Visualising and managing uncertainties

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Type: Framework

Project Phase: all

Purpose: To identify the type of uncertainties of a project and apply suitable strategies

Requirements: no special skills required

Relevant Software: none

About

This framework tool gives guidance on how to manage uncertainties in (BwN) projects. In projects using BwN design principles, uncertainty can play a bigger role than in traditional projects, as unpredictable natural dynamics are proactively used in the projects' design. Uncertai nties can be managed with an appropriate strategy after identification and classification of the uncertainties. A classification for uncertainties en strategies for dealing with specific types of uncertainties are provided in this tool. The tool is meant especially for teams and managers developing BwN-type projects. No special skills are required.

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Uncertainty can be a prominent issue in policy and project development processes, as both decision-makers and laypeople generally have difficulty accepting uncertainty about the outcomes and effects of large-scale – and probably costly – interventions. In comparison to traditional hydraulic engineering solutions (eg. dykes and storm surge barriers) that attempt to control nature, uncertainty is an inevitable part of BwN projects, due to the uncertainty of natural processes that are utilised in the design.

This tool is aimed to provide guidance on two issues. Firstly, if a specific uncertainty is identified, it is crucial to understand its nature or type. To that end, a classification of uncertainty is provided. Secondly, different types of uncertainty have quite different characteristics. As a result, these uncertainties require very different strategies to manage them. Strategies are therefore suggested for each specific type of uncertainty. This tool is mainly based on the research of Brugnach et al. (2008) for the NeWater project and the PhD work of Van den Hoek in BwN project 'Coping with uncertainty in water engineering projects embracing natural dynamics'.

The meaning of uncertainty

5 Basic steps towards Building with Nature

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Both in the scientific literature and in professional practice, uncertainty used to be regarded as a 'deficit of knowledge', caused by e.g. the absence of information, insufficient quality of the data available and/or contradictory findings. This classic interpretation implies that uncertainty can be dealt with via strategies such as “do more research”, “go for more accurate data” and “use better measuring equipment”.

In practice, interpreting uncertainty as a 'deficit of knowledge' will narrow down its analysis and management, with too much focus on specific details. Such details are usually of minor relevance for decision-makers who ultimately decide whether or not the proposed project will be realised, as well as for the public whose commitment may be essential to get things done.

Is it really necessary to reduce every uncertainty to a minimum? Recent scientific literature indicates that uncertainty is much more than a deficit of knowledge, if and when it plays a role in policy development processes. The answer to the above question should therefore be negative. It is more important to focus on those uncertainties that can become "trouble-makers" in policy and project development and threaten the continuation of promising, innovative initiatives. By definition, such innovations – like BwN – involve many uncertain elements, if it is the first time that such a project is realised (otherwise it would not be an innovation).

Uncertainty is defined here as the situation in which there is not a unique and complete understanding of the system at hand (Brugnach et al., 2008). The tool is meant to analyse uncertainty in policy and project development. It provides insight into the different types of uncertainty and provides some strategies – or tips and tricks, do's and don'ts – to deal with the "troublesome" uncertainties. Using practical examples, we will show that it is essential to correctly identify the type of uncertainty, as the type determines the appropriate strategy.

Building with Nature interest

The tool is interesting for BwN for two reasons. Firstly, BwN proactively uses natural dynamics and materials, of which the behaviour is difficult to predict on the short-term and largely unpredictable in the long run. This means that uncertainty is an intrinsic characteristic of the use of BwN design principles in a water engineering project, probably more so than in the case of a traditional engineering approach. Moreover, the use of BwN design principles is innovative and many people are still unfamiliar with the BwN concept. This means that there is also a lot of room for perceived uncertainty, feelings of insecurity, and ignorance. The tool can be used in all phases of BwN project development.

How to Use

There are no special requirements for the tool, such as software or specialist involvement. The tool is especially helpful for project teams and the project managers of promising (BwN) initiatives and can be used in the setting of a regular project meeting. The tool mainly consists of three steps:

1. Uncertainty identification
2. Uncertainty classification
3. Uncertainty management

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1. Uncertainty identification

When identifying the most important uncertainties in a BwN project's development process, actors need to focus on uncertainties that can hamper development, cause budget overruns or cuts, influence milestone decisions or even cause the cancellation of the entire project. The number of uncertainties in a project using BwN design principles is by definition very high, as this is an inherent characteristic of this type of projects. Therefore, do not focus on the numerous "minor" issues, but concentrate efforts on the (few) uncertainties that can become a major concern.

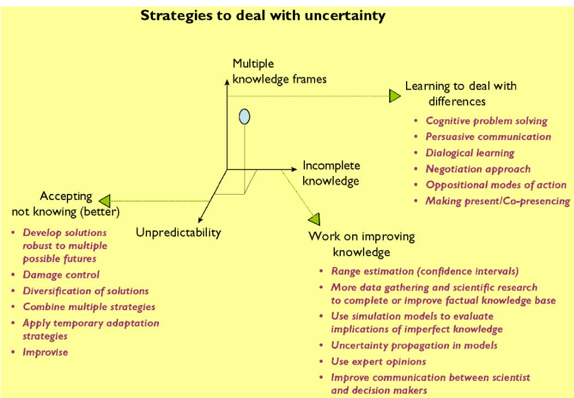
Note that there is a difference between true uncertainty and perceived uncertainty. Some issues are "truly" uncertain, for instance because there is insufficient knowledge about a subject. Some other issues can be perceived to be uncertain whereas they are not. For instance, some stakeholders may expect the project to have a specific negative effect, while it is generally known among experts that this effect is highly improbable. Yet, perceived as well as true uncertainties can influence the project´s development and are therefore equally relevant. The role of perception or framing in uncertainty studies is discussed in more detail below.

2. Uncertainty classification

Uncertainty is defined as the situation in which there is no unique and complete understanding of the system at hand (Brugnach et al., 2008). Following this definition, we distinguish three types of uncertainty:

- **Unpredictability** – uncertainty due to unpredictable or chaotic behaviour of e.g. natural processes, human beings or social processes (Walker et al., 2003; van Asselt and Rotmans, 2002). Weather conditions are a typical example of an uncertainty that is unpredictable. The uncertainty is not reducible by doing more research, as the weather is variable and unpredictable. Lorenz (1963, 1969) already showed that an indicative prediction of the weather cannot be given more than 2 weeks in advance, as minor changes in initial values can have a major impact on the evolution of the system´s state;
- **Incomplete knowledge** – uncertainty due to the imperfection of our knowledge, e.g. due to lack of specific knowledge, data imprecision or approximations (Walker et al., 2003). For example, in the case of the Sand Engine, the uncertainty about the effect of the sand nourishment on groundwater levels is due to a lack of knowledge. This uncertainty is reducible by additional research;
- **Multiple knowledge frames** – uncertainty due to the presence of multiple knowledge frames or different but (equally) valid interpretations of the same phenomenon, problem or situation (Brugnach et al., 2008, 2011; Dewulf et al., 2005; Kwakkel et al., 2010). For example, Brugnach et al. (2008) studied an irrigation problem in a Spanish river basin. While farmers framed the problem as a situation of water shortage, the government framed it as a situation of overconsumption of water resources. Both interpretations of the problem can be valid, but lead to different action paths and solutions. Hence, the presence of multiple knowledge frames causes uncertainty in decision-making.

It is important to distinguish these types of uncertainty, as different strategies are needed to manage each of them (Brugnach et al., 2008).



3. Uncertainty management

Managing uncertainty is of major importance in EDD. Brugnach et al. (2008, 2009) give a clear overview of strategies that can be applied to manage each of the three types mentioned above(see Figure as well):

- **Unpredictability** – The appropriate strategy here is to accept that we cannot know better. An unpredictability CANNOT be reduced by doing more research due to its inherently chaotic and variable behaviour;
- **Incomplete knowledge** – Here the strategy should be to increase or improve the available knowledge. In principle, this uncertainty can be reduced by knowing more or better. Yet, the opposite can also be true: more information may also enhance our awareness of knowledge gaps, and thus increase uncertainty (Van Asselt, 2000);
- **Multiple knowledge frames** – Dealing with framing differences is the strategy to be adopted here. If multiple frames are present, additional knowledge will not solve the problem. Seeking mutual understanding and shared commitment is the way to solve the problem of ambiguity.

The figure is a graphic representation of these strategies. The figure was taken from a report by Brugnach et al. (2009) from the NeWater project. It specifically addresses uncertainty in a similar context as BwN, namely ‘adaptive water management’.

4. Advice and recommendations

The BwN project ‘Coping with uncertainty’ yielded several results regarding uncertainty using the method described above. The outcomes of this analysis provide important lessons where to expect uncertainty in future BwN projects and how to deal with it. These lessons are briefly discussed below.

Practical Applications

In the BwN project ‘Coping with uncertainty’, the method described above was applied in retrospect to the Sand engine, in order to identify the most important uncertainties. The results and lessons learned from this analysis that can be of importance in future BwN projects are described in this section. The above mentioned uncertainty management strategies were not applied using the described tool.

1. Uncertainty and policy development
2. Uncertainty range
3. Acceptance
4. Uncertainty as a weapon
5. Role of reports
6. Champions
7. Timing

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1. Uncertainty and policy development

Uncertainty gets meaning in policy development and is therefore much more than what classical science defines as 'deficit of knowledge'. In policy development, there are multiple stakeholders and actors with different backgrounds, values, beliefs, interests and powers. They may have different interpretations of a (uncertain) phenomenon. As a consequence, ambiguity - uncertainty due to the existence of multiple, equally valid knowledge frames - is the most important type of uncertainty in BwN projects. More specifically, uncertainty gets meaning in policy development via its social implications, such as swimmer safety or financial commitment. These are more important than the unpredictability of weather conditions or the lack of knowledge about the natural system´s behaviour. As a consequence, strategies that "deal with differences" between the various actors and stakeholders will be the most important in managing uncertainty in BwN projects. Participation and cooperation are keywords. Facilitating dialogues and negotiation is an important way to achieve convergence.

2. Uncertainty range

In the BwN project ‘Coping with uncertainty´, no evidence was found that the magnitude of an uncertainty is important. No clues were found in either documents or interviews indicating anything like a maximum acceptable deviation or uncertainty bandwidth. Uncertainties are important if they have a potential effect on the success of a project. It is not so much the magnitude that matters, but rather the effect! To minimise the effect of uncertainties in a BwN project, however, is not an easy task as this involves longer temporal and unclearly defined spatial scales. For the same reason, it is also more difficult to determine which actors should be involved in policy development. As a result, uncertainties can arise if certain parties feel ignored.

3. Acceptance

In general, people are reluctant to explicitly accept uncertainty (although implicitly they do so all the time by accepting all sorts of risks). In the traditional command-and-control approach to flood protection engineering (e.g. construction of dikes and storm surge barriers), sufficient control and predictability is perceived to warrant a desired future state. The possibility of things taking a different course is ignored or considered acceptable. In the case of a BwN-approach, however, uncertainty is a more prominent characteristic; this means that the exact state of the system cannot be guaranteed, even though its basic functioning can. Our current policy practices are not familiar with accepting such uncertainty in projects and designs. One would rather prescribe the exact number of trees per unit area, for instance. Changing this situation requires a number of success stories of BwN-projects in the media, showing that these solutions work despite the inherent uncertainties.

4. Uncertainty as a weapon

Uncertainty can be a powerful weapon in disputes about a project. Opponents can use "high levels of uncertainty" in general or an "uncertain, dangerous issue" in particular as a weapon to create ambiguity and tackle promising initiatives. Pointing at the uncertainties and the 'precautionary principle', opponents can mobilize politicians that share their ideas, as was done in the Sand Engine case with the issues of swimmer safety and drinking water safety. In fact, it is not the uncertainty that matters here, but rather the insecurity that people tend to associate with it. These concerns should be taken seriously, given due attention and reduced as far as possible. Beware, however, of people that are not interested in the truth and just want to stop the project.

5. Role of reports

The role of reports and additional research - traditionally meant to reduce uncertainty - is different in a BwN project. Reports can still be used to "influence people", but are less appropriate to reduce uncertainty about the unpredictable natural system and its behaviour. Uncertainty about swimmer safety, for instance, is caused by the fact that the natural behaviour of the currents in the vicinity of the Sand Engine project is to a certain extent unpredictable(it may be even more so on an straight open coast, but people are accustomed to that). By definition, uncertainty due to unpredictability cannot be reduced by additional research. Nevertheless, in the development process of the Sand Engine, an additional swimmer safety study was performed. An unwritten goal of this study may have been to 'reassure' the lay public with the idea that everything possible has been done to come to grips with the uncertainty.

6. Champions

Given the innovative character of BwN-type projects and the uncertainties associated with them, the support of a strong political leader or champion is essential to bring such projects to realisation. In the case of the Sand Engine, several people credit Mrs. Lenie Dwarshuis, Province Deputy, for taking this role stating that the project would not have been realized without her continuous efforts, enthusiasm and perseverance.

7. Timing

Start to manage uncertainty as early as possible, by stimulating participation and cooperation. This will promote common framing, thus avoiding ambiguity. In the Sand Engine project, there was concern about the budget and whether dredging companies would come up with a sufficiently low price per unit sand. This potential problem was coped with by involving market parties in an early stage, so as to be realistic about the cost level to be expected.

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