability and accessibility, …
- **Complex dynamics of the delta**: difficult hydrology, multi-actor co-evolution considering community based adaptation

Tools for Evaluation

- **Cost- benefit analysis** – *societal* costs and benefits.
- **Robustness analysis** – performance under different *scenarios and extreme events*.
- **Multi criteria analysis** – including *non-tangible* effects, by local and expert panels.
- **Implementation analysis** – institutional and socio-cultural *barriers* for implementation.

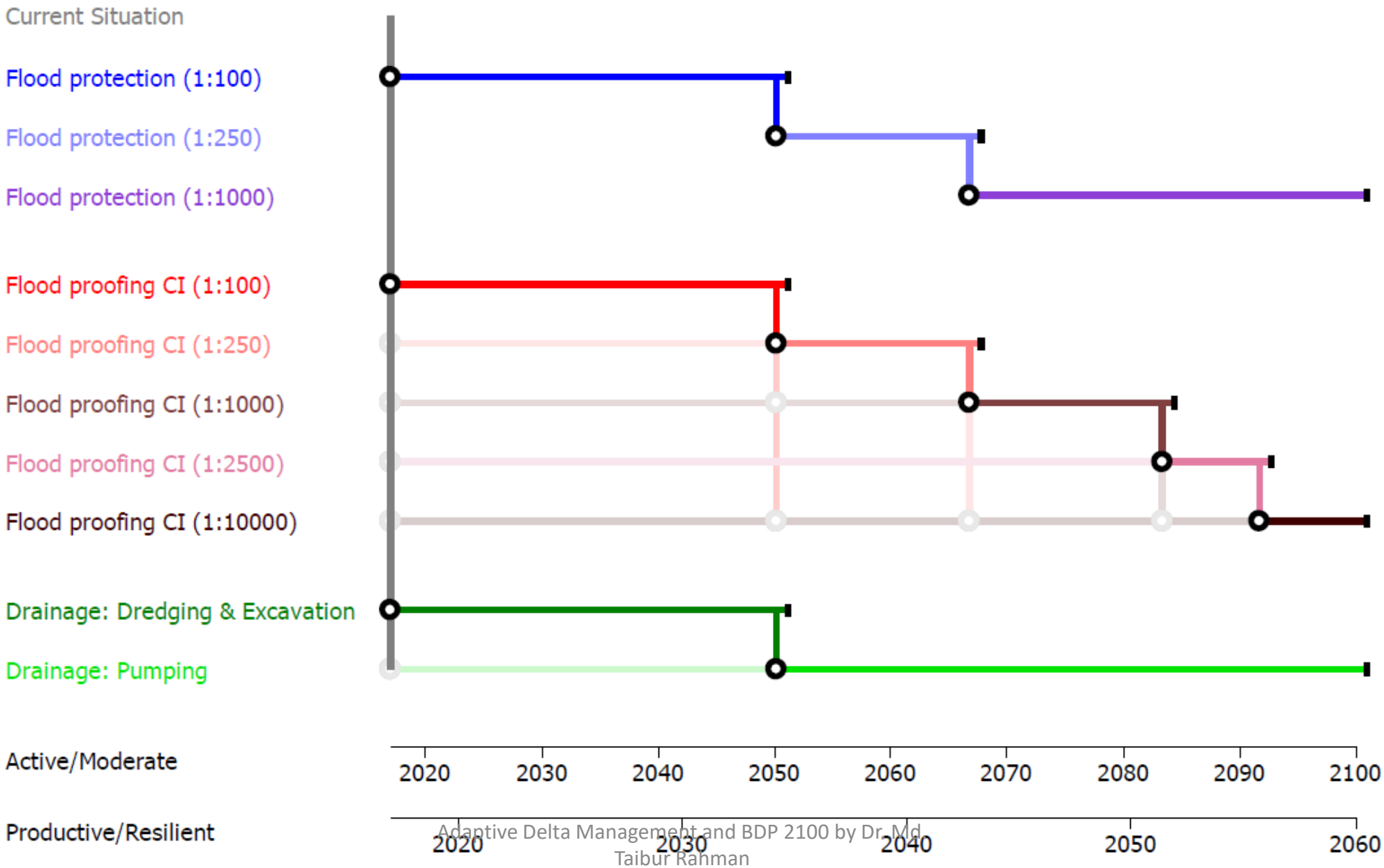
ADM Challenges

- **Normative** concept – difficult to operationalize
- **Analytical** concepts and methods
- Need for **appropriate models and tools** (broad and flexible but can represent deep uncertainty)
- Cultural and political embedding (**paradigm shift** in traditional planning and management practices)
- Operational linkages with **investment plans**

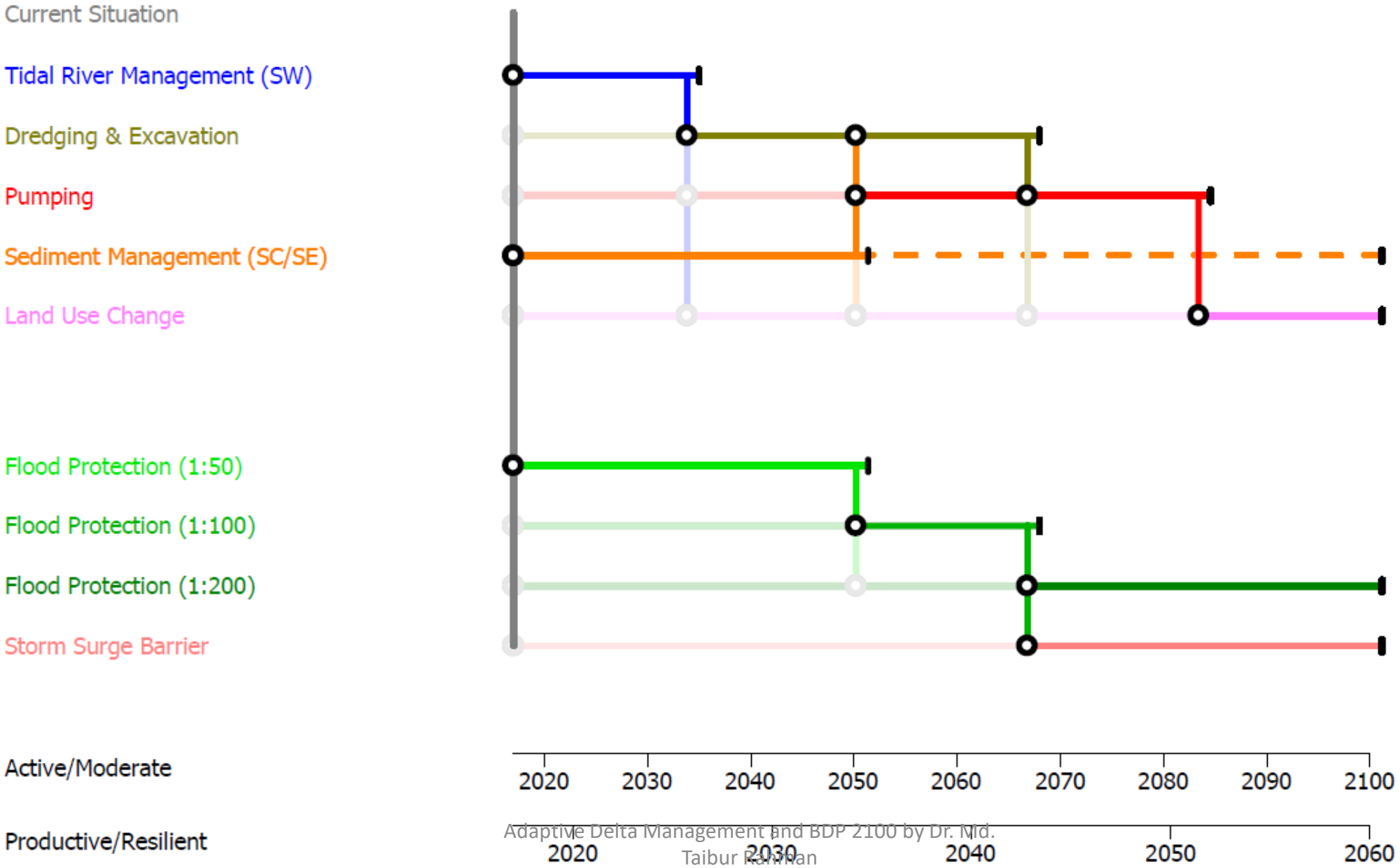
Adaptive Planning: Summary

- Essential to connect short-long term planning;
- Yet, environment shows increasing complexity, development speed, volatility
- Many future uncertainties;
- Future uncertainties become explicit by developing scenarios: possible futures
- Adaptive planning: planning framework in which robustness and flexibility are key components to cope with future uncertainties;
- Adaptation Tipping Points: point in time when policy objective is no longer met;
- Adaptation Pathway: Transition between different strategies to move ATPs to the future;
- Components: Thresholds, Strategies, Scenarios, ATPs and APs;
- Can be applied in many domains and scale levels.

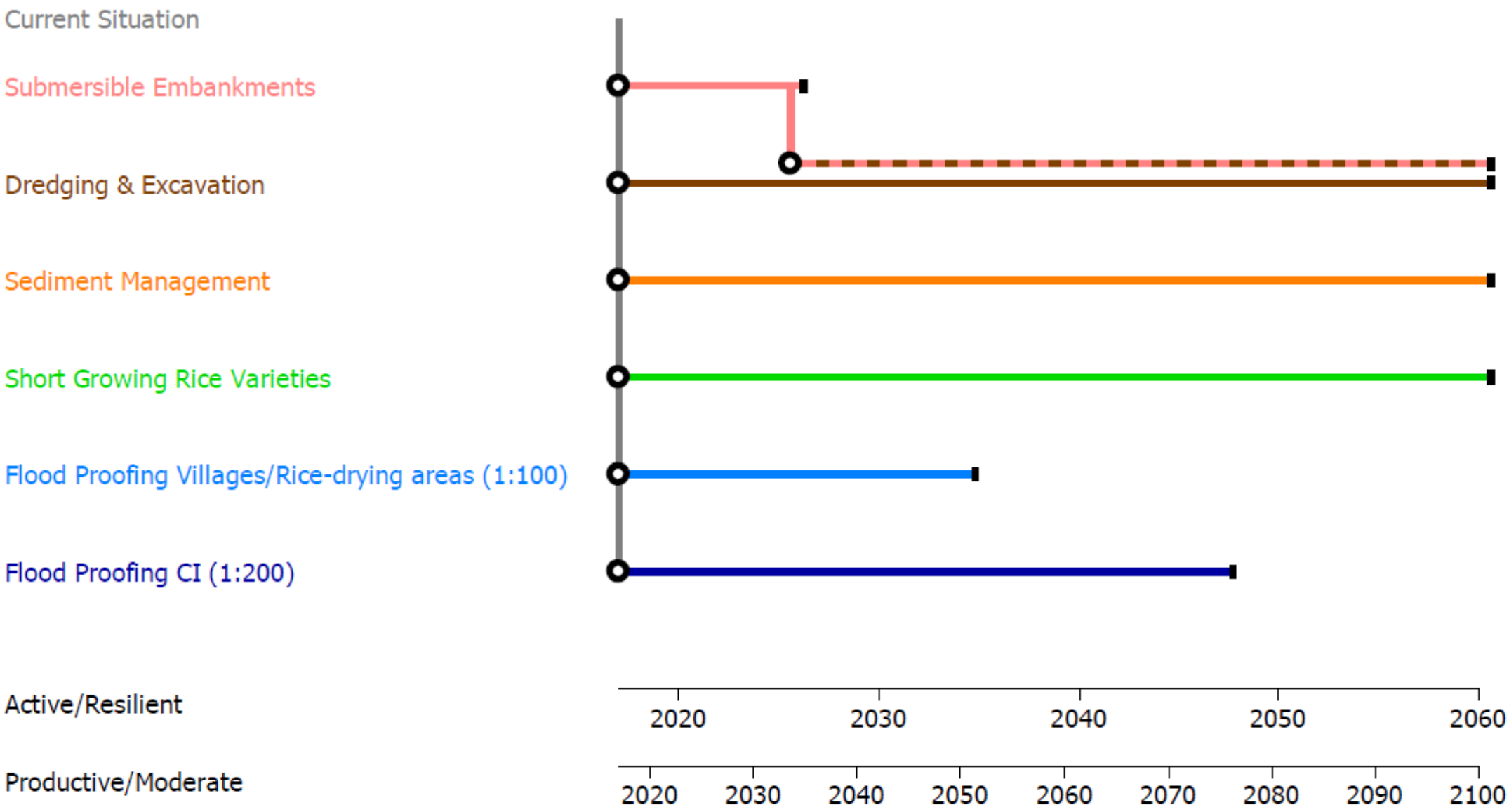
Examples from BDP 2100: Priority Economic Areas



Examples from BDP 2100: FCD Coastal areas



Examples from BDP 2100: FCD Haor areas



Next Session

- How to operationalize ADM through Metamodel:
  - Identifying new interventions through scenario analysis
  - Validating and prioritizing identified interventions/projects through cost benefit analysis/Multi Criteria Analysis
  - Identifying adaptive pathways with best combinations

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Thanks for Listening!