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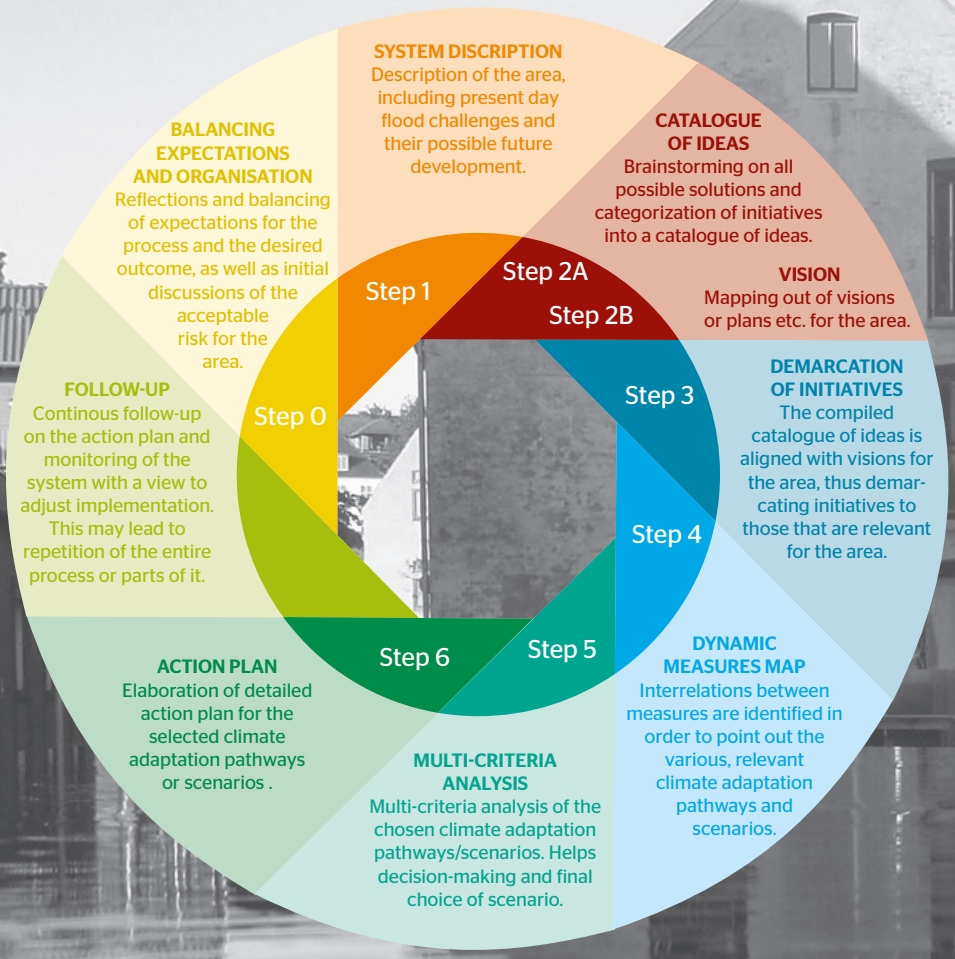

Guide to dynamic planning of climate adaptation and management of the risk of flooding in municipalities

RECOMMENDED PROCESS FOR IDENTIFYING ISSUES AND TAKING DECISIONS IN AN UNCERTAIN CLIMATE FUTURE

April 2020

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Guide to dynamic planning of climate adaptation and management of the risk of flooding in municipalities

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Introduction

How can we achieve effective municipal planning for a future with climate change, if the scope and nature of these changes are unknown? How do we ensure that the investments we make today remain sound, seen from a future perspective? What initiatives should be taken now, and how will they affect future initiatives?

This guide offers a short introduction to dynamic planning as a process for risk management and climate adaptation in relation to flooding and should ideally encourage and inspire others to start a dynamic planning process in their own municipality.

Dynamic planning is a process tool that can help to create an overview of different measures for risk reduction in relation to flooding, to align the measures in relation to each other and find the right solutions, both in terms of actual problems and in relation to future challenges. While dynamic planning cannot offer any answers in itself, it focuses on a process that ensures the necessary discussions and review of the different measures and actions, including for how long the measures are active and when other initiatives should be implemented. The process includes the drafting of a specific action plan.

The process in this guide is an adjustment of the Dutch developed process DAPP (Dynamic Adaptive Policy Pathways)[1] , which Deltares and TU Delft are responsible for developing. This guide presents an adjusted process that has been adapted to Danish conditions. The guide builds upon the experiences of the Danish Coastal Authority with the EU InterReg NSR project FRAMES (Flood Resilient Areas by Multi-layEred Safety)[2] , where the concept was tested in collaboration with Assens Municipality and Vejle Municipality in the towns of Assens and Vejle, respectively. In addition to a description of the specific steps which dynamic planning entails, the guide also includes specific examples from Vejle and Assens that illustrate the individual steps in practice.

The conclusions from the trials in the two pilot areas show that it is the entire process, especially the multi-criteria analysis and the action plan, which help the municipalities to structure the various possibilities and to clarify which actions should be taken to help them move forwards. Moreover, the process can be carried out for larger as well as smaller areas and with different starting points, simply by taking this into account when implementing the process.

The guide is aimed primarily at municipal planners and other municipal employees who work with climate adaptation or who have an interest in planning in an uncertain climate future. Dynamic planning is ideal for use in connection with city planning and strategic urban development, just as the process is well-suited for drafting climate adaptation and risk management plans. Dynamic planning helps to create a shared understanding and not least, a shared language in relation to climate adaptation and risk management at municipal level.

1 https://www.deltares.nl/en/adaptive-pathways/
2 https://northsearegion.eu/frames/

"The Dynamic planning has been very rewarding and has triggered many reflections. Deliberations and discussions about visions, challenges and options etc. across the entire organization have given us a joint knowledge and understanding, which is a valuable contribution to our continued efforts to create synergy between town planning and coastal protection. The process has contributed to identify possible solutions and their interdependence when it comes to reducing flood risk over time. This process has confirmed that adaptive planning is the way forward."

Quote, climate coordinator
Ulla Pia Geertsen,
Vejle Municipality

"One of the most valuable things about this process is the discussions triggered in our project group when we each take our own professional approach to the area, the challenges and the options. Each individual step in the process has different approaches (for instance risk, visions, options, financing etc.), which forces us to look at the area from different perspectives. In combination with our different professional backgrounds, this makes way for fruitful discussions and new insights into the project area. It is an important process to complete since there are different pathways to choose from and it is important that all professional considerations should be reflected in the solutions chosen."

Quote, Biologist and
Project Manager
Katrine Juul Larsen,
Assens Municipality

The dynamic planning process

Step 0 is a balancing of expectations before the process is kicked off with Step 1, which involves an in-depth description of the area and its challenges. In Step 2A, a catalogue of ideas is produced outlining all the potential solutions for handling these challenges, while Step 2B is a mapping of the visions for the area. These steps, together with Step 3, which connects Steps 2A and B together, are essential preliminary work for drawing up a 'map of measures' in Step 4 that shows how all the different measures would play out over time. Here, relevant adaptation scenarios are selected, which are worked with in a multi-criteria analysis and action plan in Step 5 and Step 6, respectively.

Once the action plan has been finalised, a continuous follow-up and monitoring process should be initiated. Progress should be monitored in order to make adjustments along the way. System changes or requirements for a more detailed perspective may lead to a repetition of the process in order to encompass changes or new insights and adjust the process accordingly.

Each step is described in more depth with examples from Assens and Vejle in the next section.

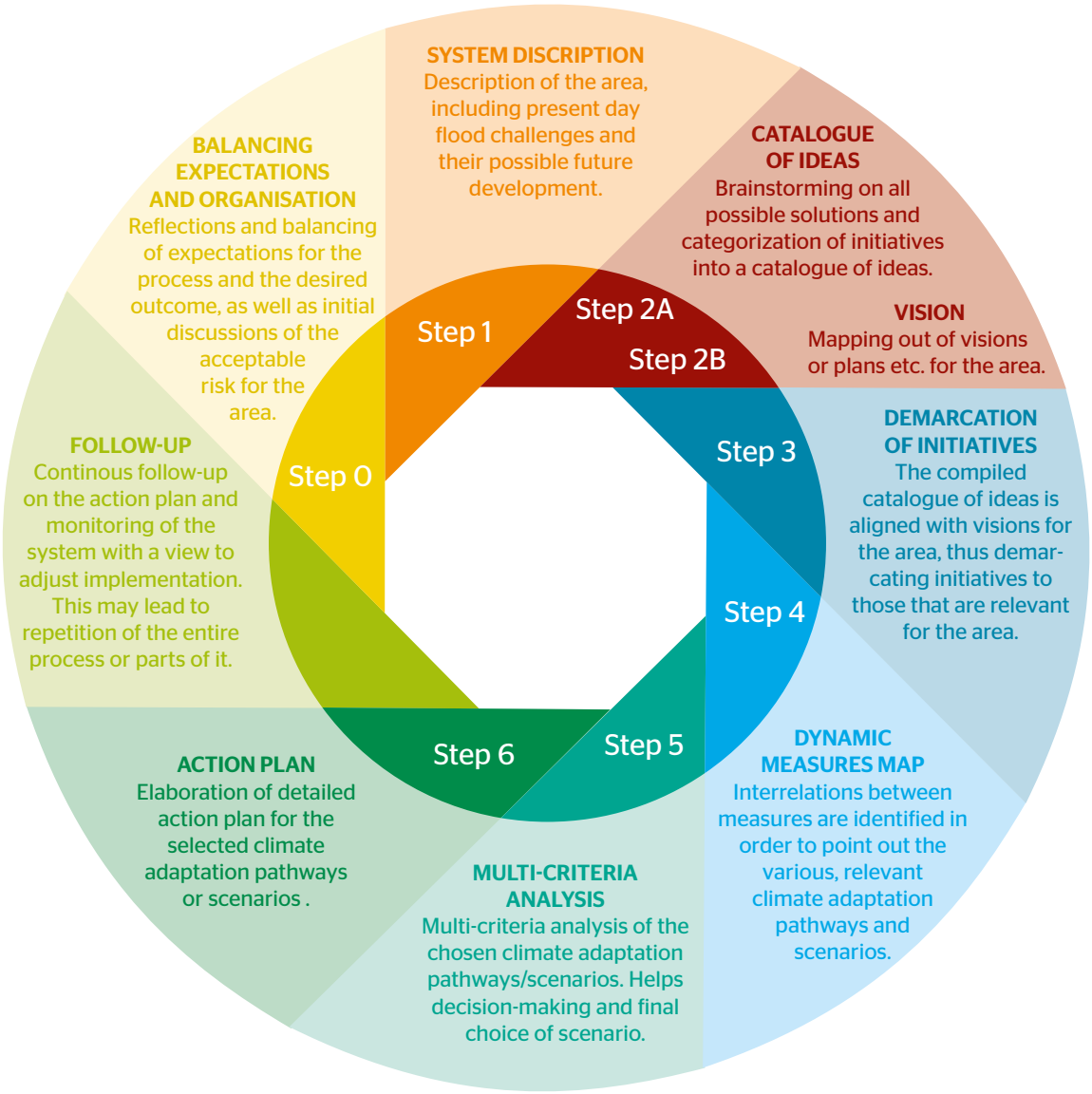
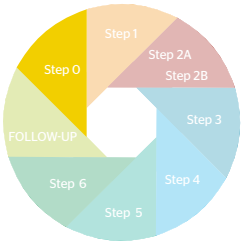


Figure 1 The process for dynamic planning consists of 7 steps



Step 0 – Balancing expectations and organisation

The purpose of Step 0 is to reflect upon and discuss the anticipated wishes and result of the work with dynamic planning, so that the purpose of the work is clarified and the coming working group have a clear mandate for the task. It is important for the process that sufficient resources areavailable, both in terms of time and staff.

Balancing expectations

Before initiating a process, an agreement must be reached as to what is the purpose of carrying out the dynamic planning and to formulate a clear goal. Furthermore, it will be relevant to discuss the acceptable risk for the area. Here, you should reserve yourself to the vulnerabilities of the area and the danger of flooding.

A consensus should also be formed regarding resources and anticipated hours needed for the project. It is recommended that all six of the suggested steps in the process are carried out. A minimum of one half-day meeting should be reserved for each step, and it would be preferable for a couple of the steps if this was extended to a full day meeting. This applies particularly to steps four and five, which experience has shown can take longer. It may be necessary along the way to revisit previous steps. If a shorter process is desired, a couple of the steps could be combined; for example, Step 3 could be carried out as a direct extension of Step 2. Alternatively, you could work with a lower level of detail. It is a good idea to familiarise yourselves with the different steps before starting, and to investigate whether data that could supplement the work are already available, or should be gathered first.

As time will also need to be set aside for processing the decisions between the meetings, a process will often take three to six months. The process may draw out further if external interests get involved. It is recommended that this process doesn't last more than a year, as it can be difficult to maintain the motivation.

Organisation

Dynamic planning requires knowledge of both the water cycle and an insight into risk reduction in relation to flooding. It also requires an overview of the municipality's development plans and strategies and visions for the area.

In order to achieve the best results it is therefore recommended that an interdisciplinary working group is established. The working group could consist of:

- City planner
- Climate coordinator
- A person who has worked with flooding and the water system
- A person with in-depth knowledge of the local area
- Possibly someone who represents the habour, if the area has one
- Possibly a representative from a utility company
- In addition, municipal employees with special skills may be involved on an ad hoc basis as and when the need arises.

It is essential that the work is led by a facilitator who has familiarised themselves with the process and who possesses the professional expertise within risk reduction. The facilitator is expected to summarize what has been discussed between the meetings and is responsible for planning each step. The facilitator role is thus relatively demanding.

As the process runs over a longer period and the project group is broadly composed, it is recommended to set up a steering committee with relevant managers in the municipality and possibly a harbour manager and/or manager of a utility company, if relevant.

The dynamic planning should encourage involvement. At each step, suggestions are made as to which stakeholders could also be involved.

Before start up, it is good idea to consider the scope of involvement, not least because involving many stakeholders places bigger demands on planning and can be time-consuming. On the other hand, the process will achieve a greater degree of legitimacy and more aspects will come into play.

Example: Balancing of expectations and organisation in Assens

Objective: The wish to incorporate reduction of risk in relation to storm surges into future town development.

Composition of project group:
A project manager from the Environment and Nature department, who works with climate adaptation, a city planner and a representative from the Marina.
The Danish Coastal Authority acting as facilitator

Number of meetings: 8
Duration of the process: About six months

Example: Balancing of expectations and objectives in Vejle

Objective: To support the decision-making process in relation to the municipality's future storm surge strategy.

Composition of project group:
The municipality's project group consisted primarily of two people who were active in climate adaptation work and risk management in the town. One is a project developer in the municipality's department for project development, while the other is an engineer from the watercourses department. Both departments are part of the Technical and Environmental Administration. Other colleagues from the development department also got involved along the way, including an anthropologist, a city planner and an architect.
The Danish Coastal Authority acting as facilitator

Number of meetings: 8
Duration of the process: About 1 year

Check list for drawing up objectives and mandate

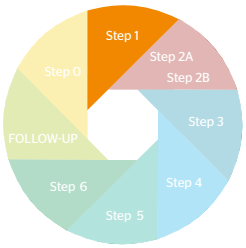
- Define the objective
- Define the acceptable risk
- Obtain a mandate (funding, time, resources)
- Establish a working group
- Possibly appoint a steering committee
- Define the process and consider involving other stakeholders
- Prepare existing data

Suggestions for involving external interests

In this step, it will be relevant to involve the following interests:

- Other units in the administration
- Other administrations, if relevant
- Relevant managers
- Technical committee (mandate)
- Harbour manager, if relevant
- Manager of a supply company, if relevant
- Possibly someone from the local emergency services
- Other people who can make valuable contributions to the process with impotant-knowledge about the local area

Step 1 – System description



The purpose of this initial step is to create a shared understanding of the area and the present day flood challenges, as well as their possible future development, including any uncertainties attached to this.

Laying down areas

In Step 1, a basic understanding for the entire relevant area must be ensured, including the sources of flooding in the area and how they interact with each other; the challenges in the area related to flooding; and how these challenges will change moving forward and with what degree of uncertainty. An area can be a larger urban district, an entire town or an entire municipality. The area is defined according to what scale one wishes to work with.

In addition to an understanding of the specific area, there must be an understanding of the system that can affect the area. By system we mean the external conditions that affect the relevant area, for example a river in an area that cannot be considered in relation to one section, only, but which runs throughout the entire area. Similarly, there needs to be an awareness of the area's position in relation to high water. Correspondingly, external parameters such as climate or political conditions can change and thus alter their impact on the area.

It is relevant to describe all the conditions in the system that can affect the area. For example, by dividing the system into sub-elements, as shown in the box on the right. As a minimum, a description of the area should include a detailed description of the water system's characteristics and related implications on society.

An understanding of the area and system is necessary in order to be able to investigate which possible measures and climate adaptation pathways are relevant in tackling the challenges in the area. A thorough and shared understanding of the area will make it easier to work further with the next steps in the process.

The suggested checklist in the box can be run through by drawing up a system description to ensure the broadest possible understanding of the system. The checklist is not exhaustive, and it is possible that there are relevant factors for a system that have not been included here.

To ensure that the description of the system is as detailed as possible, it may help to involve one or more interested parties in order to shed more light on the challenges and needs from different angles. Examples of relevant stakeholders are shown in the box.

One possible summary of the system description could be to summarise all the relevant, collected data in what is called a Source-Pathway-Receptor model (SPR), where the source of the flooding is noted and its route through the landscape followed until the final 'receptors', which are subjected to flooding, as illustrated in Figure 2.

Elements for system description

Source of flooding
- Where does the water come from and in what situations?

Spread
- Along what path does the water spread?
- Are there existing protective structures?
  - Structural (dikes, walls, raised roads etc.)
  - Non-structural (emergency preparedness, raised columns)

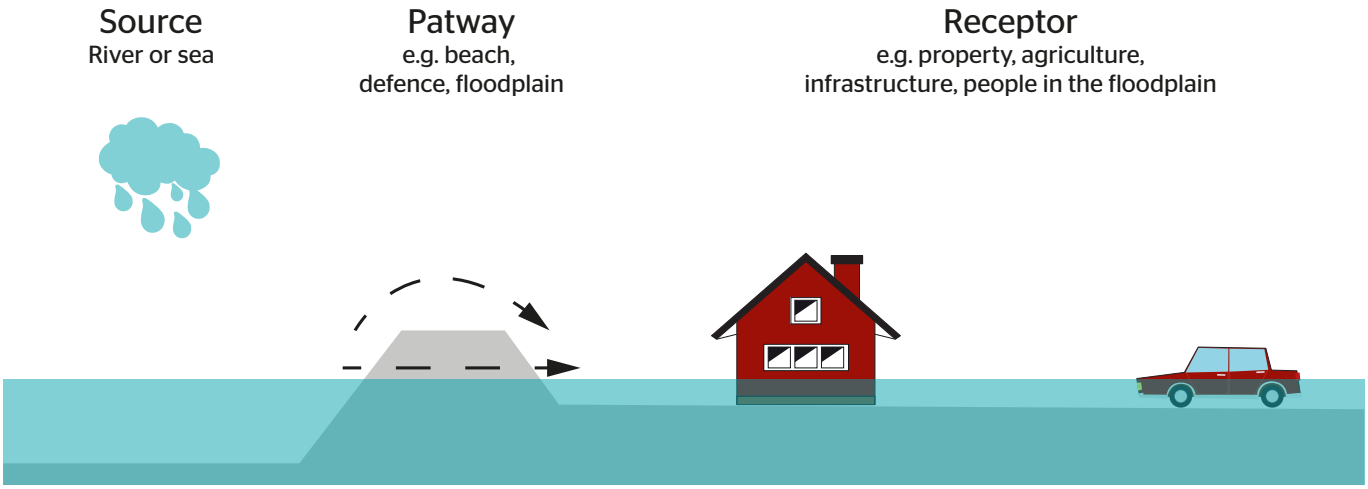
The receptors
- Who and what would be affected by a flood?
  - People and buildings
  - Supply network (water supply, waste water, electricity supply etc.)
  - Polluting companies
  - Cultural heritage (museums, buildings, churches etc.)
  - Commercial (shops, industry, businesses etc.)
  - Vulnerable sections of the population (nursing homes, daycare institutions etc.)
  - Emergency services (hospitals, fire department, police etc.)

Restrictions
- What restrictions are there for the area?
  - Political
  - Legal
  - Economic
  - Others

Outside influences, responses and trends
- What changes can we expect to see for the system and the area?
  - Lifetime of flood management infrastructure
  - Population growth
  - Climate changes
  - Local plans and similar plans
  - Connection to other plans (biodiversity, water quality and so on)

Other relevant
- Describe any other relevant conditions for the area

Uncertainties
- What uncertainties are there in relation to current and future conditions for the system and the area?



Figur 2 Skematisk forklaring af en Source-Pathway-Receptor (SPR) model

The final output from Step 1 can be illustrated schematically as shown in Figure 3. In the middle you can see a description of the source of the flooding, the pathway followed by the water and the receptors affected by the water. All of these are included in the model. In addition, consideration is given to outside influences and restrictions, which can also be seen in the checklist in the box above.

Suggestions for involving external interests in the system description
In this step, it will be relevant to involve the following interests:

- Other departments in the municipality
- The utility company
- Local emergency services

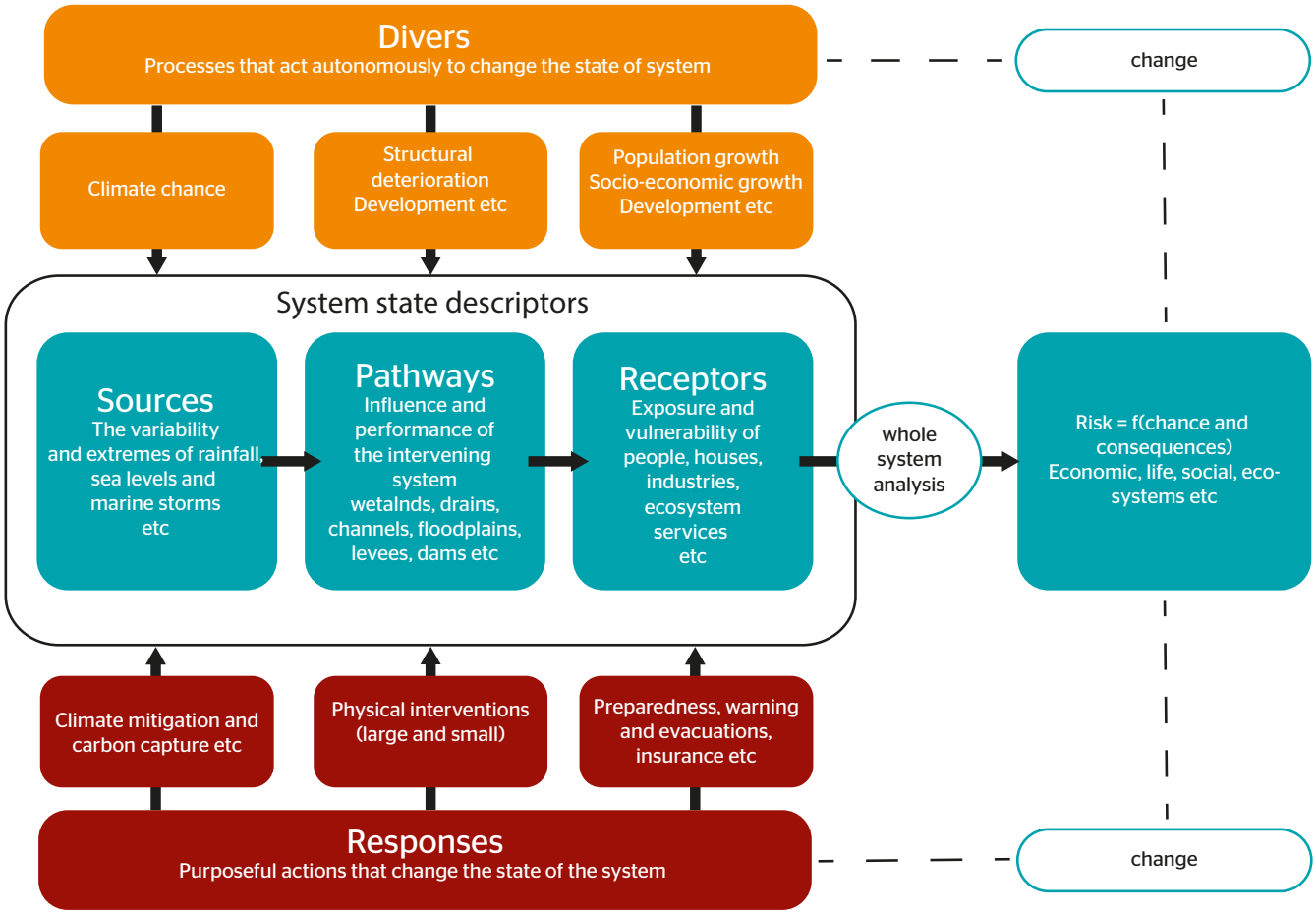


Figure 3: Suggestion for an SPR model to describe the system

Example: System description of Assens

The first step involved limiting the area, for which a dynamic adaptation map would ultimately be prepared. The demarcation of the area was based on the expected potential flooding spread. The area in Assens that was worked with covers a geographical area marked by a diverse range of characteristics. The area was therefore divided into smaller sub-areas based on how they fit together, which provided a better overview of the challenges and opportunities in the individual sub-areas. Figure 4 shows the sub-areas, as they were defined under Step 1 in Assens. The break-down of the sub-areas was adjusted several times along the way in the overall process, gradually, as other ways of breaking them down proved to be more valuable for the work. In the last step several areas were merged, so the final output is not eight separate dynamic adaptation maps, but five.

The checklist was reviewed for Assens Municipality and the basis for a shared understanding of the system was formed. This was done by adding elevation points, critical infrastructure and other elements from the checklist onto a map of the town. In the first instance, this led to a breakdown of the flooding sources, protective measures and receptors (potential flood risk points) for the different neighbourhoods in the area. The process for these can be seen in Image 1.

This led to a source-pathway-receptor model (SPR-model) as a summary of the knowledge acquired in Step 1, as shown in Figure 5

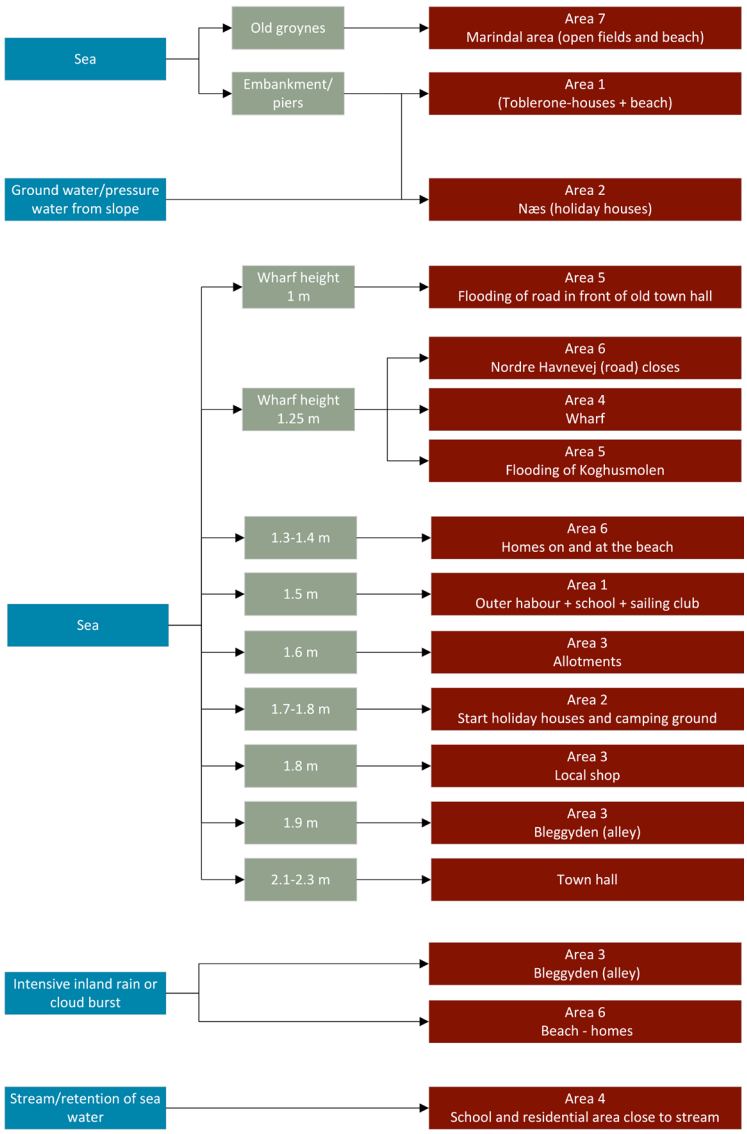


Figure 5: SPR for Assens.

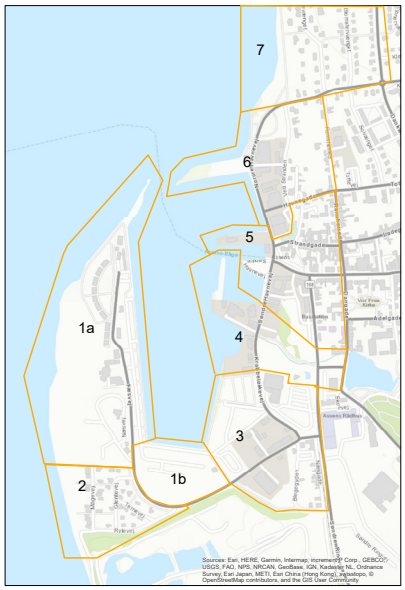


Figure 4: Breakdown of Assens into eight sub-areas

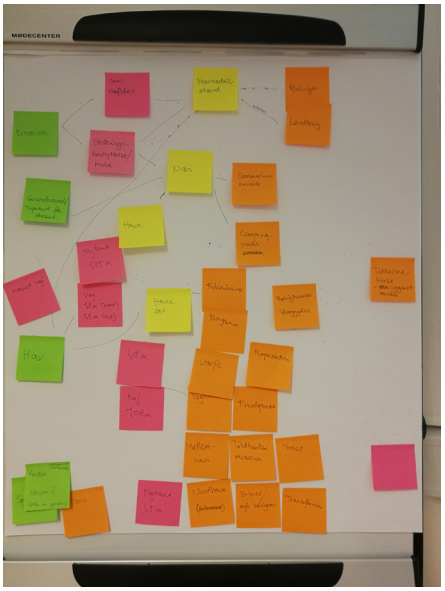


Image 1: Process for preparing a system description.

Eksempel: Systembeskrivelse af Vejle

In Vejle, the area is defined as the entire town and includes backwater from the two rivers, Vejle Å and Grejs Å, as well as water from the fjord. This was decided by Vejle Municipality, who wanted a complete picture of the potential for combining different solutions. For Vejle, the SPR model was made on the basis of the individual sources of flooding rather than for the sub-areas, as shown in Figure 6. The individual watercourses and the fjord, as well as the combination of high sea levels and elevated water levels in the rivers, are considered the main sources of flooding and were reviewed individually.

For each source of flooding, a review of the town was carried through to establish where the water comes from and where it runs to, and if, for example, there are any dikes or the like on the way (the pathway) and eventually, what assets are flooded (the receptors). This was drawn onto a map of the town. The check list was followed to ensure that all relevant information was included. This process created a shared starting point and understanding of the challenges caused by flooding in Vejle town.

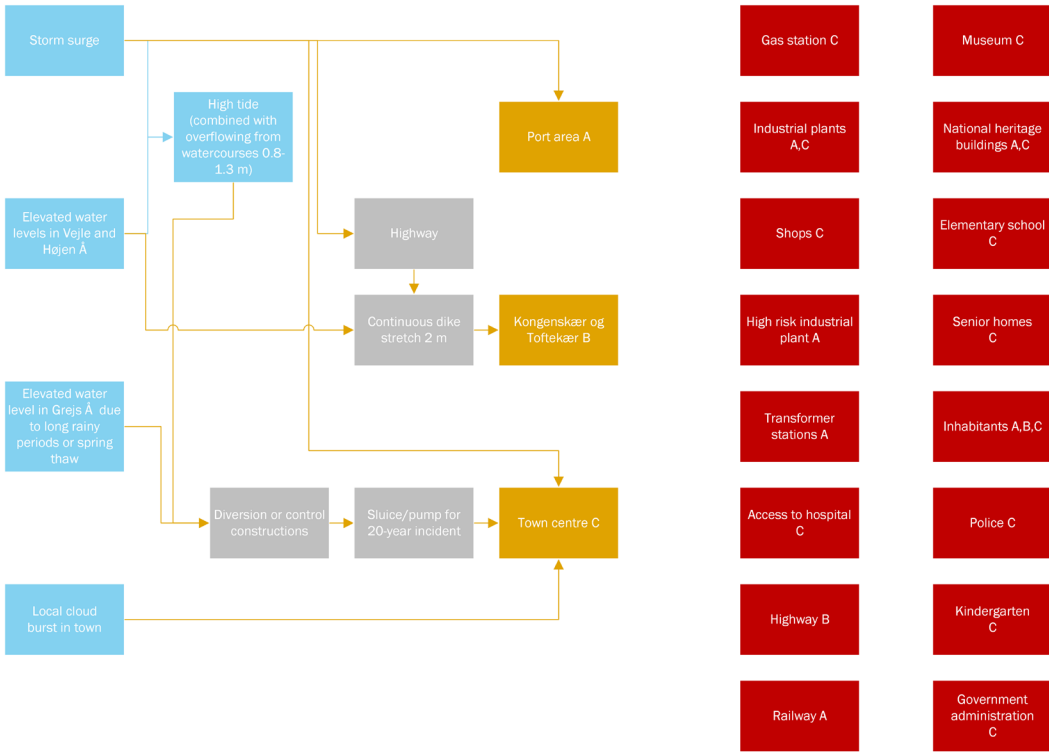
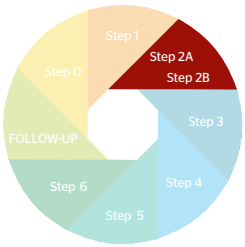


Figure 6: Final SPR model for Vejle case area.

Step 2 - Catalogue of ideas & vision



The purpose of Step 2 is two-fold. Firstly, to have a general brainstorming to come up with all potential ideas for tackling the challenges. Secondly, visions, plans ect. for the area are mapped out to make sure that any solutions carried further into the process are in line with the visions for the area.

Step 2A - Brainstorming on measures and catalogue of ideas

Step 2A involves a general brainstorming on which measures should be included to tackle the challenges from flooding in the area. In this step it is important to think broadly, as the measures chosen at this stage will form the foundations for both a short and a long-term plan for the town. So no stone should be left unturned in the brainstorming process, which should cover all the various topics in risk management. It is important that the proposed solutions and measures range from prevention and protection to preparedness, and cover both structural and non-structural measures. This will ensure great flexibility in the subsequent dynamic adaptation map.

The process for Step 2A is two-fold:

1. Brainstorming on proposed solutions
2. Categorisation of proposed solutions

It is important that part 1, the brainstorming, is an open process. It's easy to go very specifically into the individual elements or have many reservations in relation to for instance funding, economy, environmental impact, consent of residents and so on. All proposals should be treated equally, regardless of the budget available and how realistic they are. The ideas will be sorted through later and any solutions that do not match the visions will be discarded.

Sources of inspiration during the brainstorming stage could be experiences from other towns, municipalities, countries and guidelines for preparing risk management plans for flooding.

For the brainstorming, it is recommended to involve a wide range of stakeholders. See the box for suggestions for this.

Part 2 of the process, categorisation of the proposed solutions, must help to ensure that all categories of measures are discussed and considered. If not, the brainstorming process should be resumed within any specific category that might be under-represented. See the box for suggestions for the categorisation of measures.

To further systematise the ideas from the brainstorming session, the following are noted for each of the measures:

- Expected time horizon for implementation of a measure
- Expected lifetime of measure
- Whether a measure is irreversible or blocks other opportunities

Check list for brainstorming on measures

Does the brainstorming include measures for all categories?

- Prevention
  - o Local planning
  - o Communication and increasing awareness
  - o Recovery plan
- Protection
  - o Flood wall/embankment
  - o Raising terrain, e.g. roads etc.
  - o Sluice gates/storm surge barriers
- Preparedness
  - o Preparedness plan
  - o Drills involving residents
  - o Warning

Suggestions for stakeholder involvemeny

In this step, it will be relevant to involve the following interests:

- Project group
- Planning department
- Development consultant/employee with a coordinating function
- Any other relevant departments/administrative units

It is possible to skip the brainstorming session if a specific catalogue of ideas for the study area has already been made. It can be beneficial, however, to take a critical look at the catalogue of ideas or the associated brainstorming process in order to make sure that the range of solutions is sufficiently wide and that all relevant stakeholders have been included.

Step 2B - Mapping of visions

Step 2B involves a mapping of visions for the area laid out by municipality or others, which could affect it. In particular, visions in relation to urban development, changes in land use and branding of the town are relevant to include. For example, there could be a wish to build more houses in the area, ideas about developing the area as a recreational hub or perhaps a municipal vision that all its residents should have free access to the water front or a perception that the town's identity is connected with a free view of the sea. You should not only address the conditions today, but also involve strategies that reach into the future, for example a harbour expansion or urban transformation of the harbour areas. Visions should be understood not only as a fixed vision for the area, but also as a concept that covers local plans and ideas about the development of a specific area, which the municipality is working with.

Mapping of visions shall ensure that a connection is created between the other elements in the development of the area and the necessary climate adaptation proposals. If the municipality already has a vision plan in place for the area in question, then this will be a good starting point for the mapping of visions.

It is also helpful to involve other plans and strategies. It will also be relevant to incorporate the municipal plan and the local plan for the area, just as you can draw on other plans, strategies and policies that lay out visions and goals for a particular administrative area. See the box below.

Should a new vision plan be developed or strategies and visions be incorporated that are not officially adopted, it may be necessary to involve work at the political level.

It is important that visions and measures are kept separate in Step 2. This is to ensure that the visions for the area do not restrict any measures in the brainstorming process that could help to tackle the flood challenges in the area.

Check list for the work with visions

Overview of important plans, strategies and visions for the selected area

- Vision plan
- Municipal plan
- Local plan
- Other development plans for the area
- Other relevant strategies, plans and policies in the municipality
  - o architecture policy
  - o climate adaptation plans
  - o risk management plans
  - o nature and outdoor strategy
  - o settlement strategy
  - o mobility strategy
  - o inclusion of the UN's global goals for sustainable development
  - o etc.

Suggestions for stakeholder involvemeny

In this step, it will be relevant to involve the following interests:

- Project group
- Planning department
- Development consultant/employee with a coordinating function
- Any other relevant departments/administrative units

Example: Catalogue of ideas and visions for Assens

In Assens, a brainstorming session was held in Step 2A for each sub-area in relation to what measures the municipality wished to implement. These were then broken down into the categories planning, protection and preparedness, as shown in Table 1.

Table 1 Catalogue of ideas of solutions relevant to Assens categorised into three themes

Planning	Protection	Preparedness
Leaving ground floor free	Storm surge barrier	Evacuation plans
Increase house shelf heights	Dune defense	Mobile flood protection walls
retreat	Impounding basin	Preparedness plan
Retain water in catchment area	Flood wall	Water tubes
Raising the terrain	Pop-up wall	Sand bags
Building on stilts	Permanent pumps	Mobile pumps
Waterproofing buildings	Raising the promenade	Blocking off roads
	Raise road/path	Private local preparedness team
	Object protection	
	Dykes	
	Return flap	

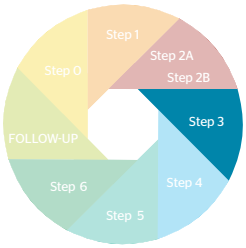
For Step 2B, a mapping was undertaken of all the visions in the municipality that would have an impact on the various sub-areas in the case moving forward. The visions were then analysed and it was assessed whether it was possible to combine visions under one overall concept for some sub-areas. In Table 2 you can see the visions for the area 1a. They deal primarily with tourism and recreational elements, so the visions are combined simply into: 'To develop an attractive tourist area'.

Table 2 Overview of visions for area 1a in Assens

Vision
Access to the water
Tourist-based
Overnight accommodation options, tourism
New building near the Marina Torv
Option: Swimming facilities at lake
Option: Municipal marina
Blue Flag beach
No more holiday houses on the northern part of Næs
Attractive place to visit, with places to sit ect.
Not a residential area
Make the beach area more exciting
Combination of flood protection and recreation

Foto: Januar 2019 © Assens Kommune

Step 3 - Demarcating initiatives



Step 3 is a summarising of Step 2 for the purpose of demarcating the initiatives/measures from the catalogue of ideas and possibly elaborating on them on the basis of the mapped visions.
On the basis of the vision for the area, the initiatives/measures from the catalogue of ideas are demarcated. Those measures that do not match the visions laid down for the area are discarded. For example, if the vision to expand the commercial harbour and deepen the navigation channel is not immediately compatible with the suggestion of establishing a storm surge barrier. Similarly, a flood wall may be at odds with the vision of ensuring an unrestricted sea view. It is possible,however, to think creatively, for example by constructing a glass wall or one consisting of removable elements so that some view of the sea is retained. By working with the proposals, new ideas may arise. It's important that initiatives are only limited in relation to the vision laid down for the area and that you continue to be open to ideas, so that initiatives are not limited on the basis of economics or implementation time, for example.

Elaboration and further development
Once the initiatives have been limited based on the vision, more in-depth descriptions are made of the remaining measures. This is to create a better understanding of what the individual measures involve in terms of potential and limitations.

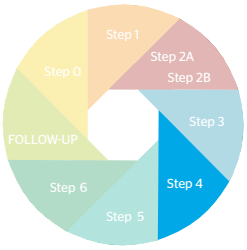
While the catalogue of ideas may contain loose ideas and overall thoughts, here the initiatives should be seen in realtion to the area, and it should be described how the individual measures might look for the particular area. In this process, it may turn out that some measures do not actually fix the entire problem, or that they create other challenges. It can be assessed whether it is possible to couple up several initiatives that were described as separate measures in the catalogue of ideas, or to further develop the existing initiatives in order to create additional value for the area. The further development and elaboration of the initiatives may relate to other elements than risk management, e.g. through the vision. Other benefits from the measures will thus also come to light, so that they can be used in the process moving forward.

Example: Demarcation of initiatives in Vejle

One of the visions that was clearest in Vejle was the wish for a town next to the water. One of the measures that was suggested in Vejle was to protect the town with a flood wall. While this measure could protect Vejle town in the short and medium-term, in the long-term it would have to be raised in order to offer adequate protection. The wall would thus have to be raised in the long term to aheigth that would mean the measure would no longer match the vision of Vejle as a town with a connection to the water. By raising the wall, an unrestricted view of the water would be blocked and visually, the wall would appear so huge that it would be experienced as a physical barrier between town and water. A raising of the wall was thus rejected as a possible measure. Alternatives were discussed, and it was considered as more attractive to work towards a storm surge barrier in the long run.

Image 2 Access to the water and the view over Vejle Fjord, which should not be destroyed by a flood wall. (Image from Vejle Municipality's Proposal for a Storm Surge Strategy (5/2/2020))

Step 4 - Dynamic measures map



The purpose of Step 4 is to interrelate those measures that can both fulfil the town's visions and reduce the risk. It should show how the various initiatives interact with each other and chart their mutual dependencies.

In this step, the sorted initiatives from Step 3 are put in relation to each other to show whether some measures could be coupled together, for example, or whether there are some initiatives that are dependent upon each other or some that are so important that many other measures will only make sense, once they have been established.

This step can be carried out with quite a general perspective, where you simply determine that a dike should be constructed in a more or less defined position, without deciding the height. Or it can be carried out in detail, where you work with precise heights and placement for the dike. It is recommended that you start along the general lines, as a high degree of detail at this stage of the process can cause challenges in relation to maintaining the big picture. Naturally, it all depends on the individual area and its complexity. A general rule of thumb is that if you are dealing with a large area with complex challenges, it is better to start off with a general perspective, while, if you are working with a smaller area with more simple challenges, it's fine to go more into detail from the start. If the picture becomes too unclear it is a good idea to work on a more general perspective.

Measures map

All types of measures have been worked with in steps 2 and 3, where it has been important to work with both structural and non-structural measures. In Step 4, you only work with those measures that reduce the risk purely physically. By this we mean those measures that either reduce the danger of flooding or measures that physically reduce the vulnerability in connection with flooding. See the box for examples . The other measures, such as an information campaign targeted at residents or an improved warning system are just as important as the other initiatives, but unfortunately, the dynamic adaptation map cannot handle these types of measures, as they can be long-lasting and independent of the other initiatives. As the entire purpose of the adaptation map is to show the interaction between the specific measures, there is no practical value in including these.

Once the measures that physically impact the area have been selected, their lifetime and expected implementation time are reviewed and it is established whether a measure is irreversible (prepared in Step 2). If this has not been noted, do it now. This is preliminary work for drawing up the adaptation map, see the example in Table 2.

Examples of measures that can be included in the dynamic adaptation map

Measures which physically reduce the danger

- Flood wall/dike
- Raising terrain, e.g. roads etc.
- Sluice-pump-system
- Storm surge barrier
- Detainment of water in catchment area
- Mobile high water protection such as a pop-up 'high water wall'
- Specific and temporary solutions, e.g. water tubes can be included

Measures which physically reduce the vulnerability

- Local planning
- High column elevation / leaving the ground floor free
- Requirement for waterproof building
- Withdrawal, e.g transformation of residential area into a park

Examples of measures that cannot be included in the dynamic adaptation map

- Emergency preparedness plan and corresponding mobile and varying measures
- Drills involving residents
- Warning
- Local planning
- Communication and increasing awareness
- Recovery plan

Tools for working with the measures maps

When working with the measures maps, you can use the Pathway Generator tool that has been designed for the purpose by Deltares. It's free to use, but it can take some time to get started. There are instructions on the website, however. Pathway Generator can be accessed here: https://publicwiki.deltares.nl/display/AP/Pathways+Generator

Alternatively, you can draw the pathways on a whiteboard or similar, where you can correct and adjust them as you go, and digitise them afterwards.

Table 3 Suggestions for a table with an overview of the measures and details about them

Measure	Expected lifetime	Expected imple-mentation time	Is it irreversible?
Construction of dike	50 years	10 years	No
Raising of dike	50 years	5 years	No
Construction of storm surge barrier	200 years	30 years	Yes

The measures are then put in relation to each other for use in the adaptation map. This is done in a very basic way by going through the situation that could develop:

- What is the first thing you could do? These solutions are sketched out and it is indicated how long they would last.
- Once the solutions stop working, what would you do then? Would combining them with one of the other solutions help extend their lifetime?
- Are there any solutions we can postpone by doing something else first?

As an example, in Figure 7 you can see an imaginary adaptation map for a smaller, low-lying area. Each measure is marked with a colour. Based on the timeline, this measure becomes valid once the measure is coloured in. Each measure can be seen individually, in which case it has a limited lifetime. If some of the measures are put together (the dotted lines), this extends their lifetime. In this imaginary example you can see two overall directions. Either it ends with an dike being built to protect the area or it ends with the area being transformed into a beach park. These two initiatives are not coupled together because it is illogical to first build a dike and then later to tear it down in order to transform the area into a beach park.

Based on the adaptation map, you can identify the adaptation pathways, the pathways created by the measures, you wish to work further with for the area. For example, this could be the pathway 'object protection – raise terrain – build dike/floodwall' in the imaginary example.

Choice of axis

In this example of an adaptation map, time has been used as a parameter for when an initiative no longer functions. This is not necessarily easy, as no one can say how the future will develop. Instead of time, you can thus use a different parameter for the x-axis. For example, this could be the water level or the elevation point you work with as a protection level, or it could be the rate of flow in a watercourse. You should find the format that best fits the challenges you are working with and the parameters according to which you wish to plan.

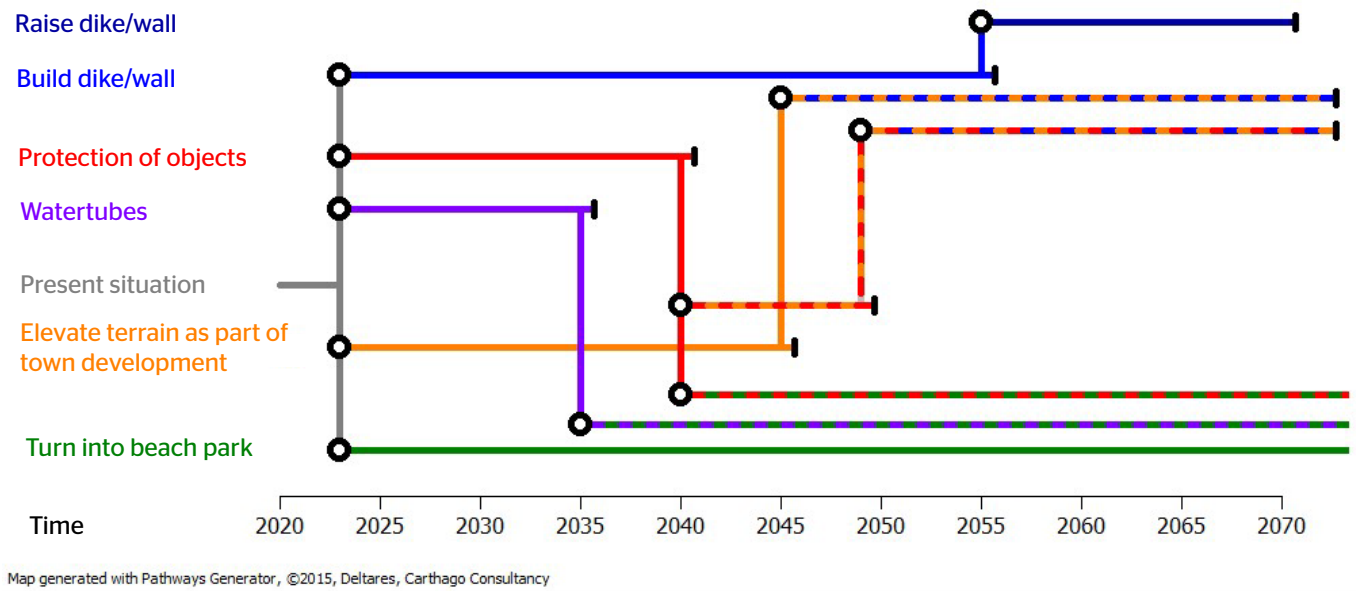


Figure 7 Example of a simple dynamic adaptation map

Working with scenarios

The dynamic measures map is a good tool for seeing the connections between the different measures and for discussing and visualising the various possibilities for climate adaptation and risk reduction for the area. On the other hand, it can also quickly become very complex, with many connections between the different measures. Similarly, it can be very difficult to use for communicating with decision-makers or stakeholders who are not deeply involved in the work.

In such instances, it can be valuable to work with more general scenarios for climate adaptation. From the example above, shown in Figure 7, two scenarios clearly emerge: one in which a dike is built and another where the area is transformed into a beach park. More possibilities can probably be added as to how the example above could develop, but ultimately, there will presumably continue to be just a small handful of realistic opportunities for how the area could develop in the long term.

Once these scenarios are identified, the next step is to cut them down so that it is clear what you will end up with, possibly with different possible options as how to get there. For the imaginary example, this can be simplified as shown in Figure 8. Here, either the construction of adike or the transformation into a beach park are begun right away; or the decision is postponed entirely, after which the measure is implemented at a later date. If the decision is postponed, the only measures that are implemented during the intermediate period are those, which are not unreasonably costly, as they are potentially temporary.

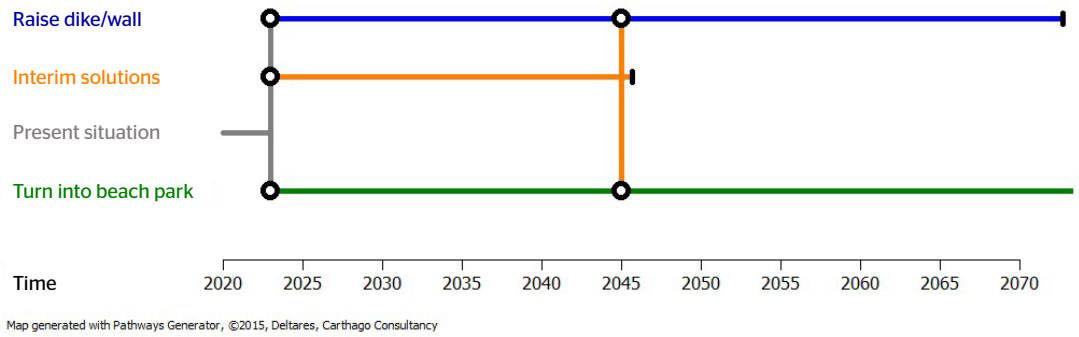


Figure 8 Example of how the map could look with scenarios instead of measures

Foto-Januar 2019 © Assens Kommune

Example: Dynamic measures map for Assens

As previously described, the Assens area was broken down into several sub-areas. To start with there were eight areas, but during the process these were combined to make five areas. Combining these areas was done during the process of preparing the measures maps, when it became clear that the measures for some of the areas were the same.

In addition to combining the sub-areas, the municipality identified three general scenarios for the area. Scenario A: a storm surge barrier is constructed today; Scenario B: the decision is postponed to a later date and more local solutions are worked on in the meantime; and Scenario C: the town is secured with local solutions. Besides these three, there was also a measure that needed to be implemented regardless of the other scenarios: a coastal dune defense at Assens Næs.

Through this process the municipality was able to prepare five adaptation maps for the five sub-areas and one scenario chart, which was used for communication purposes. In Figure 9 there is an example of an adaptation map for Assens and in Figure 10 a scenario chart is shown.

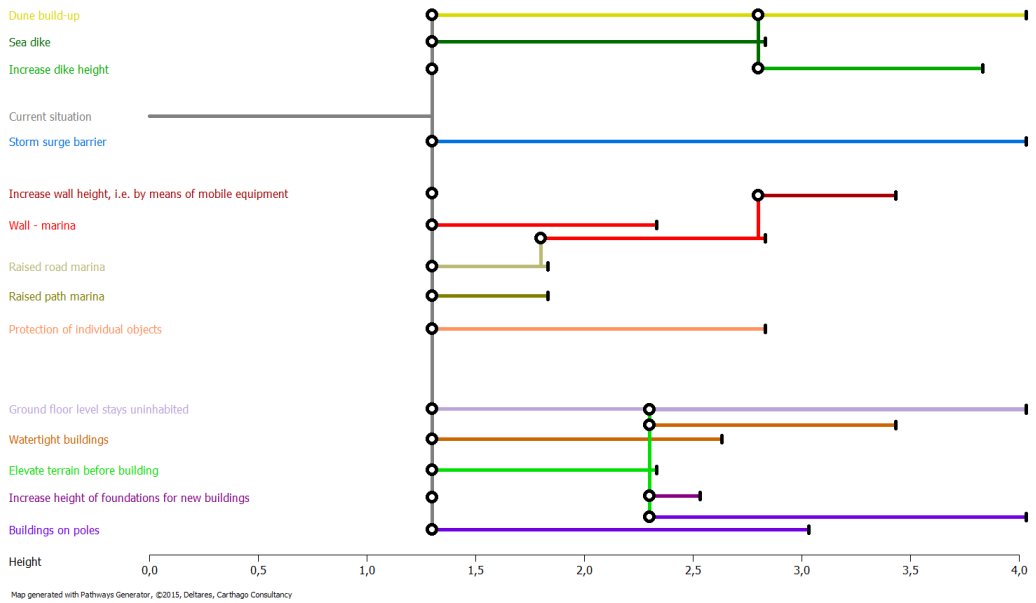


Figure 9 The adaptation map for the combined sub-area comprising sub-areas 1a, 1b and 2 from Step 1

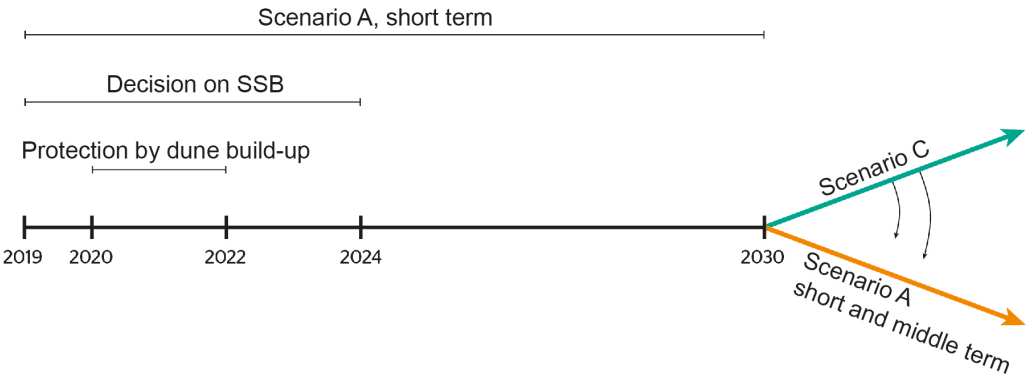


Figure 10 Scenario chart for the scenarios that are being worked with in Assens (Graph from Assens Municipality)

Example: Dynamic measures map for Vejle

Two measures maps were prepared in Vejle: one for the river, Grejs Å, which is in itself a source of flooding, and one map for the fjord and the river Vejle Å, where there is a greater connection between water levels. It was decided to make this breakdown as the solutions for Grejs Å do not play together with the solutions next to the fjord and Vejle Å. The measures map for Grejs Å is shown in Figure 12.

Based on the work with the measures maps, three general climate adaptation pathways or solution scenarios were identified, with which work was continued in the next step. This is shown in the map for the fjord and Vejle Å in Figure 11. Pathway 1 is marked in green and consists of the construction of a dike/wall along the harbour, which can be raised, the establishment of a sluice and finally, the construction of a storm surge barrier that can be raised. Pathway 2 is marked in orange and is very similar to pathway 1, but instead of raising the dike/wall, the terrain in raised in connection with urban development before a storm surge barrier is built. Pathway 2, which is marked in blue, consists of object protection of the threatened elements and a subsequent relinquishment of the area, which would mean vacating the location.

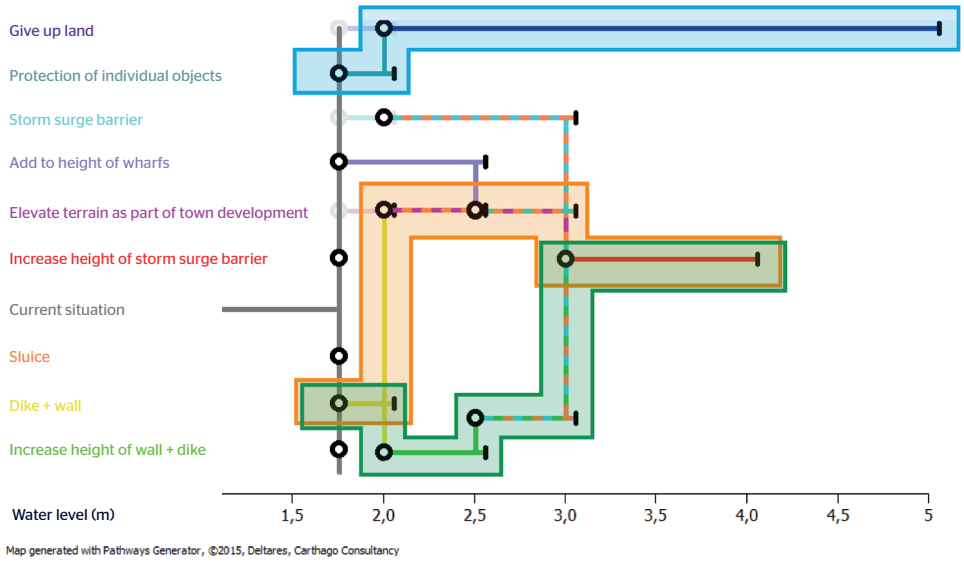


Figure 11 The measures map for the fjord and Vejle Å with the three selected scenarios marked in.

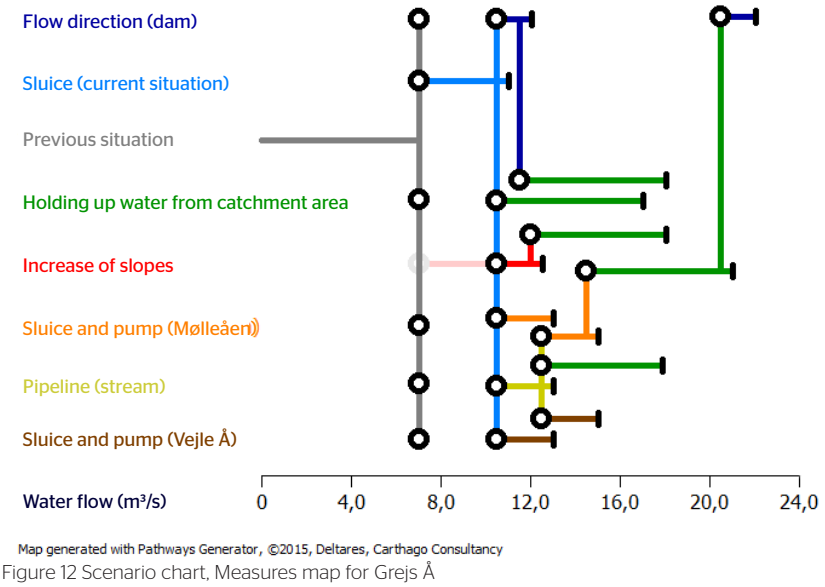
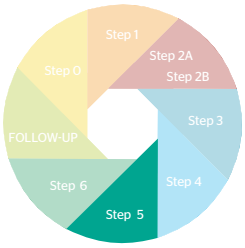


Figure 12 Scenario chart, Measures map for Grejs Å



Step 5 – Multi-criteria analysis

The purpose of Step 5 is to perform a multi-criteria analysis (MCA) for a smaller number of selected pathways from the developed measures map, as well as to involve the weighting by different stakeholders. The multi-criteria analysis is a decision-making tool that can integrate various stakeholders into the decision-making process.
The multi-criteria analysis is a prioritisation tool most often used in connection with complex problems across professional disciplines and with a high level of uncertainty. In a multi-criteria analysis, you assess the different measures based on a list of criteria that you have established. For example, this include the measure's risk-reducing effect, economic factors, environmental complications or the system's architectural quality. The criteria are weighted based on their importance. This enables you to chart the advantages and disadvantages of the different measures.

A panel will often be appointed in connection with a multi-criteria analysis consisting of a wide range ofstake holders, who give the various measures scores in terms of the listed criteria based on a predetermined scale. The tool offers an insight into the preferences of the different stakeholders and creates a shared understanding of the various issues. It is also extremely valuable in relation to any subsequent political process on a committee or in the town council, as the politicians get a more balanced picture of the issues and a greater understanding of the dynamics involved.

There are many different ways to tackle a multi-criteria analysis and a facilitator should familiarise themselves fully with the method before the analysis begins. It is important to keep in mind what subjective assessments, choice of attributes and scales are used. The process can be adjusted up or down in relation to the involvement of stakeholders.

Below we go through a simple, basic approach to the multi-criteria analysis, as used in Assens and Vejle as a starting point. Applicable to both municipalities is the fact that it was the project group which was solely involved in preparing the analysis, as both opted not to involve external stakeholders. There were also some challenges with the analysis; in particular, the way the multi-criteria analysis is carried out for the pathways proved challenging. This is elaborated upon in the method report, where it is also recommended that further work should be carried out in this area..

Review of the process in a multi-criteria analysis:
The multi-criteria analysis can contain several phases, which are presented in the box.

Phases in a multi-criteria analysis
- Selection of pathways
- Selection of criteria
- MCA for measures
- MCA for all the pathways
- Weighting of criteria

In the first phase, a number of climate adaptation pathways are selected from the prepared measures map to be analysed. By climate adaptation pathways we mean a combination of measures that lead to the end goal being achieved by a definite date. It is suggested that you do not select more than three pathways, in order to keep the process specific and manageable.

A brainstorming session is then done to determine the criteria on which you wish to base your assessment of the pathways. These can span broadly, from economic, organic and social to recreational considerations. It is essential that all criteria are measurable, as they give a score in the analysis. Here it is recommended that no more than 10 criteria are finally selected in order to ensure a certain level of transparency and to make the work manageable.

The set measures are assessed according to a scale from -5 to 5, where -5 is lowest, 0 is neutral and 5 is the highest possible score.

Each measure is given a score for each criteria in relation to whether the measure has a positive or negative effect on the criteria. The measures are reviewed systematically in relation to the criteria, and it is important to check that the scores are given in relation to each other. A storm surge barrier costs more than adike, but the exact cost will not necessarily have to be stated, unless you know it.

It is recommended that the selection of pathways and criteria is done by the project group, while the assessment if the measures in relation to the selected criteria is carried out by a broad-ranging panel. The panel could for example consist of local council members, experts in risk reduction, biologists, representatives from a supply company, the director of thehabour, local contractors, landowners, private and commercial, local associations and organisations, as well as residents (the wider population with an interest in the problem). You can hold a physical meeting, where you do the scoring and discuss this together, or you can let the various stakeholders fill out a form and explain their preferences. If you do not wish such broad involvement, the project group can do the scoring.

Involvement of interested parties
In this step, it may be relevant to involve the following interests:

- • Residents
- Politicians
- Shareholders (businesses and landowners)
- Local associations and organisations
- Experts in risk reduction
- Biologists (in relation to the environmental aspects)
- Supply company
- Representative for the marina
- Others who may be relevant

Once the analysis has been carried out for the measures, the values for the individual measures in one pathway are added together. So if pathway A includes higher quays, a flood wall and a sluice, then each of these scores are added together for the individual criteria, so the overall pathway has just one score for each criterion.[3]

A weighting of the criteria is then performed according to importance. All criteria are not equally important. Thus the criterion 'reduction of risk level' will often be seen as more important than, for example 'architectural quality'. This is not taken into consideration during the scoring of the individual measures. The weighting could for example be broken down as a percentage, where a total of 100 % is distributed across the selected criteria. Once the criteria have been weighted, a new scoring is done in relation to both measures and pathways. Those criteria that are weighted highest will receive a higher percentage share and thus have a greater influence on the measures and on the total number of points for the pathways. Similarly, the same stakeholders as those described above ought to be involved in the weighting process.

3 It can be problematic to perform the MCA for the pathways in this way if there are big differences in the number of measures between the pathways.

Example: Multi-criteria analysis for three pathways in Vejle

When the multi-criteria analysis needed to be carried out for Vejle, the municipality first selected three general pathways that it made sense to work with. The three pathways are shown in Figure 13. Pathway 1 is marked in green and entails the construction of a dike/wall (the height of which can be increased) along the harbour, the building of a sluice and finally, the construction of a storm surge barrier that can be raised. Pathway 2 is marked in orange and is very similar to pathway 1, but instead of increasing the dike/wall height, the terrain in raised in connection with urban development before a storm surge barrier is built. Pathway 2, which is marked in blue, entails object protection of the threatened elements and a subsequent relinquishment of the area, which would mean vacating the location.

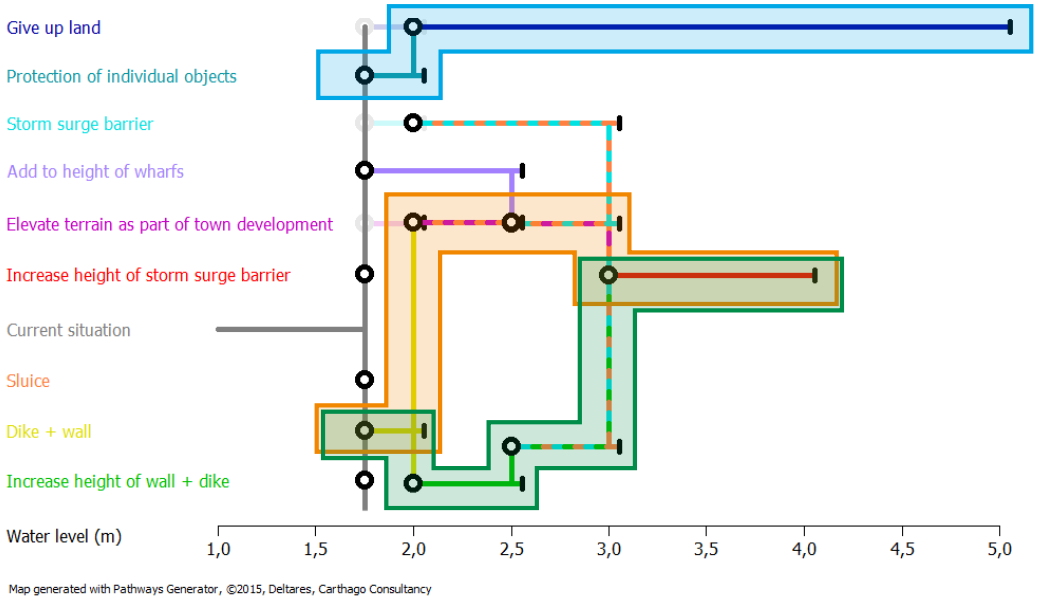


Figure 13 The 'measure map' for Vejle with markings of the three selected pathways. Pathway 1 is marked with a green outline, pathway 2 with orange and pathway 3 with a blue outline.

The process began by defining which criteria should form the basis for the Multi-Criteria Analysis (MCA). These would need to cover a broad range of criteria that are crucial for the town and important in relation to the risk-reducing measures. All relevant measures were assessed for each criteria on a scale from -5 to 5, depending on their impact on the area. A total was then calculated for the pathways, to which the extra criterion, flexibility, was added. The score is shown in Table 4.

Table 4 Multi-Criteria Analysis for Vejle of the specific measures and pathways

Criteria	Measure								Paths		
	Floodwalls and embankments	Raised floodwalls and embankments	Storm surge barrier	Sluice	Raise storm surge barrier	Protection of objects	Indicate area	Raise terrain urban development	Pathway 1	Pathway 2	Pathway 3
Ecosystem	0	0	-2	-2	0	0	0	0	-4	-4	0
Mitigation of risk	2	1	4	3	2	1	-1	1	12	12	0
Flexibility	-	-	-	-	-	-	-	-	4	3	5
Recreational additional value	1	0	4	1	0	0	-1	3	6	9	-1
Construction costs	-1	-1	-5	-2	-3	0	0	0	-12	-10	0
Municipal running costs	-1	0	-5	-3	0	0	0	0	-9	-9	0
Emergency preparedness requirements	-3	0	-4	-3	0	-5	0	0	-10	-9	-5
Taxable value	1	0	2	0	0	-2	-4	3	3	6	-6
TOTAL	**-1**	**0**	**-6**	**-6**	**-1**	**-6**	**-6**	**7**	**-10**	**-2**	**-7**

A weighting was then performed between the various criteria in relation to how much they ought to constitute as a percentage in the total weighting. It was then decided, for example, that the risk reduction ought to constitute 30% in relation to the taxable additional value, which should constitute 5%. The weighting and the adjusted MCA are shown by Table 5.

Table 5 Multi-Criteria Analysis for Vejle of the specific measures and paths incl. weighting

Criteria	Weighting	Measure								Pathways		
		Floodwalls and embankments	Raised floodwalls and embankments	Storm surge barrier	Sluice	Raise storm surge barrier	Protection of objects	Indicate area	Raise terrain urban development	Path 1	Path 2	Path 3
Ecosystem	5%	0	0	-2	-2	0	0	0	0	-4	-4	0
Mitigation of risk	30%	2	1	4	3	2	1	-1	1	12	12	0
Flexibility	5%	-	-	-	-	-	-	-	-	4	3	5
Recreational additional value	10%	1	0	4	1	0	0	-1	3	6	9	-1
Construction costs	15%	-1	-1	-5	-2	-3	0	0	0	-12	-10	0
Municipal running costs	20%	-1	0	-5	-3	0	0	0	0	-9	-9	0
Emergency preparedness requirements	10%	-3	0	-4	-3	0	-5	0	0	-10	-9	-5
Taxable value	5%	1	0	2	0	0	-2	-4	3	3	6	-6
TOTAL	**100%**	**-1**	**0**	**-6**	**-6**	**-1**	**-6**	**-6**	**7**	**-10**	**-2**	**-7**

Based on the MCA, pathway 2 is the one that scores highest for Vejle based on the selected criteria, current knowledge and existing conditions.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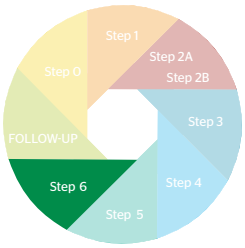
Step 6 – Action plan



The purpose of the final step, Step 6, is to develop a detailed action plan for the adaptation pathways or scenarios, with which you have decided to continue based on the preceding process and the multi-criteria analysis.
You can choose to work with just one scenario/adaptation pathway in drafting the action plan or opt for a combination : the scenario or pathway that is prioritised highest plus one or more additional scenarios/pathways. In this way, you can map out the actions necessary to carry out different scenarios and be better prepared for any future shift between the scenarios as a result of re-prioritising, new policies, unforeseen climate changes and so on.

The action plan must provide an overview of actions that must be implemented or initiated within different time horizons in order to carry out the measures in the pathways or scenarios that have been chosen. For example, the time horizons could be broken down on the basis as criteria, as suggested in Table 6.

Table 6: Suggestions for time horizons and how they could be selected

Instant 'no regret' investments	Probable medium term investments	Possible long term investments
0-5 years	5-20 years	>20 years

The action plan can be drawn up using different techniques. One method is to go into detail with all the steps that must be completed in order to implement a measure. These are then placed in chronological order and into one of the three time boxes depending on time of initiation of the individual action. If it is an action that is expected to take a long time, for examplelobbying for amendment of legislation , then both an implementation date and a date by which the goal should have been achieved can be given. Once this has been done for all the necessary measures in the individual scenarios, you then have your initial plan for how they can be carried out.

There might be climate adaptation pathways or scenarios wiyh uncertainty as to whether they will be realised. This could be due either to one wishing for a second scenario, i.e. a 'plan B' scenario, or it could be the result of many uncertainties as to the extent to which the measures in the scenario are necessary or realistic, e.g. perhaps it is uncertain whether funding can be obtained. In such cases there may need to be preparatory work to make the scenario happen , despite it being uncertain whether the scenario will be carried out, but which is important for determining whether it can be achieved later. For example, this could be reserving an area where an dike could be constructed, if necessary. The dike-scenario cannot be achieved if buildings have been erected on the necessary plot in the intermediate period.

Preparation of an action plan should thus show all the steps or elements to be completed in order for a measure to be implemented later, if it proves necessary at that point.

Example: Action plan for Vejle

An action plan was made in Vejle for the municipality's adaptation pathway 2, which is marked in orange under the example for Step 4. The pathway consists of:

1. Construction of a dike/wall along the harbour.
2. Raising the terrain in relation to town development.
3. Establishing a sluice in Vejle Å.
4. Construction of a storm surge barrier, which can be raised.

An action plan has thus been prepared for each of the four measures that are necessary in order to implement the pathway, as shown in Table 7. The action plan was extremely detailed, and the specific actions have already been cut down slightly in the example. Vejle Municipality has worked further with this action plan, as can be seen in its proposal for a storm surge strategy, where the action plan is presented as an adaptation in three phases. Phase 1 is a protection line at an elevation of 2 metres, which will be initiated immediately. Phase 2 is an extended protection line at an elevation of 2.5/3 metres, which will provide protection in the medium-term. The third and final phase is long-term protection. For each phase there are actions that must be initiated and carried out in the short-term, medium-term and long-term in order for the measures to be implemented, see Vejle Municipality's Proposal for a Storm Surge Strategy from 5 February 2020.[4]

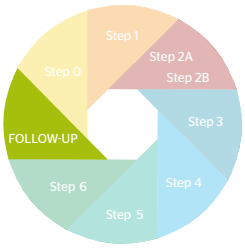
Table 7: Action plan for adaptation pathway 2 in Vejle

	Short term, within 5 years (2019-2024)	Mid term (2024-2050)	Long term (2050-2070)
Storm surge barrier	• Lobbying for changes to legislation that could cause obstacles • nvestigate relationship to other legislation • Investigate financing possibilities	• Involve stakeholders and relevant collaborative partners (residents, neighbouring municipalities etc.) • Update the risk assessment and make further, more detailed studies of local conditions • Gathering of experience and analysis of barrier types • More detailed MCA and C/B analysis • Narrowing down the ideas and possibilities, including coupling up to other stakeholders (infrastructure, recreation etc.) • Specific funding potential • Make a decision • Choice of location and type	• Detailed modelling • Draft for organisation of operations • Conceptual design • Residents' involvement • Various legal frameworks put in place • Project design • Programme of operations and organisation • Decision on a solution and its funding • Permits, incl. VVM • Put out to tender and build in 2070

4 Vejle Municipality, 2020. Storm surge strategy (Proposal 5/2/2020). https://www.vejle.dk/media/29687/200205_forslag-stormflodsstrategi.pdf

Wall/embankment	• Decide on the line of the embankment • Identify delegation of responsibility • Identify allocation of funding • Final specification of an adaptation strategy • Conceptual design (choice of solution) • Funding in place • Overall study in relation to other sources • Project design • Permits, incl. VVM • Put out to tender and build	• Operation and maintenance	• Operation and maintenance
Raise terrain	• Final specification of an adaptation strategy • Development plan and resident involvement • Involvement of the Marina due to potential new areas	• Assuming: The municipality takes over the areas from the habour • Start-up of a partnership re. external funding – Specification of a development plan – Design process with sketch/plan for the district • Basis for the plan in place • Project design in relation to land development – Funding – Involvement • Put out to tender and build	
Sluse i Vejle Å	• Final specification of an adaptation strategy • Once the line of the embankment has been determined, the location of the sluice must also be decided • Investigate financing possibilities	• Specify ownership and secure the area • Conceptual design • Basis for the plan and VVM • Funding in place • Overall study • Project design • Permits, possibly incl. VVM • Put out to tender and build	• Operation and maintenance

Follow-up



Once the process has been finalised, a continuous follow-up of the action plan and an on-going monitoring of the system should be initiated. This is necessary to ensure that both the plan and its implementation may be adjusted when required.

On-going monitoring and adjustment of the action plan and its implementation are crucial in order to achieve the desired future scenario. The importance of readiness to respond to any needs for adjustments to the action plan cannot be underestimated. In a similar manner, the entire system should be continuously monitored to reveal any changes that would ultimately affect the action plan.

Examples of changes to the system could be climate change happening at an unexpected pace, i.e. quicker or slower than first expected. New legislation may turn out be an obstacle to the process, or town development might pick up unexpected speed, meaning that some actions must be accelerated. Such changes to the plan will not be unusual. In case of major changes, it may be recommendable to repeat the entire dynamic planning process. Important changes may lead to new challenges or new options, which may become apparent when repeating the relevant steps of the process. Naturally, this should be done as an add-on to the original process.

Bringing in more detail

As mentioned earlier, a more or less detailed approach can be taken, when going through the process, depending on the complexity of the area in question or on the amount of information available at the time. Sometimes, it may therefore be beneficial to go through the process again to ensure a more detailed view.

Once the process has been completed taking a general perspective, it may have revealed options to be investigated further. This may require re-visiting some of the steps of the process, this time in more detail. For instance, it may be relevant to go into more detail about the actions laid out in Step 4, or Step 5 could be executed as a proper cost-benefit analysis. The actual requirements, the complexity of the area and the possible climate adaption pathsways should determine the degree of detail applied to the process.

If a more detailed perspective is required for the entire area or for a portion of the area, it may be beneficial to restart the process, either from the very start or from one of the steps along the way, depending on what would be the actual requirement. The first steps in the process may seem rather comprehensive and it is tempting to skip them. However, it is always recommendable to at least consider the elements of each of the steps, since this may reveal options that would otherwise never have been thought of.

Foto: Januar 2019 © Assens Kommune

Dynamic planning - process description

A brief overview of the process

Step 0 is about alignment of expectations and is useful for reflections and discussions about the desired outcome of the dynamic planning process. This step should clarify the purpose of the work and ensure that the work group has the mandate required to carry through the task. It is essential to a successful process that suitable resources are available both in terms of time and manpower.

Step 1 is a description of the target area for the planning process and the system, which influences that area. The purpose of this initial step is to create a joint understanding of the area and present day flood challenges, how these challenges may develop in future, as well as the uncertainties involved.

Step 2 consists of two parts. Part one, Step 2A, is a general brainstorming process to come up with ideas of how to handle flood challenges. These ideas are then sorted into relevant categories and organised into a catalogue of ideas. The second part, Step 2B, is an overview of visions, plans ect., already in place for the area, in order to align solutions generated in the course of the process with existing visions and planning.

Step 3 is a revision of Step 2, with a view to demarcate or broaden the possible initiatives compiled the catalogue of ideas in line with visions mapped out. This should ensure weeding out of initiatives that contend with the general development plans for the area.

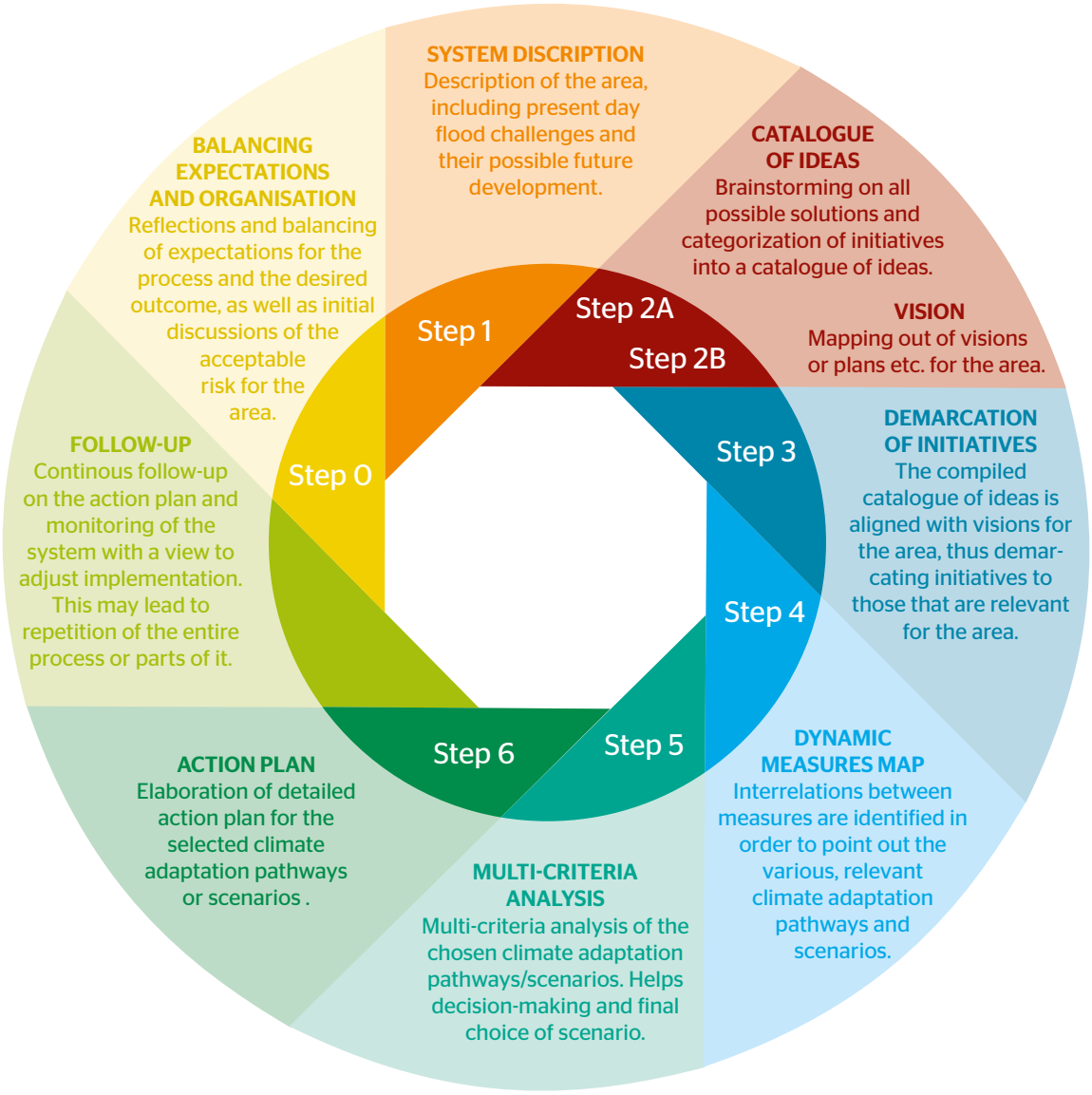
Step 4 is a compilation and sorting of initiatives. The aim is to find initiatives that match the visions for the town and reduce the risk at the same time. This should demonstrate the interrelation between the various initiatives, as well as their mutual dependencies. This is the platform from which the desired climate adaptation paths are chosen. This step may also be useful in clarifying any general scenarios suitable for communication work or for further discussion at the political level.

Step 5 is a multi-criteria analysis (MCA) for a limited number of selected pathways from the map of measures. At this stage it will be beneficial to include weighting by stakeholders and politicians, since the multi-criteria analysis is a decision-making tool, designed to find the desired climate adaptation pathways for the area.

Step 6 is the elaboration of a detailed action plan for the work with the climate adaptation pathways or scenarios selected based on the completed process and the multi-criteria analysis.

Follow-up

Once the process is completed, a continous follow-up and monitoring of the system should be initiated. System changes, requirement for a more detailed perspective or new insights gathered along the way may mean that the process will have to be repeated. This will ensure that the plan and it implementation are adjusted, when necessary.


SYSTEM DISCRIPTION
Description of the area, including present day flood challenges and their possible future development.
CATALOGUE OF IDEAS
Brainstorming on all possible solutions and categorization of initiatives into a catalogue of ideas.
VISION
Mapping out of visions or plans etc. for the area.
DEMARCATION OF INITIATIVES
The compiled catalogue of ideas is aligned with visions for the area, thus demarcating initiatives to those that are relevant for the area.
DYNAMIC MEASURES MAP
Interrelations between measures are identified in order to point out the various, relevant climate adaptation pathways and scenarios.
MULTI-CRITERIA ANALYSIS
Multi-criteria analysis of the chosen climate adaptation pathways/scenarios. Helps decision-making and final choice of scenario.
ACTION PLAN
Elaboration of detailed action plan for the selected climate adaptation pathways or scenarios .
FOLLOW-UP
Continous follow-up on the action plan and monitoring of the system with a view to adjust implementation. This may lead to repetition of the entire process or parts of it.
BALANCING EXPECTATIONS AND ORGANISATION
Reflections and balancing of expectations for the process and the desired outcome, as well as initial discussions of the acceptable risk for the area.
Step 0
Step 1
Step 2A
Step 2B
Step 3
Step 4
Step 5
Step 6

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