



Who is here today?

- Briefly introduce yourself. Name – organisation – role.
- What do you hope to get out of this 2-day workshop and/or what are you looking forward to?
- What makes you happy when you look back at the end of a working day?



Introducing the ICARUS adaptation implementation process

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Deltares

tecnal:a
MEMBER OF BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

RAMBOLL

RDS
RESEARCH DRIVEN SOLUTIONS

Maple Consulting

CEDR
Conférence Européenne
des Directeurs des Routes
Conference of European
Directors of Roads



Today's Training session

- Understand the process on how to implement climate change adaptation within NRAs
- Understand the approaches of building the case for adaptation
- Understand how CCA can be implemented in projects and/or via changes in asset management
- Understand relationships between decision-context, resilience assessments and implementing in projects or via guidelines.
- Understand the steering mechanism and key decision criteria used by the NRA
- Understand how climate events impact the KPIs

Today's Training session

- During the training you will get questions.
- For each question you can invest part of your budget (15 mEUR).
- Compare it to investing in climate change adaptation:
 - *Correct: you receive benefits of your investment: it will be doubled*
 - *Wrong: You lose your money, wrong investment. Costs outweigh the benefits*

A

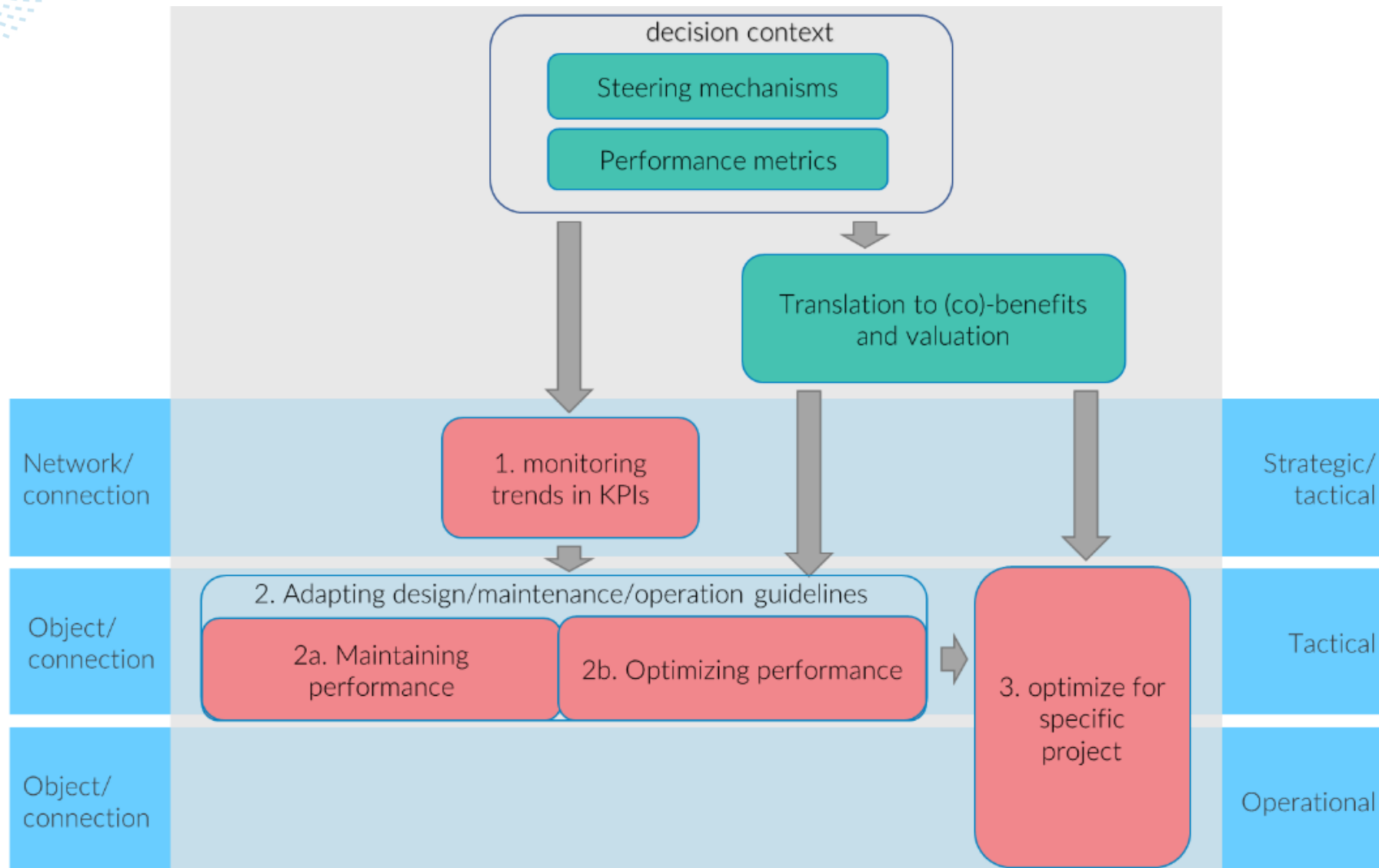
B

C

D



Building the case for adaptation: 3 approaches

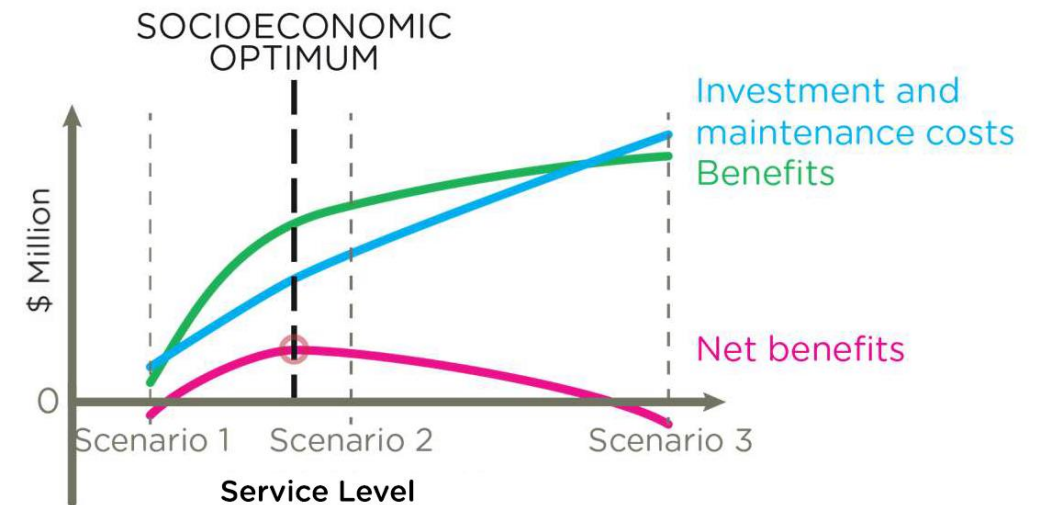


NRA decision making



Optimum service

Strive for service levels where costs and benefits are balanced



Source: Ramboll Denmark

NRA decision making



Optimum service

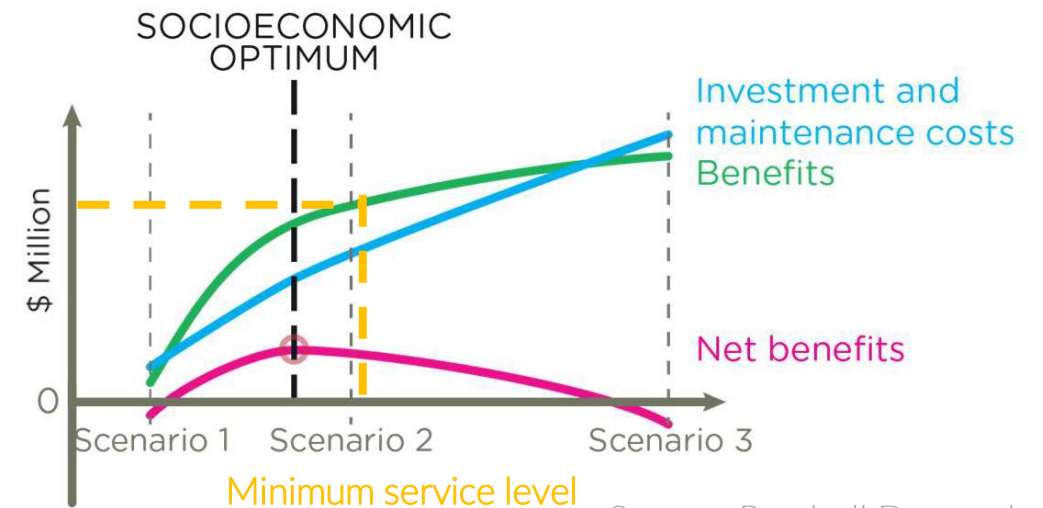
Strive for service levels where costs and benefits are balanced



Service driven

Ensuring a minimum service level

With corresponding benefits



Source: Ramboll Denmark

NRA decision making



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Service driven

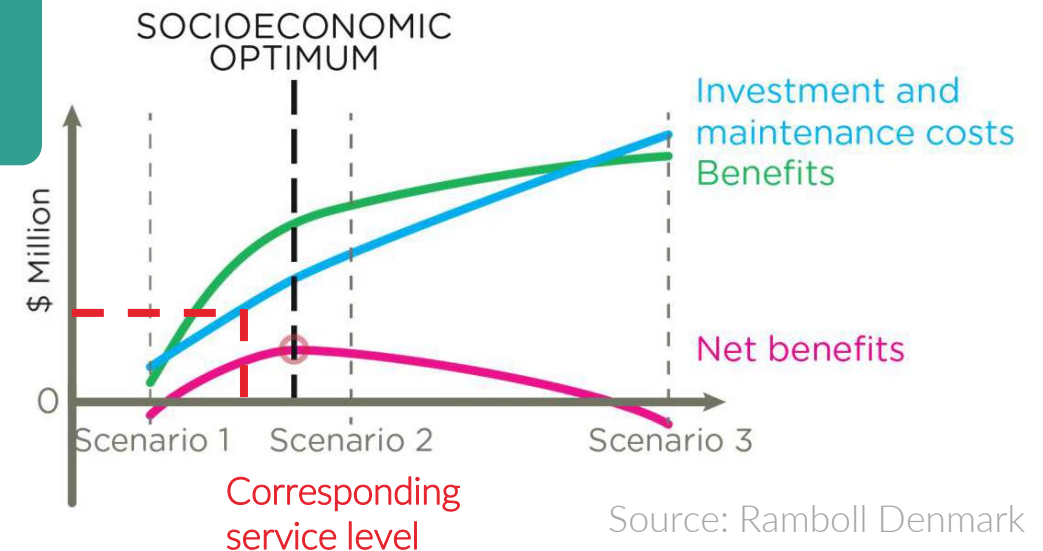
Ensuring a minimum service level



Budget driven

Maximum service with given budget

Maximum budget



NRA decision making



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Service driven

Ensuring a minimum service level



Budget driven

Maximum service with given budget

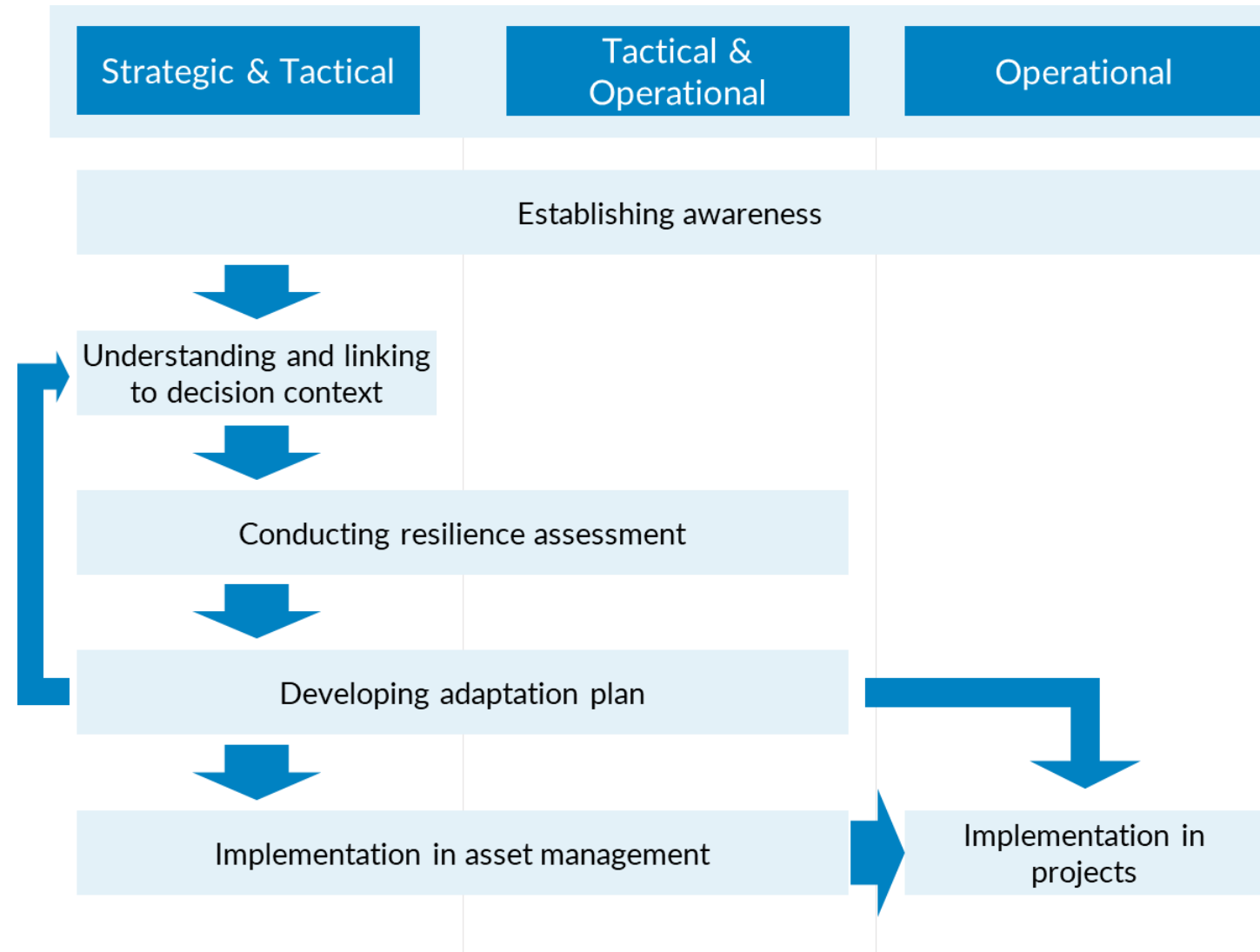


Policy driven

Biodiversity
Carbon
Climate change adaptation
Environmental partnerships
Equity and inclusion

Adaptation Implementation Process

- All management levels should be engaged
 - Continuous shifts
 - One person in charge recommended
- Link with the decision context is key
 - Resilience and adaptation assessments should be tailored
- Understand how climate change affects performance
- Implementation via two routes
 - Adapting asset management
 - Individual project level



Strategic & Tactical

Tactical & Operational

Operational

Engagement at the NRA: due to climate change the road network is facing more disruptions

Resources for resilience assessment

Connect to long term planning at NRA

Awareness

yes

no

Decision context

Understand decision context: which criteria are used for decision making?

AND

Clear how climate events affect KPI's?

no

yes

OR

Method 1 *

Find correlations between climate events on KPI performance

Identification of thresholds: when is resilience deemed acceptable?

Resilience acceptable?

no

yes

The roads are resilient

Resilience assessment

Translate criteria used for decision making to criteria expressing (co-) benefits

Ensure data availability and conduct climate resilience assessment

Expert input

Strategic & Tactical

Tactical & Operational

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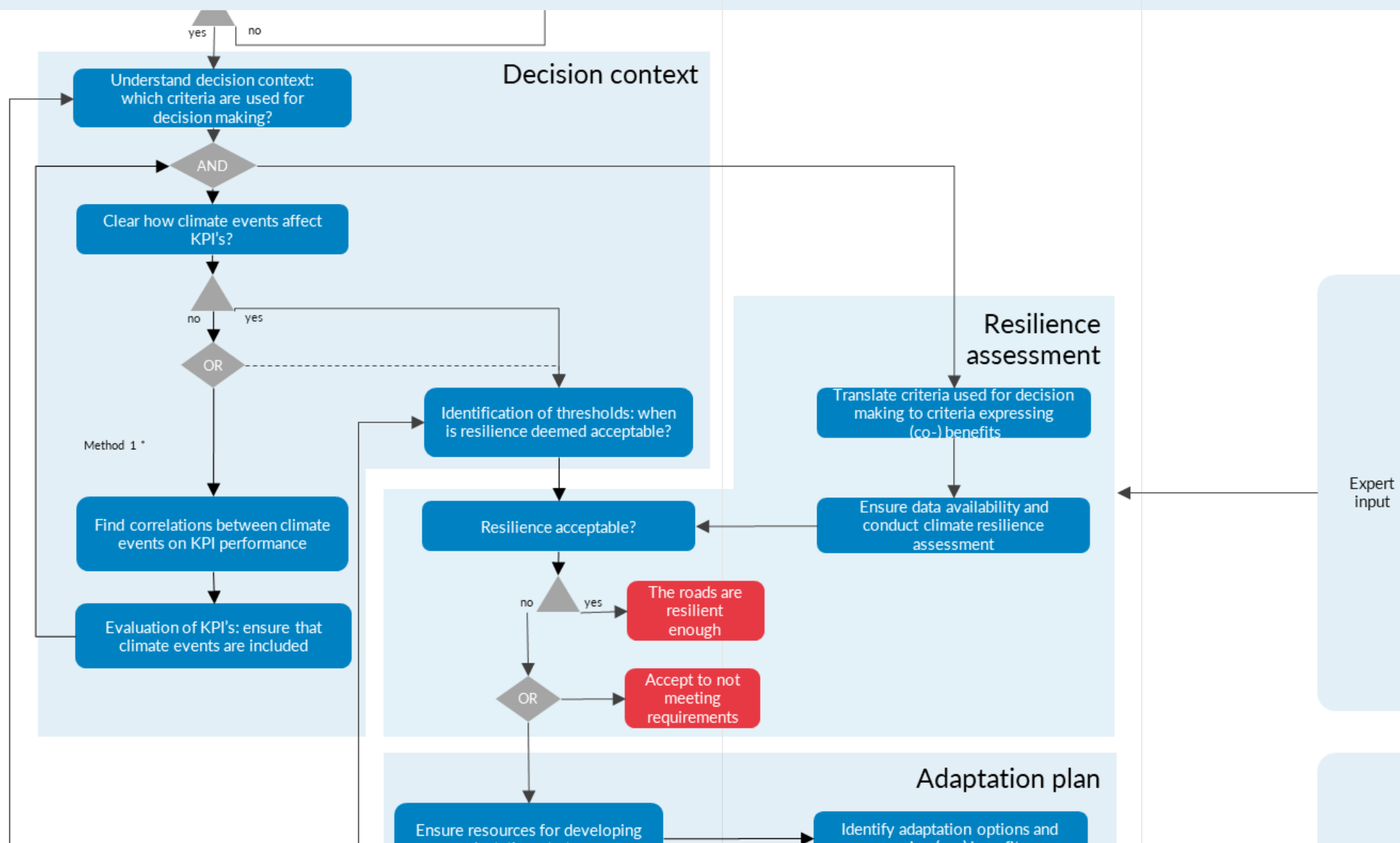
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Tactical & Operational

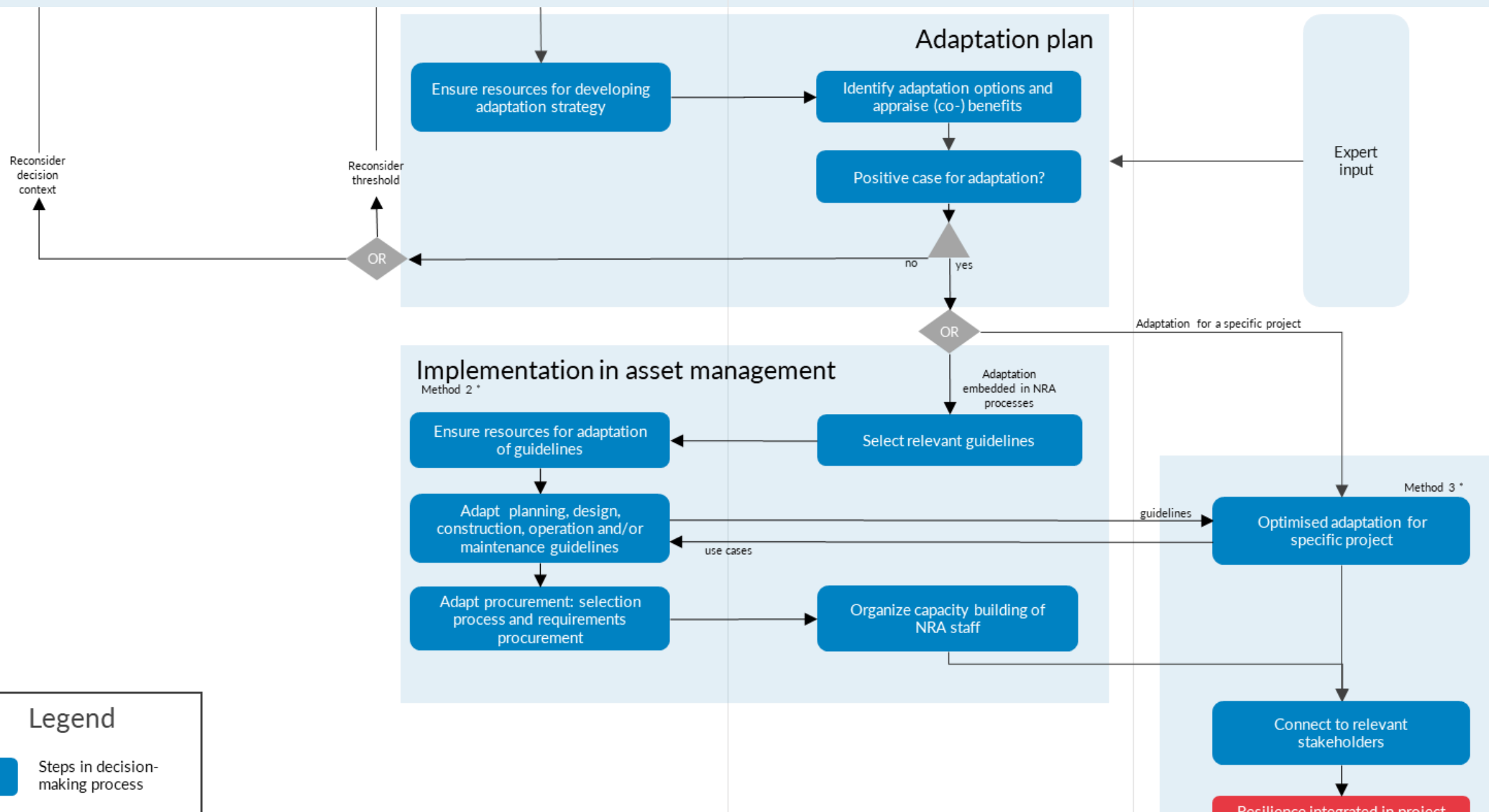
Operational



Strategic & Tactical

Tactical & Operational

Operational



What is the recommended order for implementing climate change adaptation?

- a) Decision context – Resilience assessment – Awareness – Adaptation plan – Implementation
- b) Awareness – Decision context – Resilience assessment – Adaptation plan – Implementation
- c) Awareness – Resilience assessment – Decision context – Adaptation plan – Implementation
- d) Resilience assessment – Awareness – Decision context – Adaptation plan – Implementation



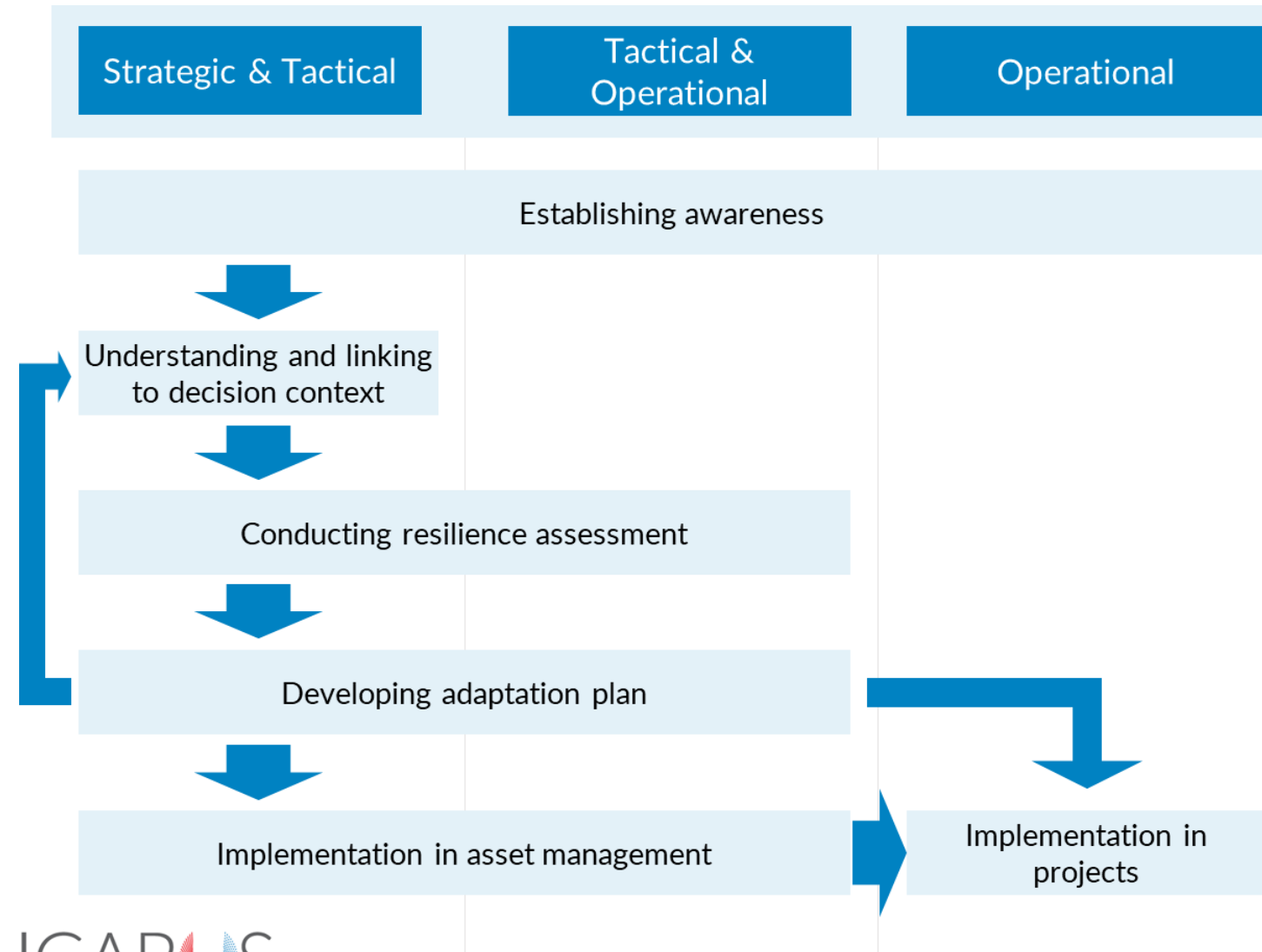
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d) Resilience assessment – Awareness – Decision context – Adaptation plan – Implementation



Strategic & Tactical

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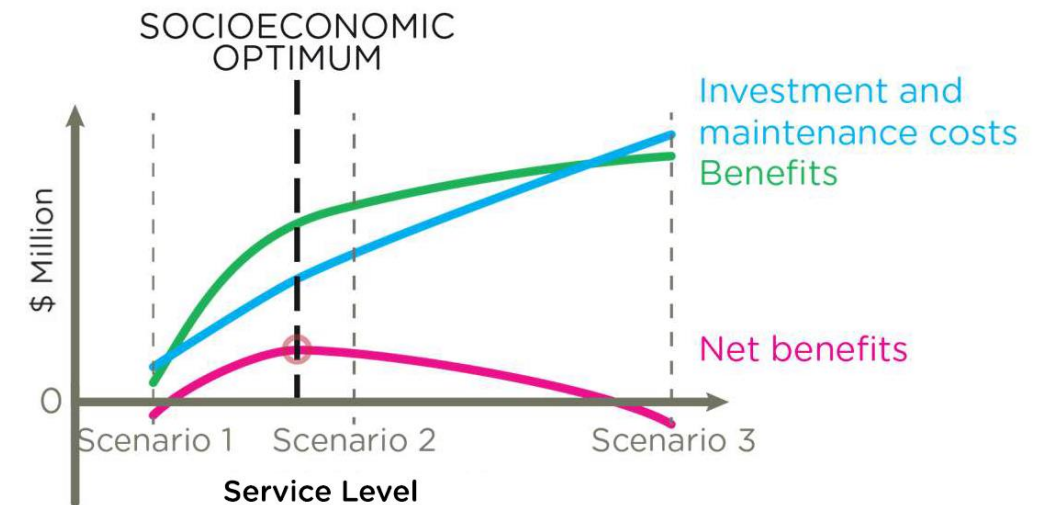
What steering mechanism at an NRA strives for service levels where costs and benefits are balanced?

- a) Service-driven
- b) Budget-driven
- c) Optimum-service
- d) Policy-driven



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Why is it crucial to understand how climate events affect the KPIs of the NRA?

- a) This is needed to indicate the benefits of adaptation
- b) Otherwise, the KPIs cannot be determined
- c) This is needed to establish thresholds for KPIs
- d) You need this to understand potential co-benefits

There are multiple correct answers.
Benefits are rewarded when both are
correct!

1 correct means +25%
All correct means +100%





Why is it crucial to understand how climate events affect the KPIs of the NRA?

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Key Performance Indicator	Metric	Possible unit
Availability, Or sometimes referred to as fast and reliable journeys	Delay	Vehicle Loss hours; sometimes categorised by unplanned and planned closures An average delay per vehicle distance
	Network availability	% of time and length in a year that a road or part of a road is closed; sometimes categorized by unplanned and planned closures Average speed
	Travel time	Average travel time to relevant points of interest Journey time reliability
	Social inclusion	Average travel time to basic everyday activities
	Incident clearance	Average time needed to re-open a (part of) the road after an incident happened
Safety	Killed or seriously injured	Number of casualties Number of injuries
	Incidents	Number of collisions
	infrastructure safety,	% distance driven over roads with a safety rating above an agreed threshold % road network length of roads with a safety rating above an agreed threshold
	emergency response	Average time needed for first responders to be at the location of an incident
	in time preparedness for extreme weather	percentage of time and length for which the road was prepared in time for the extreme weather

Benefit	Description	Quantification	Valuation	Indicator for magnitude of impact
Availability				
Travel time, leisure	Value of travel time for persons in their leisure time	Minutes of increase/decrease in travel time	Travel loss hours / value of travel time	Number of users of network and level of change
Travel time business	Value of travel time for businesses	Minutes of increase/decrease in travel time	Travel loss hours / value of travel time	Number of users of network and level of change
Reliability of travel time	The value of reliability of predicted travel time for users	Reliability of predicted travel time measured as e.g., percentage of average travel time of a road network	Value of reliability	Number of users of network and level of change
Availability of network	The value of being able to always access public services and critical infrastructure	-		
Availability: Connectivity and social inclusion	Connectivity and travel time to basic everyday activities	-	-	-
Durability		-	-	-
Replacement	Costs associated with wages, materials etc.	Hours worked, units of material, fuel machine hours etc	Wages, costs of materials, fuels, machinery, etc.	-
Upgrading	Costs associated with wages, materials etc.	Hours worked, units of material, fuel machine hours etc	Wages, costs of materials, fuels, machinery, etc.	-
Safety	Value of injuries/fatalities	Increase/decrease in the risk of injuries/fatalities	Value of statistical life	Number of users of the network and level of change
Health effects		-	-	-
Air pollution	Improved air quality from increased coverage of plants	Increase/decrease in the level of particle matter	Value of statistical life, quality adjusted life year	Number of affected individuals and level of change
Noise	Lowered noise levels from noise barriers of coverage from plants	Increase/decrease in the level of decibel	Value of statistical life, quality adjusted life year	Number of affected individuals and level of change
Job creation	Job creation from investment in climate adaptation/resilience	-	-	-
Ecosystem services	Value assigned to areas due to their aesthetics, opportunities for walking, socializing etc.	Increase/decrease in level of greening or ha of green areas	Stated/revealed preference methods	Number of users of the area, and level of change in provision of environmental good
Water quality	Value assigned to good quality of water, e.g., stemming from contaminants from run-off	Increase/decrease in quality status, e.g., ecological status based on threshold values		Number of affected individuals and level of change.
Climate				
Embodied carbon	Emissions arising from construction materials, transport, and installation	Increase/decrease in the number of embodied carbon emissions	Social cost of carbon	Level of change in the number of embodied carbon emissions

What options do you have to determine the thresholds for KPIs

- a) Organise a workshop with experts from different disciplines
- b) Analyse past climatic events to identify relations between climate effects on performance of road in terms of KPIs
- c) Perform a resilience assessment
- d) Link the resilience assessment to co-benefits

There are multiple correct answers.
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All correct means +100%





What options do you have to determine the thresholds for KPIs

- a) Organise a workshop with experts from different disciplines
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Strategic & Tactical

Tactical & Operational

Operational

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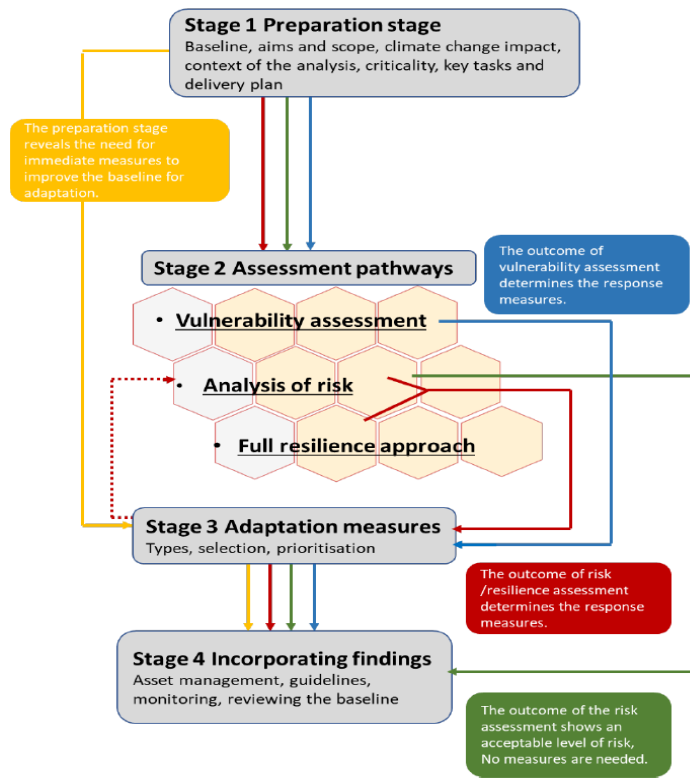
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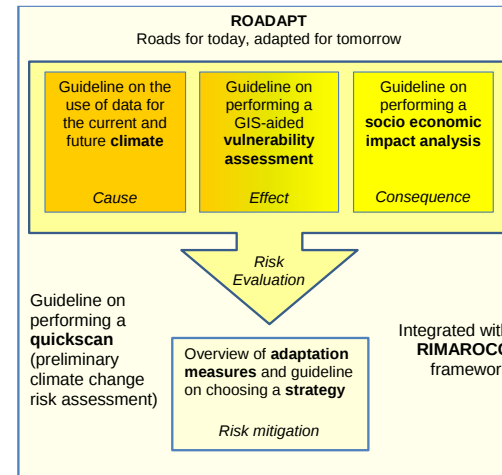
Ensure data availability and conduct climate resilience assessment

Expert input

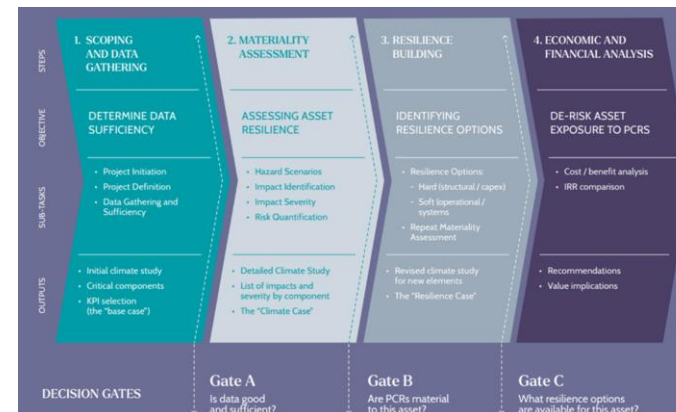
Climate change adaptation frameworks



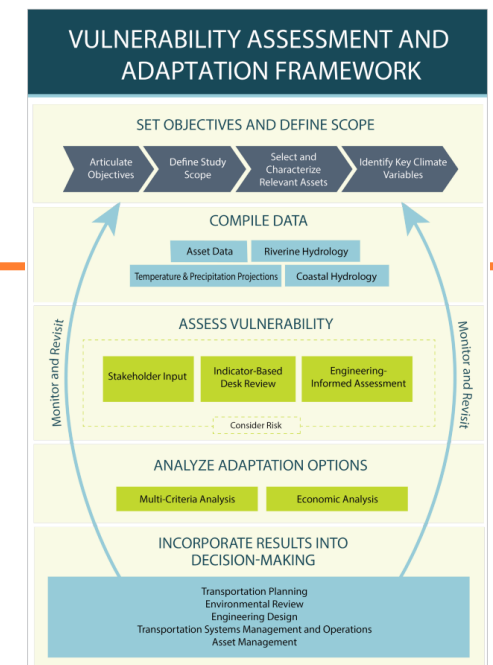
PIARC, 2023



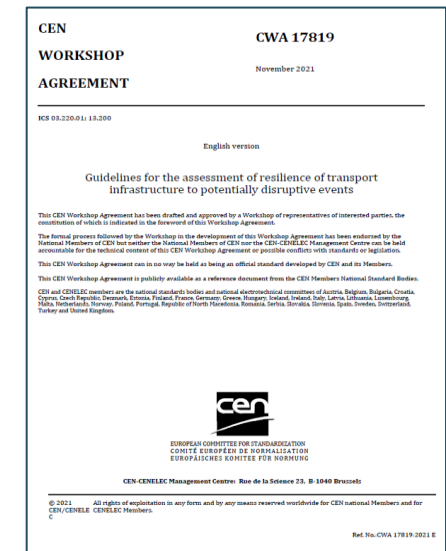
ROADAPT, CEDR, 2015



PCRAM, CCRI, 2021



FHWA, 2020



CEN, 2021



In this example: is the resilience acceptable ?

An NRA has a decision criterium where the availability of the road should $> 95\%$ in any circumstance. The resilience assessment shows that climate events result in 8500 Vehicle Loss Hours per years.

- a) Yes
- b) No
- c) You don't know



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KPI: Availability $> 95\%$
Resilience assessment:
expressed in Vehicle Loss
Hours

In the same example: What should the NRA do next?

An NRA has a decision criterium where the availability of the road should $> 95\%$ in any circumstance. The resilience assessment shows that climate events result in 8500 Vehicle Loss Hours per years.

- a) Determine the steering mechanism of the NRA
- b) Redo the resilience assessment with metrics that can be compared to the KPIs
- c) Match the vehicle loss hours to a percentage of availability
- d) Identify adaptation options

There are multiple correct answers. Full benefits are rewarded when both are correct!

1 correct means +25%
All correct means +100%





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- d) Identify adaptation options



In this example: is the resilience acceptable?

An NRA has a decision criterium where the availability of the road should $> 95\%$ in any circumstance. The resilience assessment shows that climate events result in 8500 Vehicle Loss Hours per years. 8500 VLH corresponds to an availability of 92%

- a) Yes
- b) No
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What to do when the resilience is not acceptable

An NRA has a decision criterium where the availability of the road should $> 95\%$ in any circumstance. The resilience assessment shows that climate events result in 8500 Vehicle Loss Hours per years. 8500 VLH corresponds to an availability of 92%

- a) Accept to do nothing or reconsider the decision context
- b) Accept to do nothing or start working on adaptation
- c) Start working on adaptation or reconsider the decision context





What to do when the resilience is not acceptable

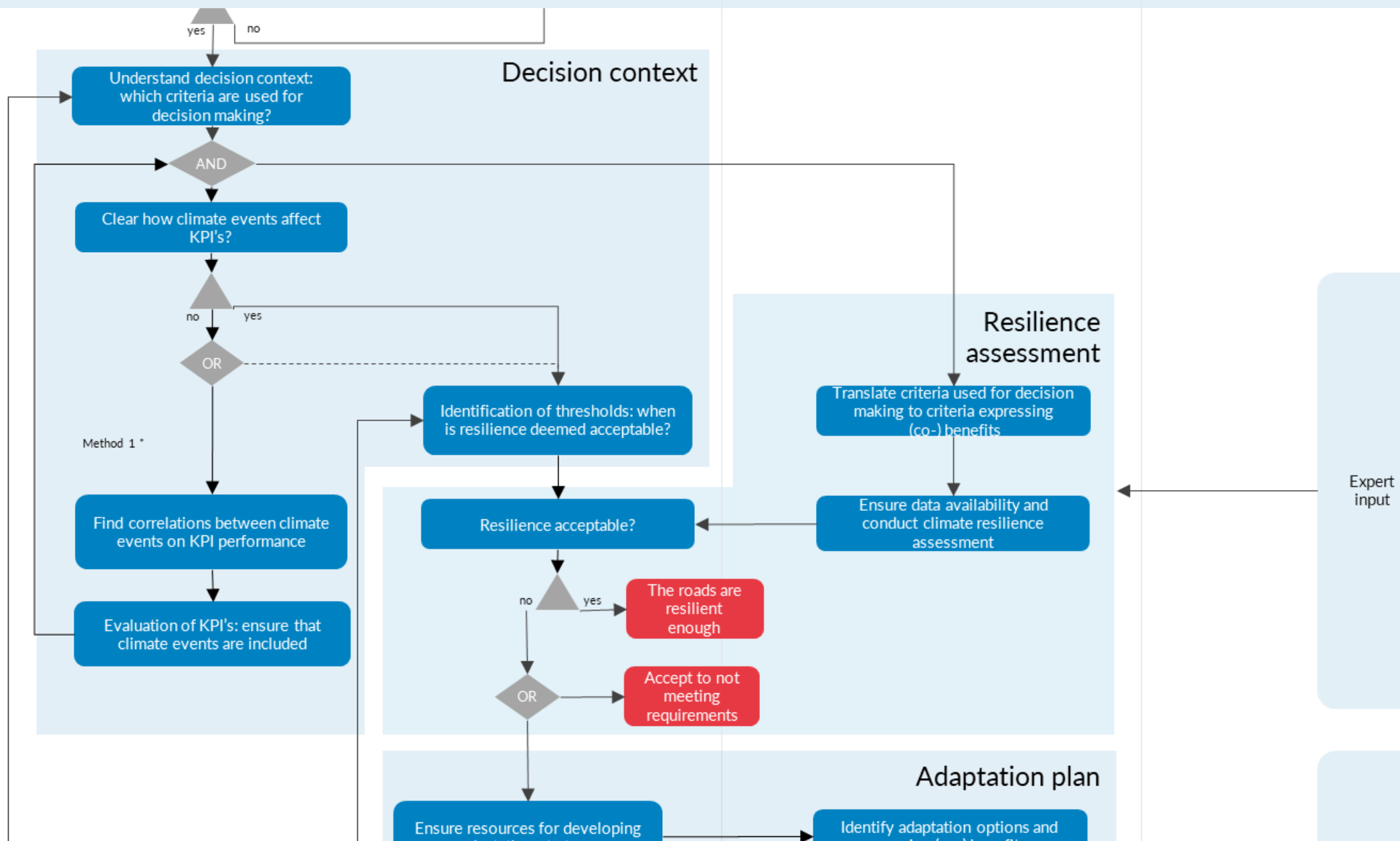
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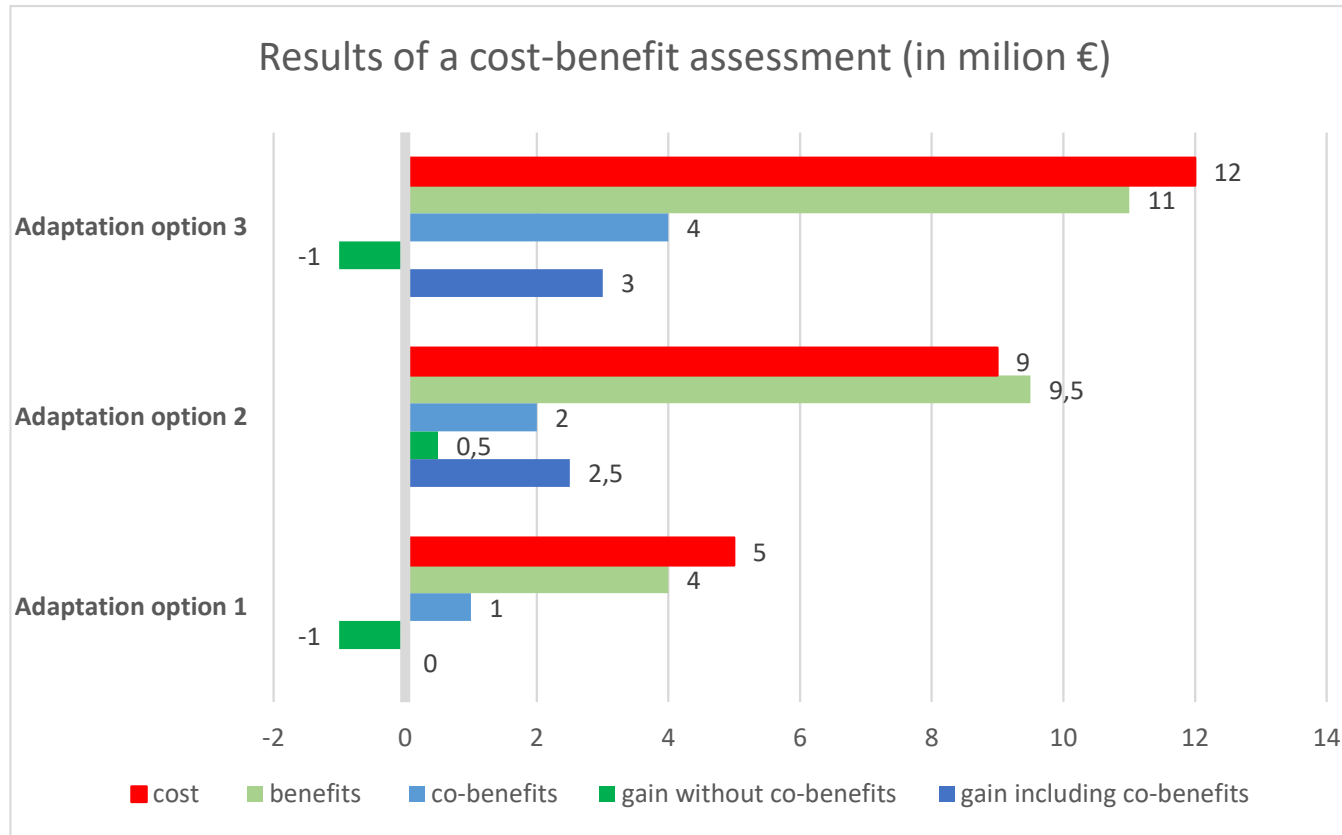
Strategic & Tactical

Tactical & Operational

Operational



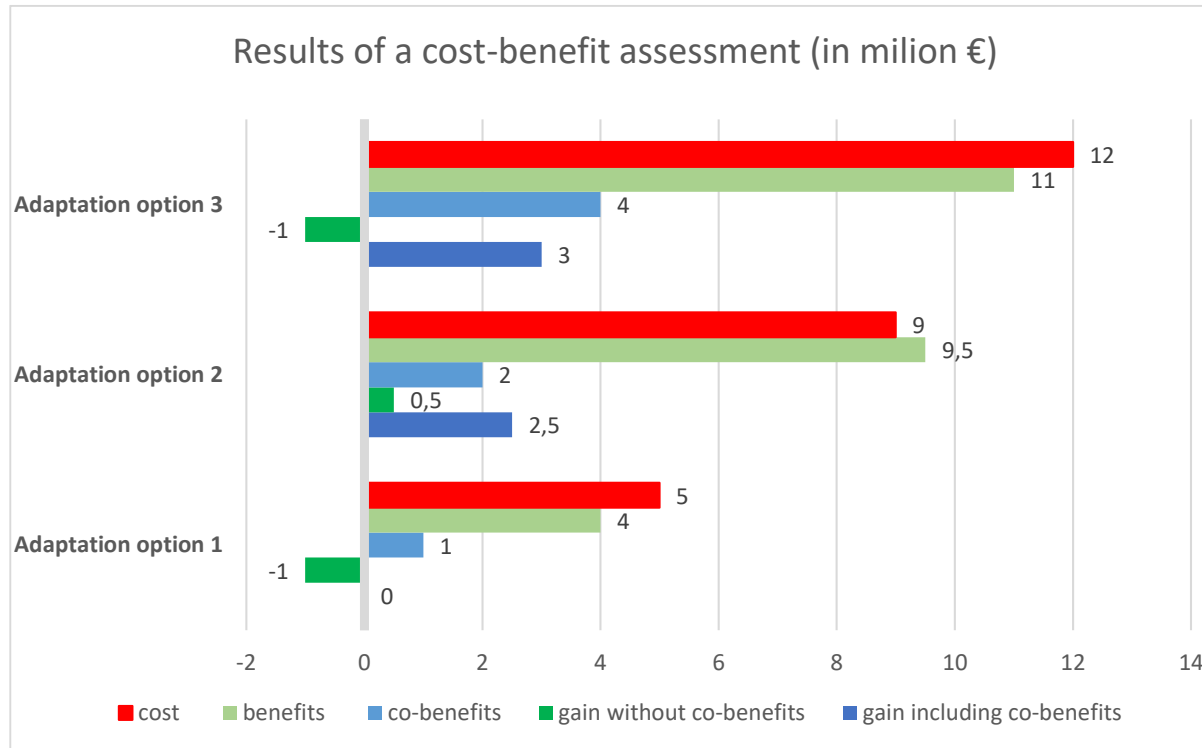
If a NRA has tries to achieve optimum service. Which option would they most likely choose?



- a) Adaptation option 3
- b) Adaptation option 2
- c) Adaptation option 1
- d) None of the options



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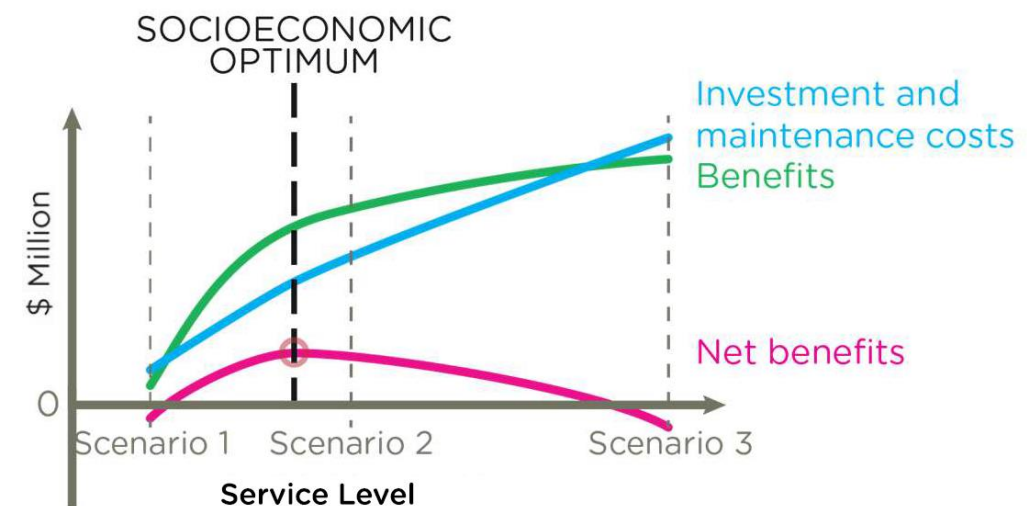


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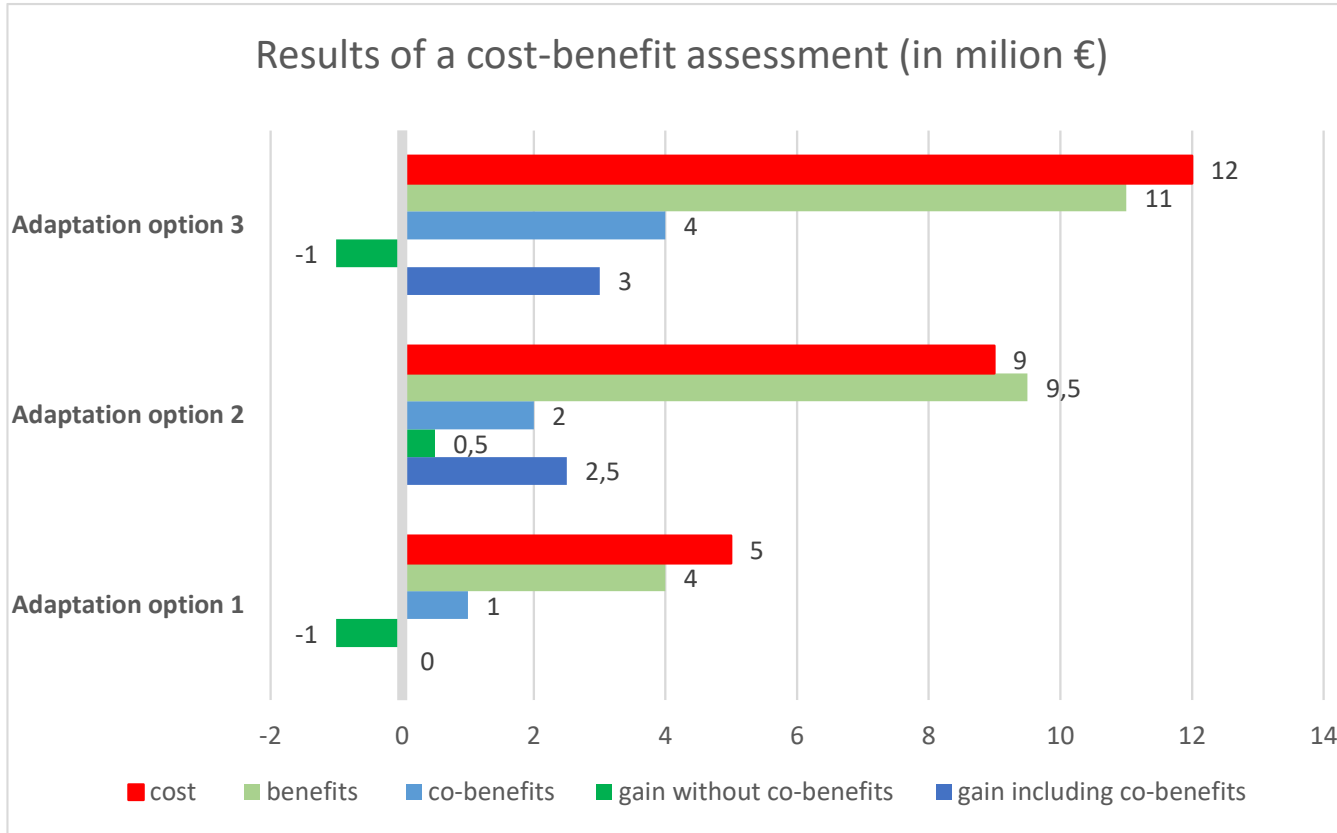
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Optimum service

Strive for service levels where costs and benefits are balanced

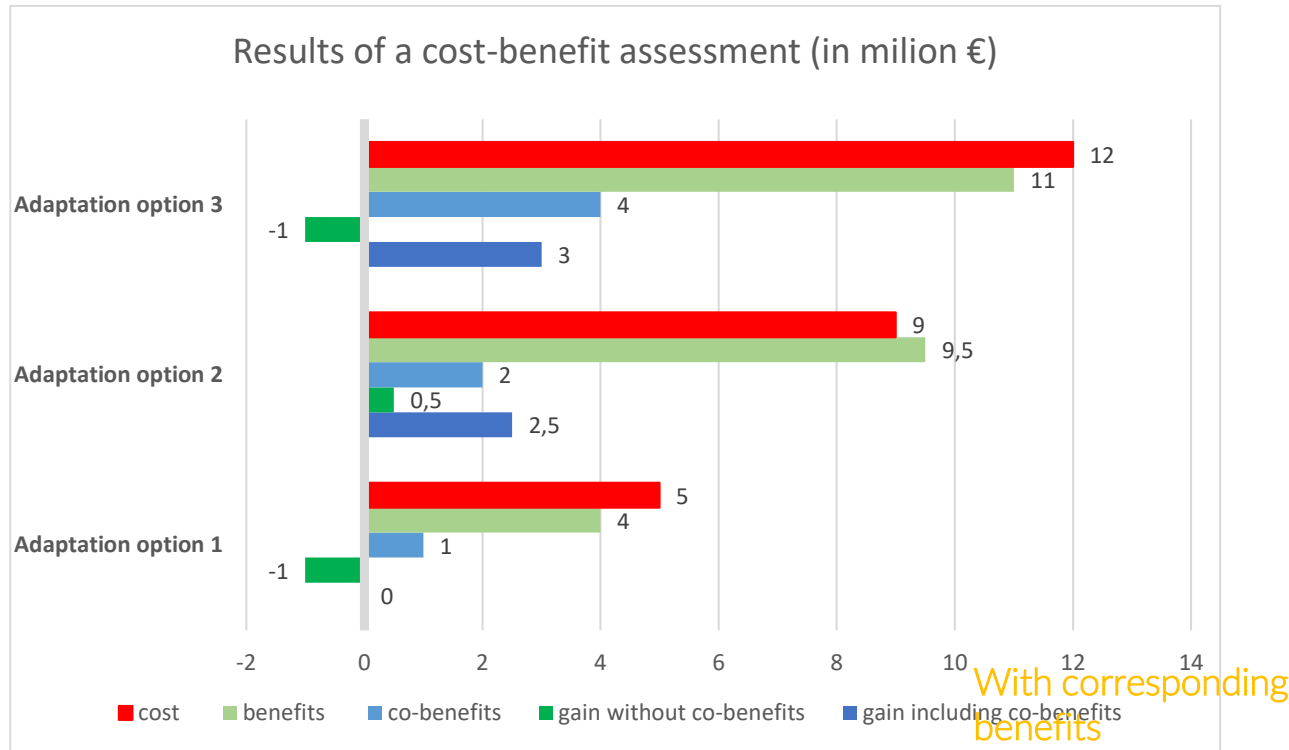
If a NRA would have only 8 M\$ to spend



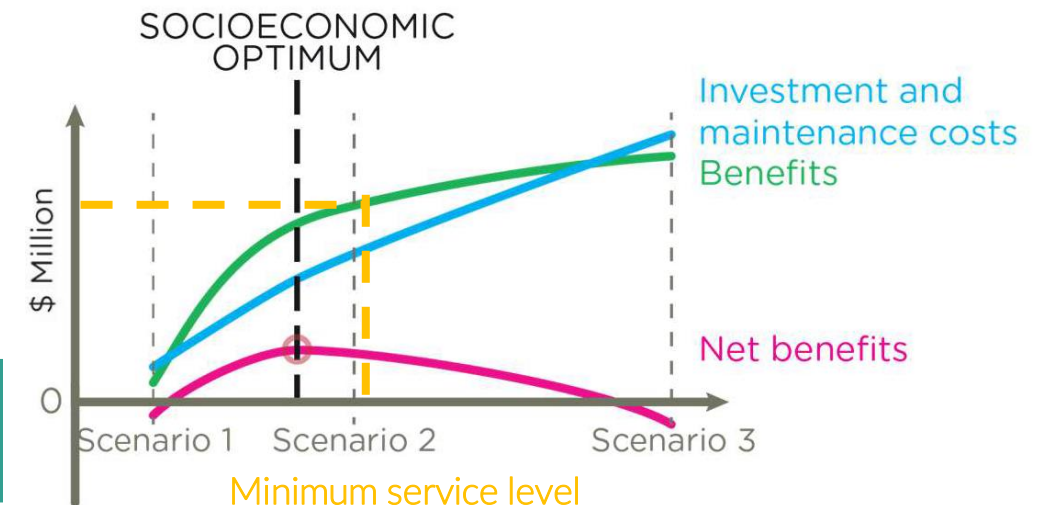
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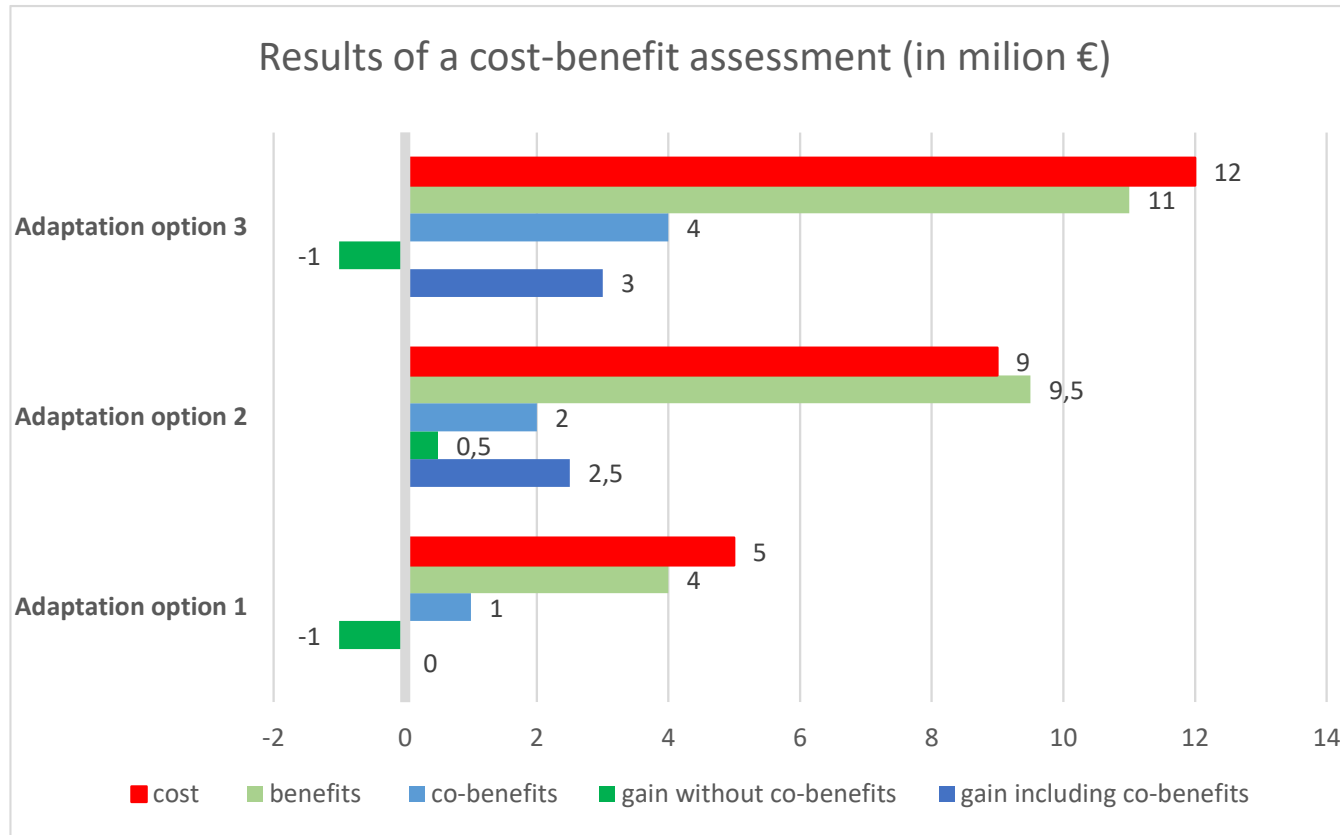
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Budget driven

Maximum service with given budget

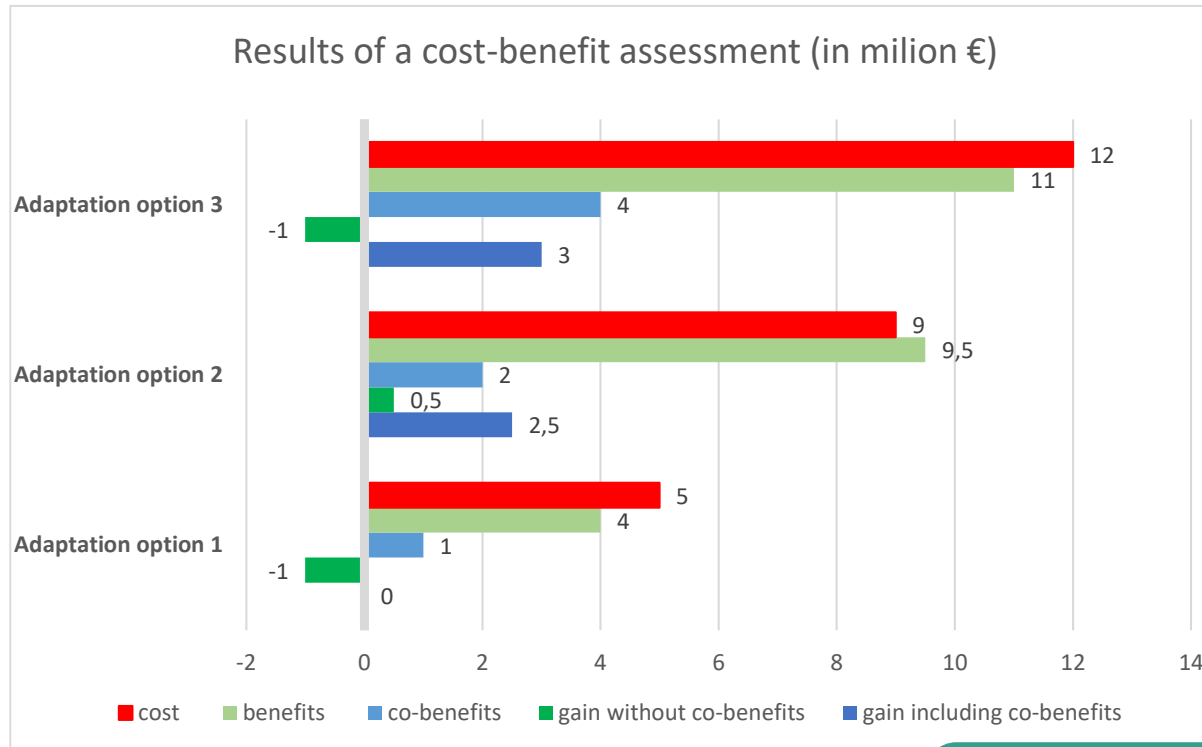
Likewise for a NRA with a more policy-driven approach



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Policy driven

Biodiversity

Carbon

Climate change adaptation

Environmental partnerships

Equity and inclusion

What can the NRA do?

An NRA has a decision criterium where the availability of the road should $> 95\%$ in any circumstance. The resilience assessment shows that climate events will result in 8500 Vehicle Loss Hours per years. 8500 VLH corresponds to an availability of 92%

When adaptation options are identified it seems that the benefits don't outweigh the costs of the adaptation option.

- a) Ensure to understand the decision context, and identify and appraise co-benefits, to check whether the total sum of benefits and co-benefits may be higher than the cost
- b) Decide to do nothing and accept that the desired level of resilience can not be achieved
- c) Still implement the adaptation option (although benefits are lower than cost), as it is a requirement to achieve the required resilience level
- d) Make sure that awareness and engagement related to climate change adaptation is high enough

There are multiple correct answers. Full benefits are rewarded when both are correct!
1 correct means +25%





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What could be a possible barrier for implementing CCA?

- a) No understanding of the correlation between climate events and performance of the road network in terms of KPIs
- b) No clear lead of the entire climate change adaptation implementation process
- c) No involvement of all levels of the organization: strategic, tactical and operational
- d) No resources for analyzing and updating the asset management process
- e) Improper adaptation of the procurement of projects

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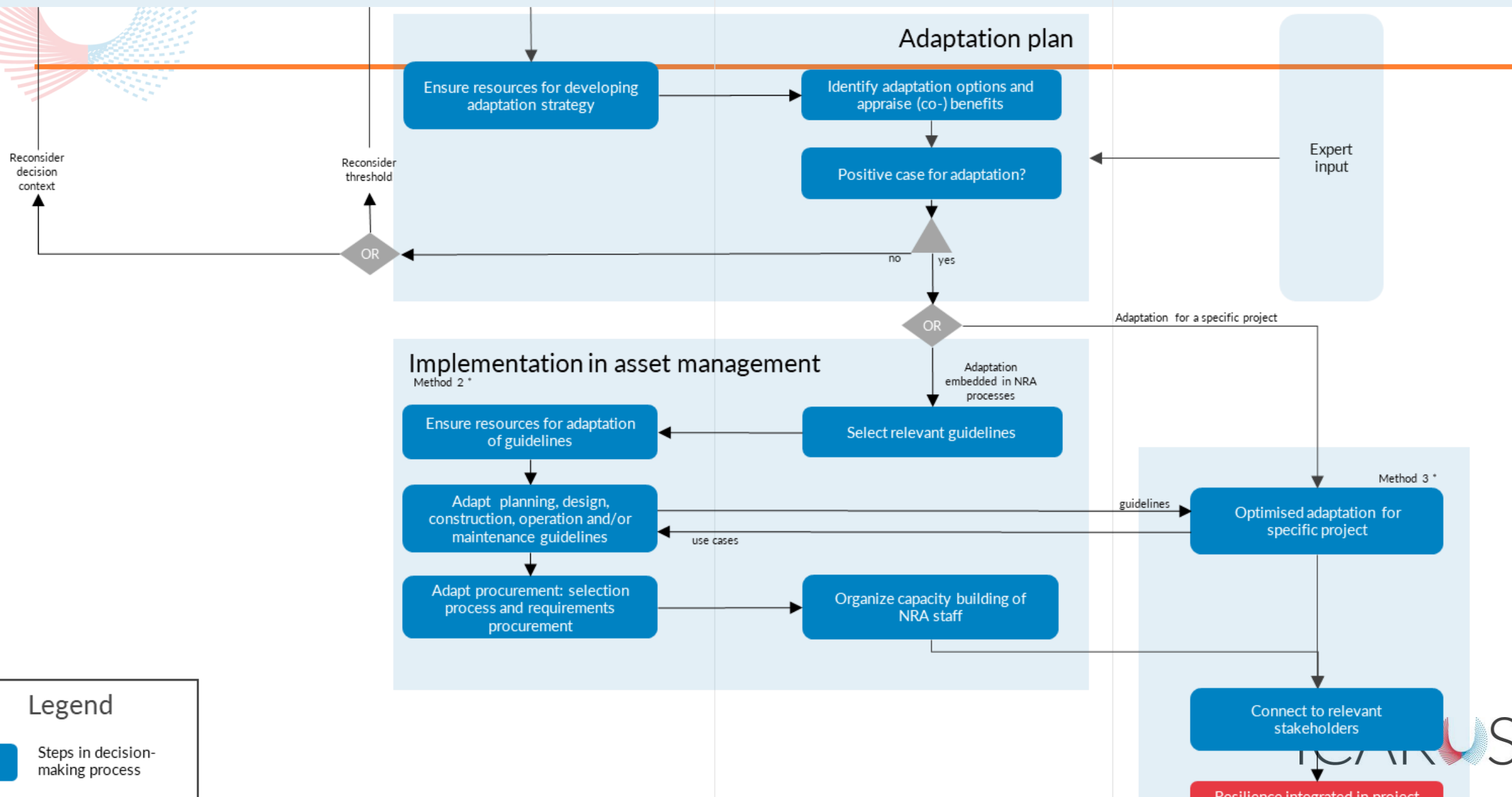
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Strategic & Tactical

Tactical & Operational

Operational





Working with the implementation process

- Make smaller subgroups (3-4 people per group)
- Think for your situation about a concrete question/case ~ 1 min.
- The case study can be something you are currently working on and cover any part of the implementation process:
 - A specific project to implement climate change adaptation
 - At asset, connection or network scale
 - A stresstest for the highway network
 - A process to start implementing CCA in guidelines
 - Understanding of how your KPIs can be translated to criteria used in the resilience assessment.
- Discuss on whether to work on specific projects or guidelines and how this would work for your organisation
- Share in two sentences with the group. Decide together which one to discuss for ~20 min



Reflection
