

## Building adaptation strategies for infrastructures and networks

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## 1 Description work package

### 1.1 Problem definition, aim and central research questions

The problem addressed by this work package is that there are no comprehensive adaptation strategies for the main economic hotspots of the Netherlands that are threatened by climate change. It is unlikely that the PhD and post-doc research projects carried out in parts of the program will by itself lead to a degree of multidisciplinary integration of scientific and practical knowledge, required to deal successfully with climate adaptation. We believe that it is necessary to facilitate knowledge integration in our program in order to arrive at adaptation strategies, partly by embedding it in the research, but partly also by setting apart an integration function in this separate WP.

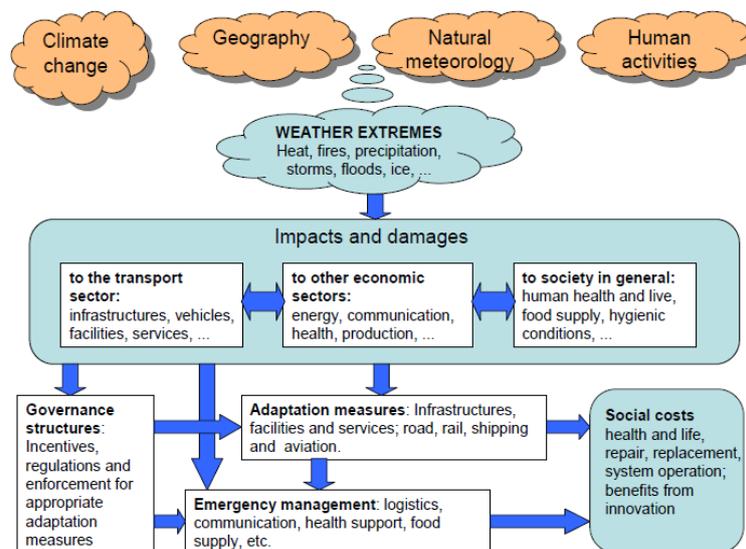


Figure: A high-level integrative system diagram for adaptation (source: Fraunhofer, 2000)

The knowledge developed in WP2-4 concerns different dimensions of the problem (technical, organizational, economic). Each WP has research activities and has reserved part of the resources for interaction with other disciplines and the stakeholders. Although we are convinced that this is a necessary approach to deliver useful results to stakeholders, it is not yet sufficient, as challenges will occur that require a multi-lateral and simultaneous integration of work areas. The WP 2-4 results, therefore, will need to be aligned and brought together at the program level as well using a broad platform. Another reason to create a program level platform is that we believe the integration of knowledge is more effective if this is not only done from the research perspective, but in a collaborative way with the practitioners.

The aim of WP1 is to design adaptation strategies at the regional level that address the policy response of 2 hotspots to climate change. This task integrates and valorizes the knowledge created in WP2-4, in dialogue with the stakeholders. The project has three underlying objectives:

- ▽ Creation of a platform where researchers and practitioners have a dialogue concerning adaptation for infrastructure and networks. All stakeholders will be involved to make sure that conditions for implementation and support can be assessed. In addition, stakeholders will be able to respond to intermediate results of fundamental research that takes place in the other WP's.
- ▽ Development of a systems model, which consistently describes the propagation mechanisms of climate change on infrastructure and networks, and the associated economic impacts. In the initial stages of the programme it will be used to assemble and structure the existing knowledge, and the insights from research in the 1<sup>st</sup> KfC-tranche, thus giving context and input to WP's 2, 3 and 4. As the programme goes on, more and more results from these WP's will become available and will be incorporated in the model. In this way, the model will have a central role in the knowledge management to make all the insights concerning climate change mechanisms and policy impacts transparent to stakeholders.
- ▽ Comprehensive and flexible adaptation strategies using a cyclical approach, for the participating hotspots. These strategies will be in the form of road maps that allow switching between different types of measures (e.g. pro-active and reactive), keeping options open where necessary and hedging risk where needed.

## 1.2 Interdisciplinarity and coherence between the projects

Not applicable (only 1 project).

## 1.3 Stakeholders

The stakeholders involved in this WP can be found in three layers around the program. The first layer includes parties that are involved by direct participation or co-financing of the program. Besides the other program theme representatives, this includes the Dutch national government, the hotspot involved

(Rotterdam-Rijnmond) and those institutes that will be contracted for co-financing (intended participants are the infrastructure providers Rijkswaterstaat, ProRail and Waternet). The second layer includes those institutes in the Netherlands that do not participate directly but share an interest in the outcomes due to their responsibilities in climate change adaptation for infrastructure and networks. The third layer is the wider professional community (both scientific and practitioner).

## 2 Project 1.1 Integration of knowledge towards adaptation strategies

Project leader: prof.dr.ir. L.A. Tavasszy

### 2.1 Problem definition, aim and central research questions

The problem addressed by this project is that there are no comprehensive adaptation strategies for the infrastructure and networks of the main economic hotspots of the Netherlands that are threatened by climate change. *The objective of project 1.2 is to integrate and apply the knowledge created in WP2-4 by designing adaptation strategies for the hotspot Rotterdam-Rijnmond and the other co-financing stakeholders.*

The research questions are the following

- ▽ What combination of measures is needed to create system robustness, from a point of view of the technical, organizational and economic dimensions (strategies)?
- ▽ What are the necessary framework conditions for implementation of these measures (governance, financial, spatial)?
- ▽ Which choices about alternative measures should be made when (roadmap)?

### 2.2 Approach and methodology

The approach in this project is focused on applicability of the knowledge for the agents responsible for development and maintenance of infrastructures. It contains 3 key elements, which will be integrated through a series of case studies:

1. A platform for dialogue between researchers and practitioners concerning adaptation for infrastructure and networks.
2. A systems model, which consistently describes the propagation mechanisms of climate change on infrastructure and networks, and the associated economic impacts.
3. Comprehensive adaptation strategies for infrastructures and networks for the participating hotspots.

#### Ad1 Platform function

The stakeholders are the users of the results of the program that participate financially, i.e. the two main port regions (Amsterdam/Schiphol and Rotterdam), the Ministry of Transport, Waterways & Public Works as well as Environment & Spatial Development and the railways infrastructure authority ProRail. Although the importance of dealing with climate change adaptation is undisputed, currently the sense of urgency

among stakeholders is low. To a large part, this has to do with the low level of awareness of adaptation issues within the organizations. We expect therefore that as the research develops, our stakeholders will be able to more clearly articulate their concerns, become more actively involved and increasingly seek to influence the research agenda. The platform of the project will materialize through conferences and smaller workshops to allow interaction between stakeholders and research groups. Stakeholders will be given the opportunity to respond to intermediate results of fundamental research that takes place in the other WP's. The platform will also be used for international workshops, where several experts from abroad will be invited once a year to deliver a presentation on climate change research and policy practice in their countries. From the perspective of the development of research program into a centre of excellence, this interaction will be valuable to benchmark practices internationally and assess necessary conditions for implementation and support. Over the course of the project, a wider group will be involved of interested institutions. Eventually, the platform will be the basis for dissemination of the project results with a view to application in infrastructure and network policy and design.

### **Ad 2 System model**

In the initial stages of the program a system model will be developed to assemble and structure the existing knowledge with a particular focus on system-wide or trans-disciplinary effects. Due to the complexity of the circumstances in the Randstad (a high density delta area, largely below sea level with a global sea- and airport) there are many possibilities for system level synergies. One example is the alignment of investments in protective (dikes) and transport infrastructure (roads). While the emphasis in WP2-3 will be on developing and using mathematical models to assess climate change impacts and adaptation measures, the focus here will be on conceptualizing the system effects, in order to show interactions between partial studies in WP2-4, for the two hotspots involved. The insights from research in the 1<sup>st</sup> KfC-stage will be added, thus also giving context and input to WP's 2, 3 and 4. As the program goes on, more and more results from these WP's will become available and will be incorporated in the model. In this way, the model will have a central role in the knowledge management to make all the insights concerning climate change mechanisms and policy impacts transparent to stakeholders. This part of the project includes a group model building exercise which will be carried out primarily by the research team in collaboration with the participating hotspots.

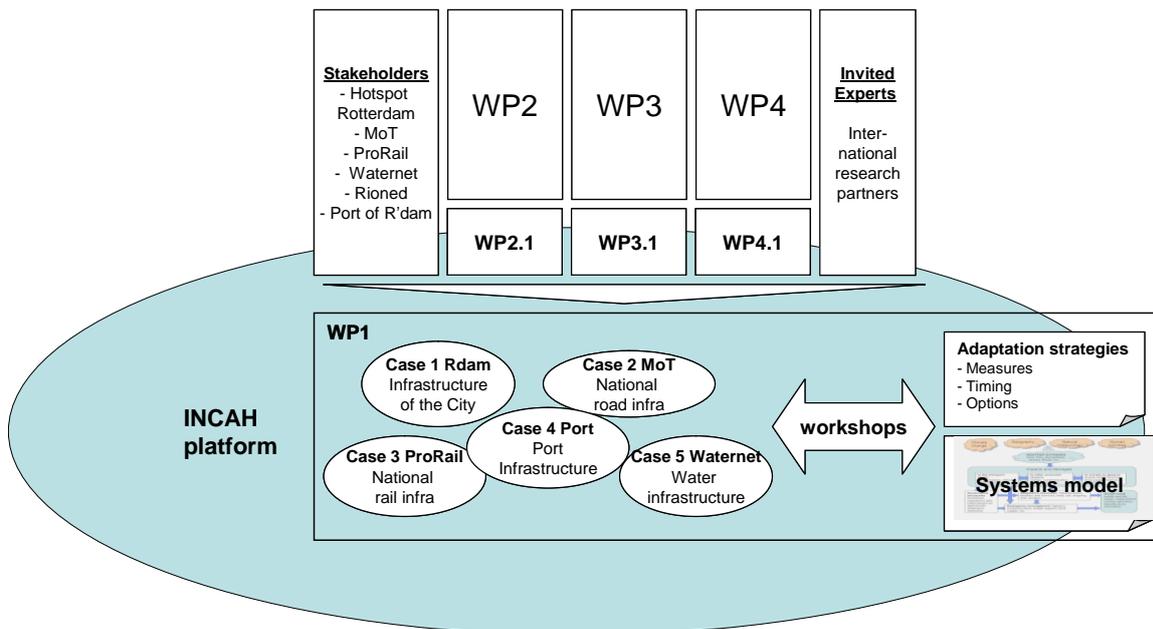
### **Ad 3 Adaptation strategies**

We define adaptation strategies as robust and consistent sets of measures that allow policy makers to respond flexibly to uncertain but changing climate circumstances, directed at maintaining a predetermined level of operational quality of infrastructures and networks over a longer period of time. This definition departs from the notion that adaptive policy making is needed to cope with deep uncertainties in the system (Walker et al, 2004). Strategies for climate adaptation will be created in the form of roadmaps. This approach will allow stakeholders to switch between different types of measures (e.g. pro-active and reactive), keeping options open where necessary and hedging risk where needed. The roadmaps will be developed starting from a future year in which risks become unacceptably high, and inferring through backcasting what types of measures are needed, and when. The roadmapping

process will use 3 primary resources as input: the platform, the systems model and the research developed in WP 2-4.

**Integration of knowledge in case studies**

The researchers from the different work packages will work together to populate the platform with stakeholders. Through a series of workshops we will develop the systems model and the adaptation strategies.



The following case studies into adaptation strategy are foreseen, where two critical conditions to initiate a case study are fulfilled (active participation of the main stakeholder and availability of in-depth research in WP2, 3 and 4):

- ▽ The municipality of Rotterdam and regional parties are the key hotspot for this program. This regional coalition has prepared its participation in the Knowledge for Climate program very thoroughly and has selected the INCAH program as one to participate in with selected city infrastructural issues (e.g. flooding of tunnels). Financial support is foreseen.
- ▽ National road networks: the main stakeholder here is the Dutch Ministry of Transport, Public Works and Waterways. The case study addresses points in the Ministry’s national action agenda for climate change and is foreseen to be supported financially by the Ministry.
- ▽ National railways: the national rail infrastructure provider ProRail has given its consent to identify the main problems that can be expected for the Dutch rail system and will contribute to the research in kind and possible in cash.
- ▽ Rotterdam Port: A second research case concerns the construction of locks in the waterways in the port area in order to prevent the intrusion of salt water and high water levels in urban areas.

The Rotterdam Port Authority has indicated it will participate in this case study, using the PhD research as a basis.

- ▽ Waternet and Rioned are two key organisations (private and public) with an integrated responsibility, for respectively, drinking water and waste water management. These organisation support the research carried out on stability of water quality and water management infrastructure and will participate in the development of adaptation strategies.

### 2.3 Scientific deliverables and results

The project will deliver two main scientific outputs, both by means of articles in international peer reviewed journals. The first output is a systems model for climate adaptation challenges in the area of infrastructure and network policy. This systems model will link the knowledge of different discipline areas. The basis for the model will be the quantitative models developed from the different disciplinary angles. To our knowledge, there is no systems model available for the complex challenge of climate adaptation in densely populated agglomerations in a delta area such as the Netherlands. The second result consists of the resulting adaptation strategy developed for the two hotspots. As this part of the project is in fact a unique case study in adaptive policy analysis for climate change adaptation, the process will be reported as well. It will include a review of the adaptive policy making literature, a careful design of the collaborative process to develop the adaptation strategies and a research report.

### 2.4 Integration of general research questions with hotspot-specific questions

The main thrust of the entire project is to integrate the research with the questions of the hotspots. We note that the platform in this project enables these stakeholders to bring in new questions along the way, in order to allow a comprehensive adaptation strategy to develop.

### 2.5 Societal deliverables and results

Next to the scientific outputs, by preparing adaptation strategies the project will in fact produce an action plan for the participating stakeholders which is a comprehensive plan based on the latest research and will also have wide support due to the use of the collaborative platform.

### 2.6 Most important references

1. Amran, M., and N. Kulatilake (1999) Real Options, Managing Strategic Investment in an Uncertain World, Harvard Business School Press, Boston.
2. Andersen D F, J A M Vennix, G P Richardson, E A J A Rouwette (2007), Group model building: problem structuring, policy simulation and decision support. J. Operational Research Society, 58, 691-694.
3. Feenstra, J., I., Burton, J. Smith and R.Tol (eds.), Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies, Vrije Universiteit Amsterdam, Amsterdam, 1998
4. Frame, B. (2008), 'Wicked', 'messy', and 'clumsy': long-term frameworks for sustainability, Environment and Planning C: Government and Policy 2008, volume 26, pages 1113 ^ 1128

5. IISD - International Institute for Sustainable Development (2006) Designing Policies in a World of Uncertainty, Change and Surprise, IISD, Winnipeg.
6. Lempert R.J., M. E. Schlesinger (2000) Robust Strategies for Abating Climate Change, Climatic Change, 45 (3/4): 387-401.
7. Lim, B., E. Spanger-Siegfried (eds.), Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures, Cambridge University Press, Cambridge, 2004
8. Walker, W.E., S.A. Rahman S.A., J.Cave (2001) 'Adaptive Policies, Policy Analysis, and Policy Making'. European Journal of Operational Research, Vol. 128, No. 2, pp. 282-289.
9. Hopkins, L.D. and M.A.Zapata (eds.): Engaging the Future. Forecasts, Scenarios, Plans, and Projects, Cambridge: Lincoln Institute for Land Policy, 2007