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Cities+1m

Urban Development Solutions for Sea-Level Rise

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Introduction

No rational individual is questioning global warming anymore. Coastal cities are already impacted due to effects like sea-level rise (SLR) and intensification of flooding events. Thereby, a precise prediction of the future impacts' extent is currently still impossible. Ice sheet melting processes due to increasing temperatures, for example, are still poorly understood. Looking at history with a comparable amount of greenhouse gases tells us that the sea can rise 15-25m in the next hundreds of years (Jones, 2017).

Humankind's potential change of behaviour won't have any recovery effects in the next decades (Samset et al., 2020). Therefore predictions of up to 1.40m or more SLR until 2100 (Oppenheimer et al., 2019) should be taken very seriously, and estimations are still developing upwards. Due to this insecurity, this book is not focusing on a particular year but on a specific height of +1m (1m above current highest astronomical tide) which derives from SLR and other potential flooding events that can occur because of stormwater run-off, rising groundwater table or river overflow.

+1m will change the coastal environment and impact elements of coastal cities. Infrastructure, buildings, industry, and communities will have to be protected, or cities have to retreat. Both concepts, protection, and retreat, are often unfavourable. The former needs elements like dykes which are costly and temporarily, the latter abandons existing urban assets and communities. Two more concepts are perhaps sometimes more promising: Implemented examples demonstrate that coastal cities can also advance onto the water or, like the HafenCity in Hamburg, they can accommodate. The intention of this publication is to consider all concepts.

Example of HafenCity Hamburg demonstrating the accommodation concept and protecting the city from 8m storm floods.

The guideline

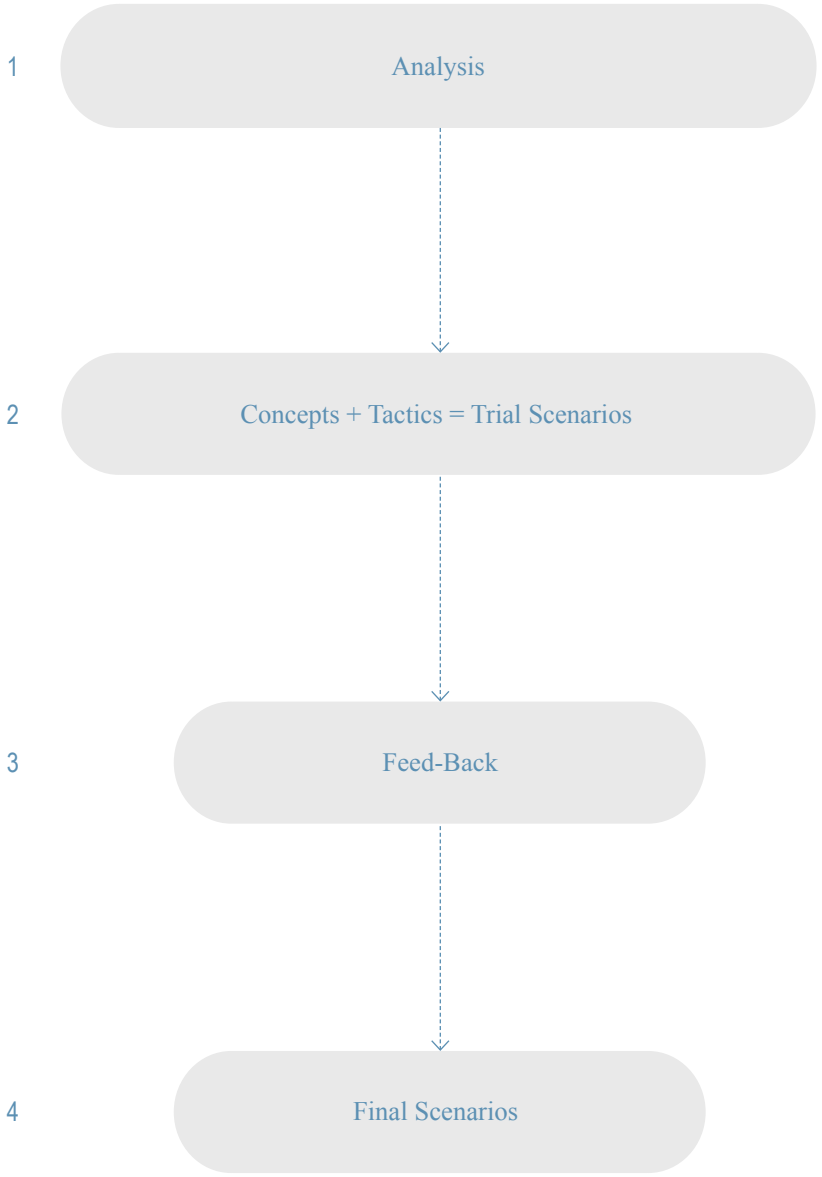
Protect, Retreat, Advance, Accommodate: Which concepts should be applied to transform coastal cities to +1m and who will make the decisions?

There are no simple answers to these questions, neither regarding the only right concept nor the one decider. Therefore we developed a guideline that considers flexibility of concepts and decision making with the aim of creating multiple scenarios.

This guideline should be tested in various contexts of coastal cities, promoting sustainable planning guidance like inclusive and participative processes; the implementation of sustainable urban design scenarios; the promotion of knowledge exchange and cooperation between government sectors, the business community, and private citizens; the stimulation of education, information, and research in urban design for sustainability and sustainable urban development (Chrysoulakis et al., 2015).

This guideline could have the potential to stimulate also the required integration of government and community into research and education in fields like urban design and planning, engineering, infrastructure, ecology, economy, and others.

Risk-Management is thereby not the primary objective. On the opposite, we want to demonstrate that the transformation of coastal cities can create more opportunities than threats. Alternatively to multi-Million Dollar investments for coastal protection, this guideline will consider more sustainable urban, green, and blue development options.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The methodology

The methodology follows a particular procedure based on observational and data-driven analysis, the creation, critical review, and improvements of experimental concepts and their simulations.

To achieve the best opportunities, this methodology considers the specific conditions of the examined site, including its current and future water-hazards, as well as the parallel development of state of the art scenarios on-site, the feed-back from stakeholders, and the final visualisation and description of the chosen “finalists”.

1. This results in a logical step-by-step approach that starts with the site analysis by focusing on the collection of relevant data regarding the site and potential flooding areas which allows afterwards an evaluation of risks and opportunities.

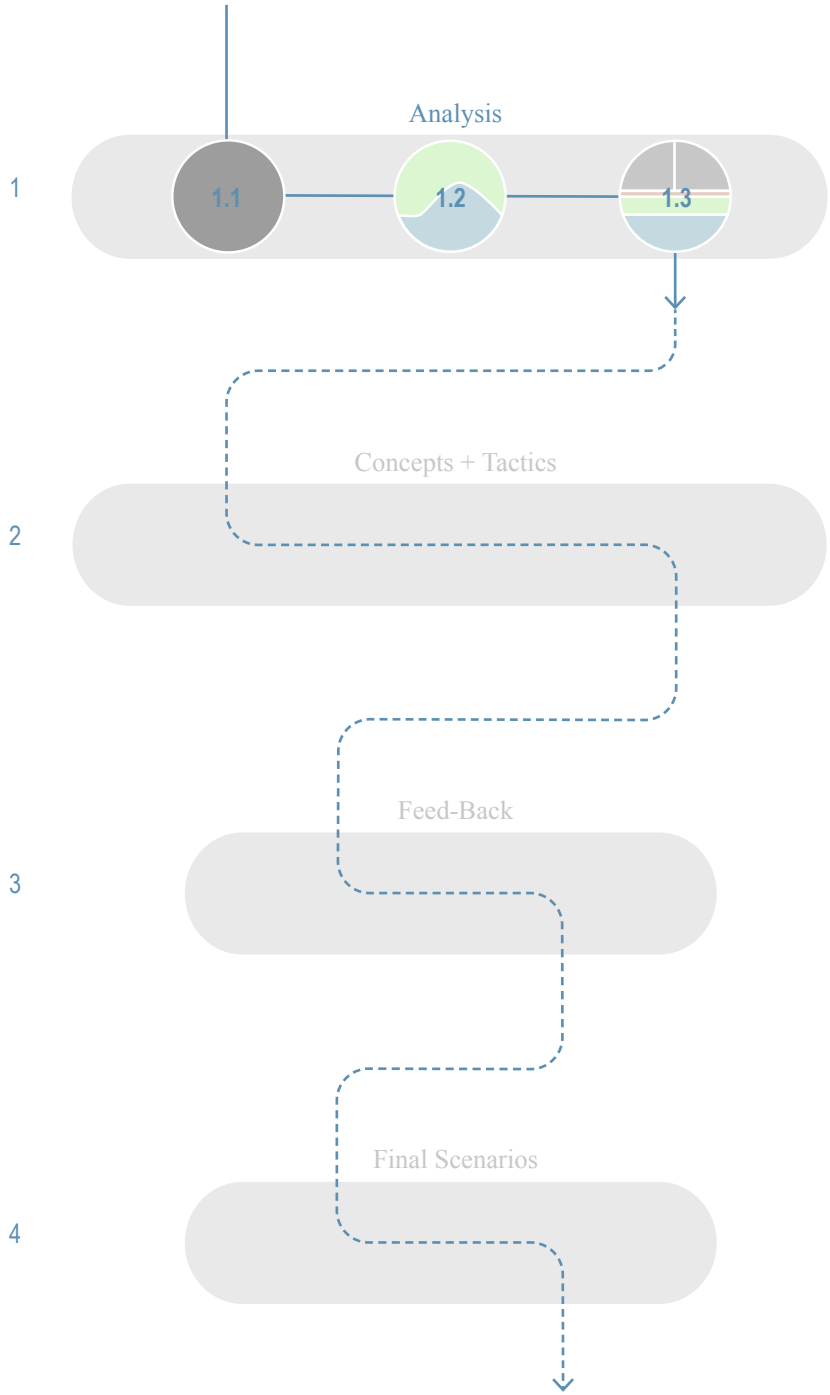
2. It continues with the creation and visualisation of trial development scenarios by introducing known concepts and tactics for the site. Concepts relate in this case to concepts of the Urban Adaptation Models for SLR Adaptation (Baumeister, 2020). Tactics reflect a single activity or technique. Scenarios consider large, overarching plans in which tactics are coordinated (Cambridge dictionary, 2020) This creates systematically four water-adaptive urban development options and provides the site at the same time with additional water-adaptive assets.

3. Afterwards the second step is evaluated by a stakeholder feed-back. Participants will get thereby the chance to comment on existing ideas and to suggest additional ones on different scales.

4. The final step visualises and describes the best development scenarios. Each of them will highlight a different water-adaptive concept with relevant urban design features.

An additional expected outcome of this methodology is (in contrast to a normal Masterplan) its flexibility in terms of decision making and adaptability for future demands of the guideline.

The success of these advantages will be assessed at the end of the test run which will follow after the upcoming detailed description of the methodology.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Steps 1.1 - 1.3

Following objectives are included in the Analysis:

1.1. Site Analysis

1.1.1. Site location: Select the site boundaries and collect relevant data (GIS, Google Earth, etc)

1.1.2. Historical development: Study the history of the site (plans, photos) including eventual water interactions like flooding

1.1.3. Site visit: Visit the site and take site photos that present potential flooding points and areas

1.1.4. Buildings, vegetation, elevation: Check buildings, vegetation types, and heights and indicate contour lines

1.2. Analysis of potential flood risks

1.2.1. Impact of SLR: Understand the impact of SLR / storm-water (past, present, and future)

1.2.2. Future flood levels: Simulate future water levels (e.g. +0.2m, +0.5m, +0.8m, and +1m)

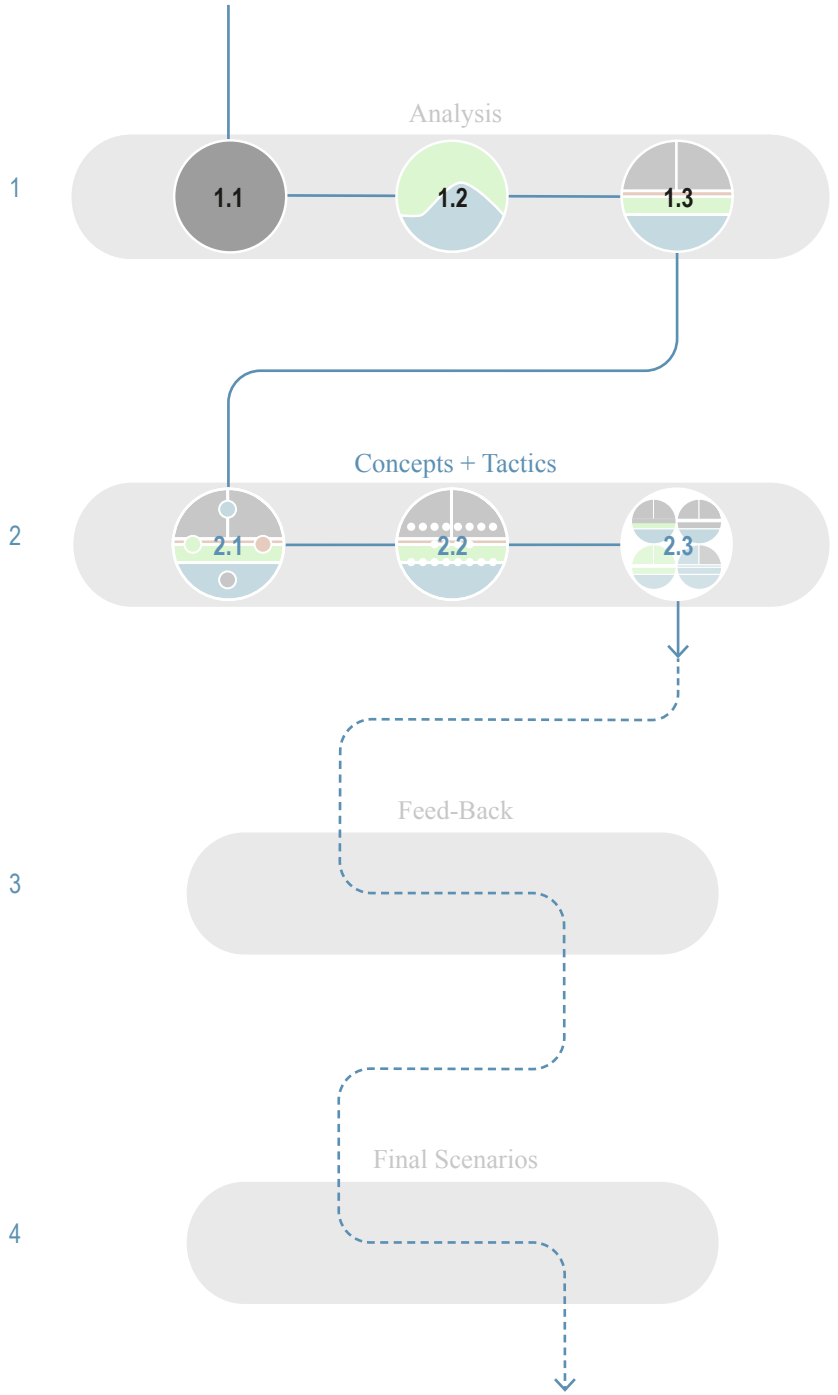
1.2.3. Risk map: Create a risk map that indicates risk levels of buildings, infrastructure, and vegetation

1.3. Analysis of risks and opportunities of the site

1.3.1. Subdivision of site: Divide the site into tangible parts with different functions and flooding levels

1.3.2. Risks and opportunities: Analyse the Urban Elements (Baumeister and Ottmann, 2014) that will be described in the test run and will compile the risks and opportunities

1.3.3. Conclusion of step 1: Review critically step 1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Steps 2.1 - 2.3

Step two is based on the introduction of concepts and tactics (Chrysoulakis et al., 2015) which will be described comprehensively during the test run:

2.1. Concepts (Urban Development Scale)

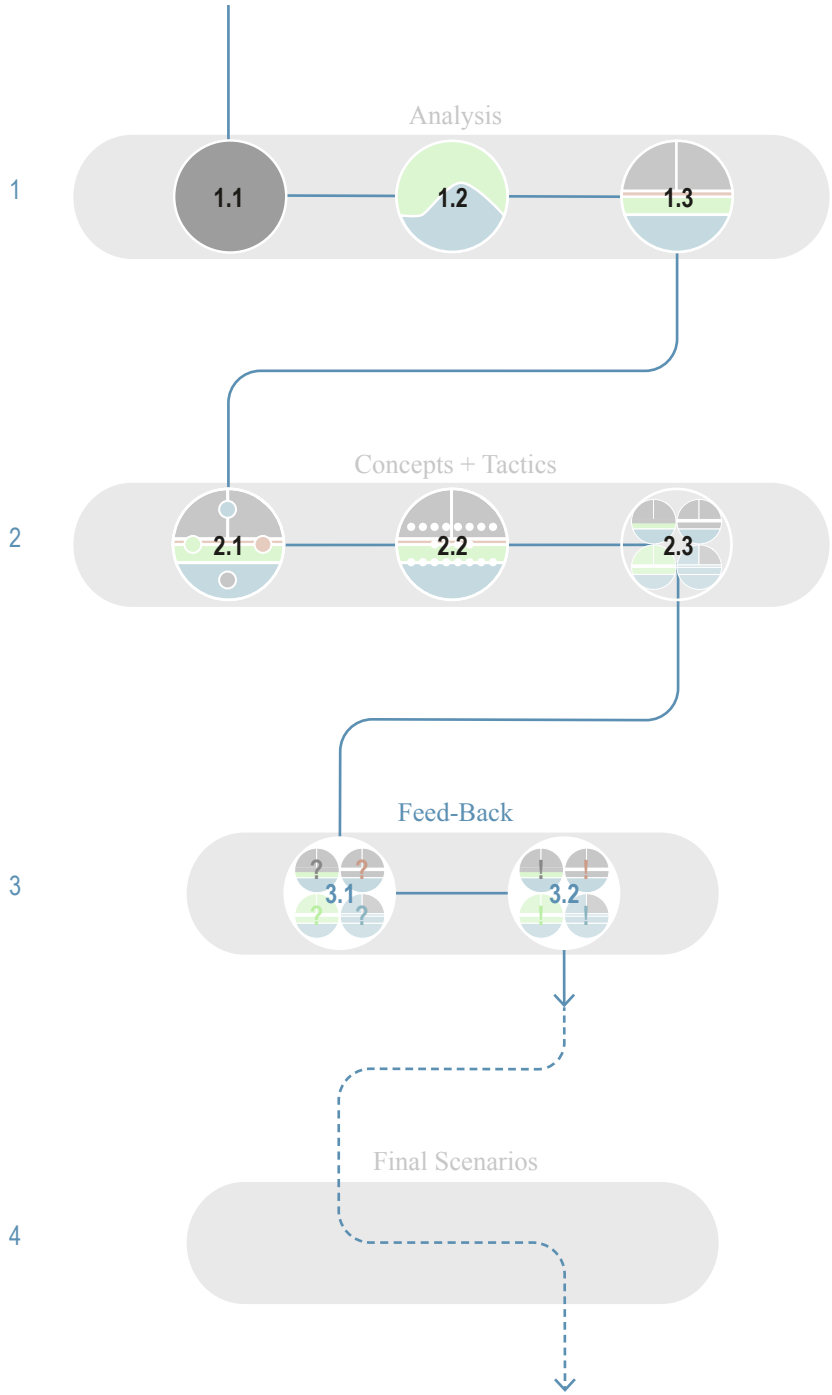
2.1.1. Adaptation Methods: Introduce and test adaptation methods on site
2.1.2. Combinations: Mix adaptation methods to increase the benefits and evaluate corresponding opportunities

2.2. Tactics (Urban Design Scale)

2.2.1. Tactics' logos: Introduction twenty tactics which can be relevant for the site
2.2.2. Tactics' explanations: Describe the different tactics

2.3. Concepts + Tactics = Scenarios

2.3.1. Opportunity A: Choose, visualise and describe the most logical mix of concepts and tactics for opportunity 1
2.3.2. Opportunity B: re 2.3.1.
2.3.3. Opportunity C: re 2.3.1.
2.3.4. Opportunity D: re 2.3.1.
2.3.5. Conclusion of step 2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Steps 3.1 - 3.2

Step three asks for feed-back from stakeholders and the community to develop the proposed trial scenarios further:

3.1. Survey

3.1.1. Survey of Adaptation methods: Ask for the advantages and disadvantages of each development concept for the specific site

3.1.2. Survey of Tactics: Explain and ask for preferred development tactics

3.1.3. Survey of Trial Scenarios: Ask for the pros and cons of each presented development scenario and collect additional personal ideas from each participant

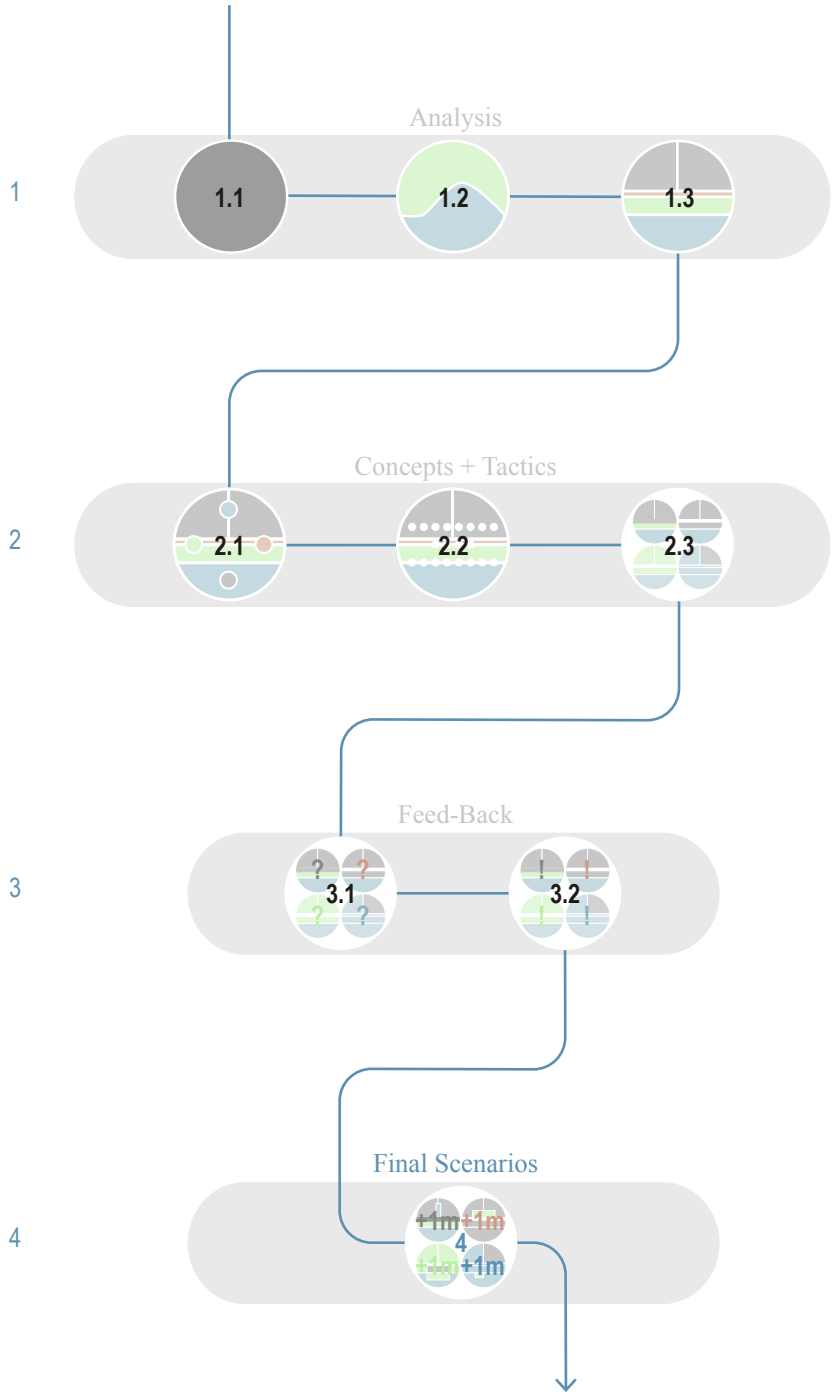
3.2. Results

3.2.1. Results of Adaptation methods: Collect the results of the invited stakeholder group

3.2.2. Results of Tactics: Collect the results of invited stakeholders

3.2.3. Results of Trial Scenarios: Collect the results of the invited stakeholders and check eventual discrepancies of results between 3.2.1. and 3.2.3.

3.2.4. Conclusion of step 3: Evaluate the outcome of the survey regarding preferences and gaps of the proposed options to create in the next step prioritised opportunities for the site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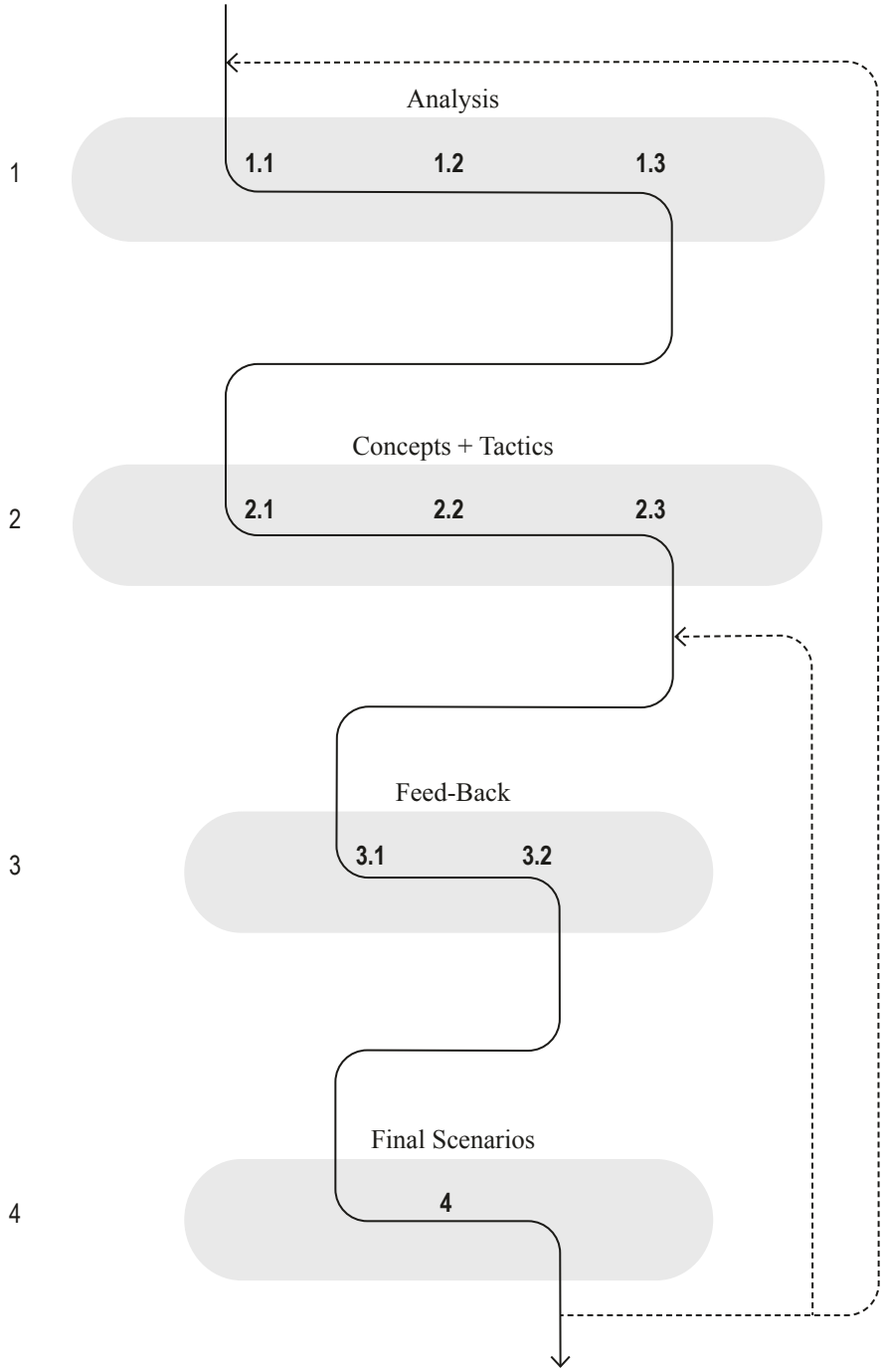
Step 4.

This final step results in urban development scenarios for sea-level rise:

4. Cities+1m

4.1. Existing conditions
4.2. Scenario **A** “Minimal Change”: Visualise the improved scenario as a site plan and in 3D
4.3. Scenario **B** “Maximal Yield”: Visualise the improved scenario as a site plan and in 3D
4.4. Scenario **C** “Maximal Nature”: Visualise the improved scenario as a site plan and in 3D
4.5. Scenario **D** “Maximal Water”: Visualise the improved scenario as a site plan and in 3D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Conclusion

This guideline has been created to generate scenarios that transform coastal cities for sea-level rise. The step-by-step approach seems to be logical but has to be tested as a test run on a specific site.

The analysis of relevant data for a specific site and the evaluation of risks and opportunities follow the normal procedure (step 1). Due to various interpretations in literature, existing concepts for sea-level rise will be redefined and reinforced by twenty tactics which will create four scenarios (step 2).

The four proposed scenarios will be presented and discussed with stakeholders and the community (step 3) before the feed-back will be compiled in final scenarios (step 4).

Two extra loops (dashed lines) can be applied to optimise the outcome of the guideline in the future. The one loop repeats step 3 which allows additional feed-back for the final scenarios in step 4, the other one reflects the entire methodology and the question of how to improve it further. This will allow a constant adaptation of the guideline according to gained experiences and changing requirements.

TheTest Run

Guidelines determine a certain course of action intending to streamline and optimise processes. The target of the proposed guideline is to prepare coastal cities for sea-level rise and other flooding events. For that, the guideline suggests a specific, integrative way that has the potential to reduce risk and the create new opportunities. A demonstration of this guideline's potential plausibility will happen in the following test run.

Insights created during the test run will check the logical structure of actions and outcomes as well as its content and depth. To test the proposed guideline as effective as possible, the following criteria for the test run's site selection have been considered:

- Already existing hazards like sea-level rise and flooding which are expected to increase in the future even more
- The site's dimension should be not too small (not less than 10 hectares) but still manageable
- Already existing functions on site should be divers to allow urban, green, and blue transformations
- Accessibility for detailed investigations on site should be possible
- Opportunities for future attractive developments (accessibility, security, environmental quality, water views, etc.)

The overlay of these selection criteria led to a specific test site that will be presented in the following first step of the test run.

The test site is located at the City of Gold Coast in Queensland, Australia. Selection parameters included the proximity to a river with flooding challenges and an ocean experiencing a sea-level rise. Moreover, the low-lying and diverse urban character, which combines industrial and residential functions, are providing various design opportunities. The authors would like to clarify that neither the community nor stakeholders selected this specific site. Instead, it was selected by the authors as a test run model.