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Building with Nature: ecodynamic design in practice

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Abstract

If the natural and human world are to co-exist in a sustainable way, our society needs to make the transition to building with nature, rather than building in nature or building of nature, which is what we are doing at present. Building with nature utilises the strengths of the natural system in infrastructural and hydraulic construction, and at the same time creates new opportunities for nature; this is 'eco-dynamic design'. With the help of new insights, nature itself is then used as an 'engine' for strengthening ecosystems, thus making both the constructions and the natural system more sustainable. Building with nature as a paradigm resembles 'Room for the River'. The latter policy change has prepared the ground for thinking of nature as an ally instead of a foe. However, it is likely that the legal, technical and social challenges facing the proponents of eco-dynamic design are much greater. Demonstration of success in case studies will be an important argument to present for a change in paradigm, as will scientific research showing that the ecological and technical foundations are sound.

The Dutch programme Building with Nature has the ambition to show that building with nature is possible. Its programme consist of three elements: developing the knowledge and expertise required for eco-dynamic design; 2) realise eco-dynamic design in a number of on-going cases and projects; 3) change the current thinking and practice amongst scientists, administrators, politicians and the public, and facilitate future implementation of eco-dynamic design by proposing appropriate legal and policy frameworks. Each of these elements faces difficult challenges, increasingly so going down the list. The interdisciplinary character of this programme requires ecologists, scientists and technical specialists to work, design and create together. The different, joint perspectives should be aimed at optimal synergy. However, the new knowledge must be usable for society so the potential users of the new knowledge are involved from the onset, to collectively conduct research and to ascertain the applicability of the new insights. In the setting of an ongoing project, where multiple interests compete to achieve mutually exclusive goals, the priority for trying out a seemingly academic idea is likely to be low. For such proposals to be successful will require on-the-job experimentation and adaptation of plans to findings, both technical, social and political. This experimental and adaptive character is possibly the most challenging part of Building with Nature, because administrative and planning procedures are not geared towards a stepwise adjustment of the project programme. We present different possible framings of the preliminary findings from this novel set-up in order to elicit further discussion and reflection .

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1 Building with Nature's vision: new possibilities for reshaping nature

Building with Nature (BwN) is a prime example of a programme in which adaptive water management is implemented in practice. The BwN mission is to show that sustainable win-win solutions for society and nature are possible and feasible in the realm of large-scale water-related infrastructural and regional development (Box 1). Its core idea is based on recent developments in thinking about hydraulic engineering and its relationship to ecosystem dynamics.

Until the 1970's civil engineering works were generally designed and constructed with little concern for impacts on ecological systems. As engineering possibilities increased and Dutch society became more wealthy, democratic and environmentally aware (Bijker 2002), societal pressure led to the adoption of ever more stringent environmental laws aimed at minimising impacts on ecosystems. This phase can be summarised as 'building *in* nature': nature is a given that engineering has to take into account. Its climax, but also its effective end, was reached with the construction of the Oosterschelde dam, part of the Deltaworks (Disco 2002). However, this impact minimisation paradigm is still present e.g. in the EU Habitats Directive, where designated Natura 2000 sites are strictly protected from any negative change, even if this is for future enhancement.

Meanwhile the idea developed that it is possible to compensate for lost nature by creating new nature. This principle of 'building *of* nature' was applied e.g. in Environmental Impact Assessment laws in the 1990's. Minimising impacts is still the main goal, but if it can be shown that they cannot be prevented, mitigation en compensation are allowed and required. The third paradigm to arise approaches ecosystems more positively: it assumes that it is possible to cleverly work along with the dynamics of the natural environment, such that this supports the realisation of the project and at the same time increases chances for the development of existing nature and creation of new nature. This 'building *with* nature'[2] involves a shift from 'doing less harm' to 'producing benefit': of letting nature do the work where possible. Plan Stork was an early exponent of this paradigm (De Bruin et al. 1987). It set out to promote the redevelopment of floodplains then in use for grazing or brick making into an 'original floodplain habitat', which is an exponent of 'building of nature'. However, the large-scale reshaping of the floodplain necessary to implement these ideas would at the same time aid flood protection by providing more space to convey river floods. Thus it would increase the resilience of the river system, because naturally occurring processes would be given space: nature would do some of the work needed for flood management. The Plan Stork concept was incorporated in the national policy 'Room for the River' (Ministry of Transport and Water Management & Ministry for Housing, Spatial Planning and Nature 1997). However, contrary to Plan Stork the policy 'Room for the River' takes the creation of space for water rather than nature development as a first objective. In practice, this prioritisation means that ecosystem dynamics are kept within certain limits, e.g. when vegetation density increases flow resistance and hence flood risk. More far-reaching, current reinforcement plans of the Dutch coast, such as the Sand Engine pilot project (Province of South Holland 2009), are designed with flood safety, ecosystem dynamics and recreation potential in mind. Both examples sit firmly within the ecological modernisation of which Mol et al. (2009) provide an overview and update.

[2] In order to avoid confusion as much as possible, the programme Building with Nature is upper cased and may be abbreviated to BwN, while the paradigm 'building with nature' is in lower case and not abbreviated.

Society will benefit through ecodynamic design

With over 80% of the world's large population centres in vulnerable coastal, delta and river areas, the construction challenge in these areas is extraordinary. Trade and industry require new ports and infrastructure, citizens require housing, rivers require space to flood, and all will have to be protected from and harmonised with nature and the effects of climate change and sea-level rise.

The challenge demands many talents; research and technology; effort and experience; planning and finance; ambition and sympathy. Input is essential from all stakeholders; from owners, residents and policymakers to designers, contractors and project administrators. Ecological and economic interests have to be responsibly balanced. We are faced with the need to learn to build with nature, so that the natural and human world can sustainably co-exist.

The Dutch national programme Building with Nature targets discovering and developing all the know-how and expertise required to allow this to happen. To create state-of-the-art models for ecodynamic design. To permit the aims to be realised. Society will benefit in many ways: from improvements to administrative and policy-making processes, development of new business opportunities, establishing new positions in technological and scientific excellence, to provision of new and innovative design tools and consolidation of skills.

EcoShape is a consortium of Dutch specialists with a rich history of solving coastal infrastructural challenges in the Netherlands and abroad. As custodians of this knowledge inheritance of past land reclamation, sea and river defences, dike building, dredging and protecting nature, EcoShape will provide its knowledge resources for the benefit of sustainable coastal development - anywhere in the world it may be needed.

EcoShape Brochure *http://www.ecoshape.nl/downloads/EcoShape_brochure.pdf*

Box 1 Building with Nature as presented by EcoShape

Building with Nature in appearance sits firmly within the current framing of flood management, including policy discourse and implementation projects. Nevertheless, the consortium members consider the realisation of their ambition to see building with nature ideas adopted, used and further developed by experts and policy makers outside the consortium a major challenge. We want to understand why this should be such a challenge, given the fit with current policy framing, and explore how BwN can deal with it. Is it a challenge because the policy discourse is at variance with the implementation? Because the hidden assumptions about society-nature relations are different even when the discourse used is similar? Because regulations and procedures are lagging behind and impede novel ways of working? Because the way BwN is set up is at odds with the usual ways policy innovations are introduced and implemented? Or is there no real problem, and is the acceptance of a new paradigm simply a matter of time and a lot of advocacy? Formulated differently, the purpose of this paper is 'to explore sociology's potential for helping to better understand the social possibilities and limits of the 'shapability' of an ever-changing natural world' (announcement of this conference) in relation to the BwN project. By increasing our insight we not only want to find possible strategies to deal with this challenge, we also want to explore how social sciences can benefit BwN and thereby strengthen their position in this kind of natural science and engineering-dominated projects.

In Section 3 we will further elaborate the project's characteristics and explain the principal challenges it faces, and in Section 4 we are suggesting possible directions for further analysis. First, however, we will sketch the institutional context in which BwN is operating.

2 Institutional context

Opportunities for building with nature often concern large-scale infrastructural projects with a significant spatial planning component. This means that decision making is multi-level (central government, provinces, municipalities, water boards), multi-sectoral (across several ministries) and multi-stakeholder (involving non-governmental parties). A recent analysis of the decision making on spatial planning around Lake IJssel identified as many as 53 governmental institutions, not counting the number of non-governmental actors. Add to this a myriad of spatial planning, environmental and water management laws, policies and procedures, and an assertion that 'true power, according to most Dutch scholars in administration science, is in the informal policy networks that support formal decision-makers' (Deelstra et al. 2003). It is not surprising then that the demand for innovation in spatial planning and infrastructure development does not only concern new knowledge and technology, but also a review of decision making formal and informal rules and procedures. This is one reason why BwN includes a governance component (see Section 3).

In the Dutch legal system any natural or legal person can appeal at several instances against any administrative decision. The highest administrative court is the Council of State (Raad van State), which applies the precautionary principle in environmental issues. This stance creates many possibilities for parties to object against infrastructural projects, for instance by claiming that insufficient research has been done to be certain about the environmental impact. This can delay contested projects almost indefinitely. One example is an 8 km stretch of motorway planned between the cities of Delft and Schiedam, which has now been stuck in the planning process for 40 years. Other legislation, e.g. the fact that flood protection levels are legally determined, also gives opportunities for opponents to appeal against innovative initiatives. For example, in the Integrated Assessment Meuse project a forward look to prepare for climate change by increasing the capacity of the river system met with resistance from regional and local authorities who did not want to compromise their spatial plans for the sake of not yet proven increased discharge. They ultimately referred to the legal standards to underpin their position (Wesselink et al. 2009).

In order to avoid such appeals, project initiators tend to morally, politically or financially commit as many parties as possible via an extensive consultation and negotiation process before formal planning is initiated ('polderen': the famous Dutch consensus style), but of course this is no guarantee against a future legal challenge. Ultimately, because of the uncertainty inherent to complex natural systems, opportunities for building with nature depend on the adaptation of a more bold and brave approach where uncertainties are accepted and goals are pursued by learning-by-doing in experiments. BwN is trying to influence this situation e.g. by generating the knowledge needed to disprove adverse effects and by reviewing existing regulations.

Administrative fragmentation is another impediment for building with nature projects. Government institutions tend to take a sectoral approach in the choices they make, without looking much beyond the boundaries of their specific brief. This hampers decision making across departmental boundaries, a necessity for most building with nature projects. For instance, the Ministry of Transport, Public Works and Water Management is responsible for flood safety. It wants to achieve this at minimum expenditure, hence it is not inclined to

support measures that involve higher costs but at the same time yield higher benefits for nature, recreation, etc. This problem is not limited to innovative initiatives, it also affects the implementation of accepted policies such as Room for the River.

At a more general level, BwN operates in the Dutch cultural context where in the public opinion engineering works and hence engineering contractors generally tend to be associated with the destruction of nature. Specific to flood defence engineering however, there is also a public awareness that engineering works protect the country from flooding and there is pride in the Dutch achievements in land reclamation and flood defence, esp. the Delta Works (Wesselink et al., 2007). It is in the interest of the hydraulic engineering sector and all other parties involved in this type of water-related engineering projects that the negative aspects of this image be reversed. This is one reason why the dredging firms are keen to play a prominent and visible role in the Building with Nature programme.

3 The BwN programme

3.1 History and content

The Netherlands are lagging behind many other European countries in the level of investment in research and innovation. On the other hand, the Netherlands government is committed to the Lisbon Agenda. In order to stimulate innovation, it has therefore established an Innovation Platform led by the Prime Minister, and an Innovation Fund to finance programmes offering perspectives on innovation. Building with Nature is one of these programmes; it is organised and managed by the NGO EcoShape that was established specifically for this purpose. EcoShape receives a subsidy from the Innovation Fund on the condition that it aims at technological as well as policy making innovation. Funding conditions require 50% co-funding from other parties. The idea of building with nature was first brought up by Honzo Svašek, a Dutch hydraulic engineer, and later extended and promoted by Ronald Waterman, scientist and politician (Waterman 2008). The origin of the present BwN-programme lies in Water Front, a Dutch network of private parties, knowledge institutes and government institutions discussing innovation strategies in hydraulic engineering (Van Oostrum 2005). The idea was picked up by the two major dredging firms in the country, Boskalis and Van Oord, who brought together a consortium of some 20 other organisations active in hydraulic engineering. Early 2008, their joint proposal for the BwN-programme was accepted for co-funding by the Netherlands government. Yet, it is fair to say BwN is first of all an initiative of the two dredging companies.

The BwN ambitions are reflected in the composition of the consortium and in the funding. Apart from the two major dredging companies the consortium comprises engineering consultancy firms, some governmental institutions, applied research institutes and universities, with possible future membership of environmental NGOs. BwN is funded jointly by the consortium partners, the Netherlands government, the municipality of Dordrecht and the European Fund for Regional Development. Although this set-up creates a strong alliance with a real potential to influence Dutch and international practices, policies and regulations, BwN does not conform to a regular Dutch policy innovation initiative. Usually new ideas are generated in boundary work initiated by civil servants. Governmental advisory bodies will play an important role, with more or less direct involvement of academics. Depending on the policy domain, private companies may be invited to contribute to this process; in the policy area of water management this is not generally the case.

With its ambition to achieve product innovation, that is successful new applications of ideas and products in practice, it resembles the research-for-innovation programmes as set up in industry. However, two main competitors in the dredging industry have joined forces in BwN, so the commercial rationale of BwN is quite different from that of competition: these partners realise that they will not be able to innovate their products unless they join forces. Another difference is the fact that, apart from a relatively small proportion of basic research, most experiments and observations through which BwN attempts to fulfil its innovation goals are real-life and need the consent and often collaboration of external partners, usually in first instance governmental bodies that are not part of the consortium. If BwN is conceptualised as an innovation programme, then it aspires to achieve innovation at all levels (see Section 3.2). Some of this innovation is so-called 'policy innovation', and we expect that an analysis of BwN in terms of contradictions and convergences between processes of technical innovation and of policy innovation could lead to useful insights.

BwN conceptualises the realm in which it operates as a triangle building – nature – society, which spans a continuum of relationships and interactions. The programme therefore includes components on natural sciences, technology development and societal processes, all of course related to building with nature and all interlinked. The BwN activities are organised along three lines:

1. basic research to fill knowledge gaps identified by analysing past projects;
2. active involvement in a number of ongoing real-life infrastructural projects with a significant (potential) building with nature-component;
3. development of practice-oriented user products, such as a user manual, a portfolio of examples and user tools (models, data, design tools).

The activities are interwoven as much as possible by mutual involvement in each others' projects and by exchange and discussion in common workshops. The basic research programme is organised as 20 PhD-projects on the functioning of the natural system (esp. ecology and morphology), the effects of human interventions and how to monitor these, and societal aspects of building with nature-type infrastructure development (esp. decision making processes).

The ongoing projects that provide case studies were selected on the basis of the government's prioritisation of water-related spatial development projects, as laid down in a number of policy documents, such as the Water Vision (Ministry of Transport, Public Works and Water Management, 2007) and the Delta Commission (2008). In these projects, BwN usually plays an observer's role, trying to draw generic lessons from observations in the case; if and when possible, BwN brings in ideas and experiences from elsewhere in order to encourage the adoption of a building with nature approach. In each case study, several sub-projects are defined to cover the relevant aspects. The PhD research is also embedded in these cases in order to benefit both the research and the cases. Three cases were chosen in the Netherlands (Figure 1). We describe these cases in some detail to show what a building with nature approach would mean in practice.

- The Southwesterly Delta, the area protected by the Delta Works, where we now face a number of unforeseen negative consequences of these interventions, such as eutrophic and oligotrophic areas and a sand deficit in the Eastern Scheldt that threatens to destroy precisely the intertidal habitat that the Eastern Scheldt semi-open barrier was meant to protect (De Vriend, 2004). BwN wants to contribute to solving these problems by making use of natural mechanisms, such as bed protection by mussel or oyster beds, and environmentally friendly ways of making eutrophic areas brackish again.

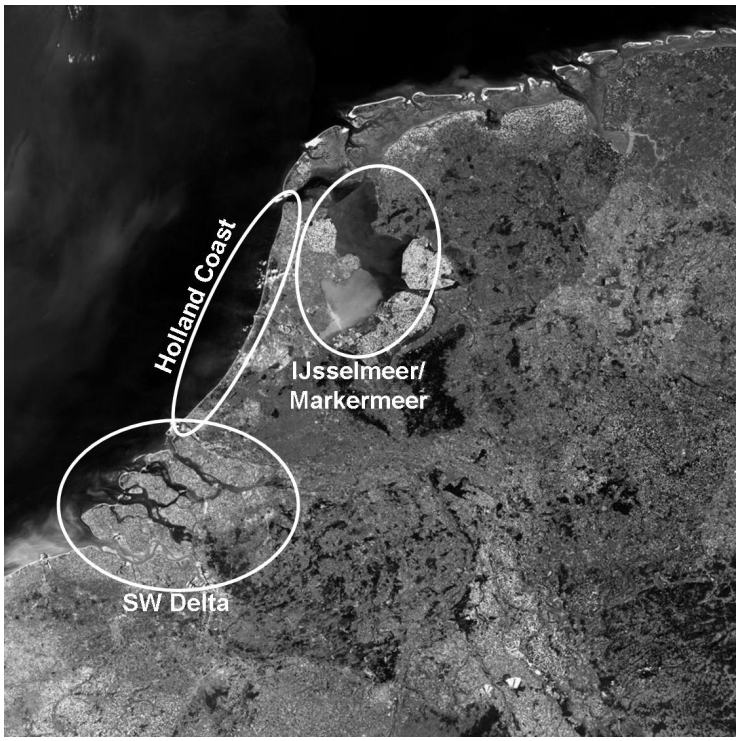

Figure 1 Location of the cases in the Netherlands

- The Holland Coast, a 120 km stretch of dune coast protecting the densely populated economic heart of the Netherlands from the sea. Under the influence of Holocene sea level rise, this coast tends to retreat inland unless it is kept in place by sand nourishments, an effective and efficient way to keep up with the sea level. Recently, the Delta Committee (Delta Commission, 2008) has advised to investigate the possibility of widening the dune area by over-nourishing this stretch of coast. This has raised the question whether other nourishing practices, such as a mega-nourishment in front of the coast (the 'sand engine'; Province of South Holland 2009) could be more attractive from an environmental point of view. Building with nature in the sand engine means letting nature distribute the sand alongshore, in the meantime creating safety against flooding, space for beach lagoon and young dune development, recreation potential, etc. BwN wants to contribute to this project by bringing in ideas on how to shape the original nourishment, landscaping the offshore borrow area where the sand is taken from and by monitoring the morphological and biological effects of the nourishment. At a larger scale, BwN wants to help developing long-term nourishment strategies for this stretch of coast.

- The IJsselmeer / Markermeer area, two adjacent large inland lakes resulting from the construction of the Afsluitdijk barrier in 1932 and the construction of a further secondary barrier in 1976. While these lakes were designated as strategic freshwater reserves for the whole country, in the Markermeer environment the change from a marine environment to a freshwater lake has resulted in a high turbidity that impedes a healthy ecosystem, probably because old marine clay deposits became desalinated, lost their coherence and are now easily suspended. In addition, the Delta Commission (2008) advised to let the water level in the IJsselmeer follow the sea level. The water level variations involved will raise many

problems, among which additional stress on the valuable historical landscape and cities along the Frisian coast. Building with nature in the Markermeer means taking measures (e.g. digging pits, or creating marshland) that help to trap the fine sediment, making use of physical as well as biological mechanisms. BwN contributes to an extensive ecosystem analysis, biotic as well as abiotic, and a study of this ecosystem's response to the turbidity-induced stress. Building with nature on the Frisian coast that surrounds the area in the Northeast means to design measures that enable this coast and the meadows in front of it to follow the lake level and at the same time create new opportunities for the ecosystem, recreation and other functions.

In addition, one tropical case was included because many of the consortium partners operate worldwide; obviously, the Netherlands cannot typify all environments in the world. Singapore provides this fourth case. BwN will here analyse turbidity in the coastal waters, how this is influenced by dredging works and how it affects the ecosystem. In addition, it investigates the possibility of utilising different types of biota (eelgrass, coral, mangrove) for coastal protection. Like the other cases, this study includes governance aspects.

3.2 Scales

The programme works at different scale levels. Spatial scales extend from the plot, via the geomorphic unit to the regional system; time scales over which eco-morphological process develop generally concur with this hierarchy. With its limited duration and limited funds BwN had to chose at which scale(s) to operate. The BwN cases concern regional problems, usually related to spatial planning. Solving these problems involves many actors and usually takes a long time, probably more than the duration of the programme. This is the level at which BwN ultimately wants to have its main impact, the level at which the BwN-ideas should be adopted, but also the level at which the programme has least direct influence on the process. The BwN research on societal aspects takes place at this level. It includes PhD projects on multi-level policy and regulations, the feasibility of BwN initiatives in local arenas, dealing with uncertainty in decision making, the use of knowledge in building with nature projects, and the feasibility of eco-dynamic design in other national policy environments.

In order to be able to show appealing results before the end of the programme, the engineering experiments focus on the next lower scale level: the geomorphic unit, e.g. a shoal in the Eastern Scheldt, a piece of the Holland coast. At this scale level, BwN can be actively involved in pilot experiments to bring in and test its ideas. One example is the stabilisation of intertidal shoals in the Eastern Scheldt by mussel beds, another is a mega-nourishment on the Holland coast south of The Hague. At this scale level, BwN is a partner to the water managers and politicians in charge and has a say in the design and the monitoring of the experiment.

Most of the basic research on natural processes and technological issues takes place at a still lower scale level: the plot. For instance, the interaction of benthic organisms with the sediment composition in the bed of an intertidal shoal is investigated at plots of a few square metres. Turbid plume formation due to dredging works is investigated in the first instance very close to the source, the hopper dredger. Clearly, once this knowledge is available it needs up-scaling in order to be of use to actual building with nature-projects. Important issues here will be how to fit such detailed understanding of a sub-system into a larger, complex whole, and how to integrate knowledge produced by different disciplinary sub-projects. This requires thinking in terms of coherent system dynamics instead of the behaviour of isolated system components. Hence it requires an interdisciplinary approach, with researchers from different

disciplines exploring this new area together. The way each party's knowledge and expertise are used in this type of innovation processes is an object of study in itself which we hope to explore in another paper.

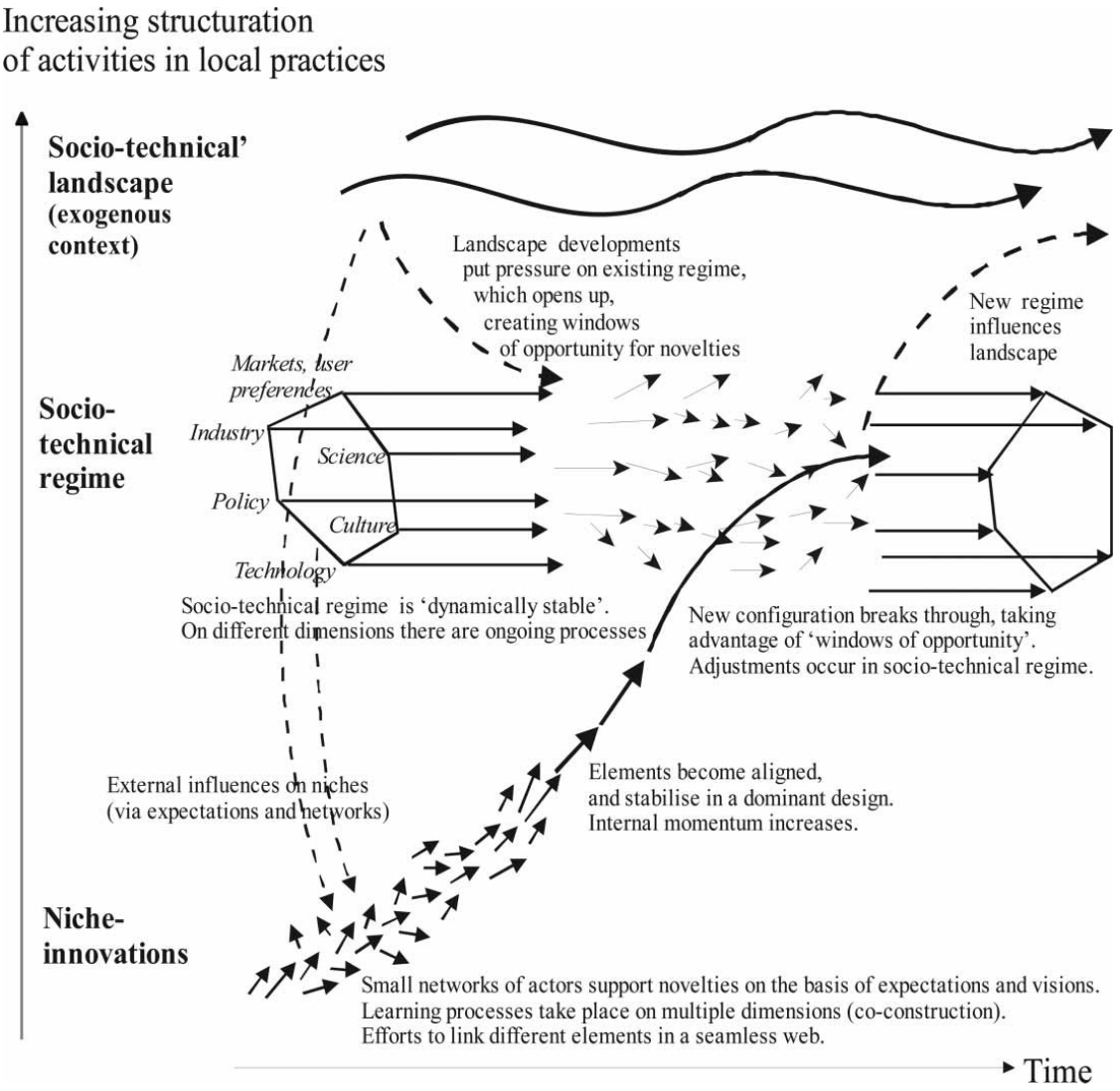

Figure 2 Multi-level perspective on transitions (adapted from Geels 2002, 1263 in Schot & Geels 2008).

We can also use scales to describe the BwN objectives in terms of a multi-level perspective on innovation (e.g. Geels 2002) (Figure 2). We employ it as a heuristic framework rather than a theory, although we expect that using this framework as a theory may lead to some insight in BwN's possible strategies. When looking at scales from a socio-technical innovation perspective, BwN has different ambitions at different scales. At the niche level, it designs technological innovations aimed at reducing the environmental impacts of engineering works and making optimal use of the forces present in nature. The achievements at the niche level need to be embedded at the regime level: administratively in standards, regulations and norms, technically in designs, guidelines and generic expertise. The programme's ambition is to

make this happen as much as possible. Technically, this is the product development part of the programme. Administratively, BwN tries to make this happen in the four BwN-cases. Yet, changing regulations and norms is beyond the programme's means. It's activities have to be limited to collecting knowledge about and developing insights on the necessary changes in regulations and norms in order to better make use of and create new opportunities for nature.

Changes in the socio-technical landscape take place at time scales much larger than the duration of the BwN-programme. Nonetheless, BwN works towards changes in the attitude, e.g. in the mostly traditional civil engineering circles, towards human activities in relation to nature (from a defensive approach to an offensive one), as well as in the public perception of engineering works (from a threat to nature to an opportunity to nature development). The programme includes a significant communication component, addressing researchers, professionals, policy workers, politicians, the broad public and future generations of experts via teachers and students at institutes for higher education.

3.3 Resistance

Despite its broadly accepted and applauded ambitions, BwN experiences resistance at various levels and instances, externally but also internally. These instances of resistance are likely to indicate where an innovation initiative sits uncomfortably with existing practices, hence where they are truly innovative (Smith & Stirling 2007 356, Schuitmaker & Ter Haar 2009). When we can understand why BwN encounters these resistances, BwN should also be able to better deal with them.

The Netherlands adhere to a rather strict interpretation of European environmental legislation. The prime objective seems to be the conservation of existing nature, rather than creating opportunities for new nature. A large part of the surface waters in the country have been brought under Natura2000, which in combination with this strict interpretation hampers new developments. As a consequence, it is difficult to get permits for full-scale experiments, even if they are intended to create new opportunities for nature.

Innovation in this area is impossible without the involvement of private parties that in the end have to exploit the results in practice. The involvement of private parties in the consortium, however, raised the issue of illegal state support in relation to the government subsidy, which is forbidden by international competition laws. Although in the end this turned out to be a non-issue for BwN, it has delayed subsidy assignment and therefore the programme's start significantly. While the programme officially started in 2007, only now, mid-2009, have all funds been allocated to allow all BwN projects to start.

Innovation is a matter of trial-and-error rather than a straightforward production process. The BwN programme planning should therefore be flexible to be able to respond to new insights. Subsidy providers, however, require a very detailed planning in advance for the whole duration of programme. Adaptation of these plans, if possible at all, involves a lot of convincing and extra bureaucracy. Another implication of the government subsidy, though only 50% of the total budget, is that the subsidy regulations determine the conditions under which the programme is executed, including hourly rates and the way they are calculated. In the case of BwN, this 'Trojan horse' has led to frustration among certain partners who have to work at strongly reduced rates.

In order for BwN to be successful, such external resistances will have to be somehow dealt with. However, at the BwN programme's core is collaboration between academic researchers from different disciplines, case investigators from consulting firms, and engineers from dredging companies. This variety of interests and multiple approaches to doing science and

getting things done creates internal project dynamics that do not always appear to be working in the same direction. It means collaboration across cultures, which takes time and effort to develop. Sometimes it also means clashes of interest, often related to market position and intellectual property rights. Apart form these usual project dynamics that have to be dealt with, there are also issues which more specifically relate to the fact that BwN wants to research, experiment with and promote building with nature, and has joined together partners that do not usually work together in such an experimental context. Amongst the partners there are differences of perspectives on the fundamental characteristics of the problems BwN deals with, which leads to extensive debates, for instance on the role social sciences should have in BwN.

It may be obvious to the public here present that problem perceptions, views on desirable outcomes and interests are not the same for all parties involved in decision making on spatial planning. Moreover, spatial planning intervenes in complex natural and social systems, the behaviour of which is only partly understood and even less predictable. These type of projects should therefore be classified as wicked or unstructured problems, where problem structuring is an essential part of the decision making process (Hoppe in press). However, the more traditional engineering partners are used to dealing with problems after they have been tamed. They are used to clearly defined project specifications that allow them to design a construction and a pre-determined construction schedule. Changing this perception to one that assumes learning-by-doing and adaptation is necessary, but difficult.

However, as indicated above, BwN has to operate in an external environment that imposes this same control paradigm on project planning, in spite of discourses to the contrary. An example of the latter is the notion of transition management of innovations for sustainability that was briefly promoted by the Ministry of Transport, Public Works and Water Management (Van der Brugge et al. 2005). When the implications for management became clear the Ministry was less enthusiastic: innovation requires adaptive management, which means delegating authority and the impossibility to engage in the box-ticking so favoured by New Public Management. The kind of profound system innovation that BwN advances not surprisingly hits a wall of existing authority and established perceptions of roles.

4 Perspectives on the BwN programme

As is the case with any real life situation, the BwN programme can be viewed through a nearly infinite number of lenses. As relative outsiders to environmental sociology, we appreciate that ‘sociologists [..] develop the ability to switch between different frames of reference’ (Collins and Yearley 1992 301) and that this enriches understanding. Only by using multiple perspectives can we do some justice to the complexity of the ways societies try to deal with environmental problems. As expressed by Dewulf et al. (2009 11) when discussing their choice for theoretical multiplicity: ‘Only variety beats variety, also at the level of theories, which can serve as a box of conceptual tools to analyse situations and to design interventions. This does not mean that each of the theories should proceed as if the others did not exist. In fact, by writing this paper we are assuming that it is worthwhile to compare theories and to look for points of connection and difference. This approach can be understood as a meta-paradigmatic approach (Gioia & Pitre 1990), which recognizes the value of the distinctiveness of each individual theory and the value of exploring zones where theories overlap or can inform each other, but does not try to integrate everything into one paradigm’.

However, with a multitude of frames to choose from, which ones are particularly appropriate for BwN? Which frames yield complementary, and which yield contradictory perspectives?

How can social science theories help us to understand the issues of nature policy and management that BwN is trying to impact on, and the implications for policy arrangements and actor strategies?[3]We invite participants at the conference to help us think about useful analytical perspectives on the issues faced by BwN, both in providing clairty and in providing concrete courses of action. The potential for and usefulness of combining perspectives on policy analysis has been demonstrated by e.g. Meijerink (2005), Van den Brink and Meijerink (2005) and Dewulf et al. (2009). Compared with their focus on policy processes, an additional challenge for BwN is presented by its (initial) focus on technology development within the ongoing policy innovation. This suggests that (objectifying) perspectives on innovation need to be combined with (reflexive) perspectives on governance, with outcomes conceived as a emergent co-construction (Grin 2006, Smith & Sterling 2007). Or can socio-technical transitions be managed, as some would have us believe (e.g. Rotmans et al. 2001)?

We have already referred obliquely to some possible approaches in our description of BwN in the preceding Sections. We framed policy as a (hegemonic) discourse when we described the apparent concurrence between BwN and current policy on flood management; we worked concepts of innovation studies into the text when we described the levels at which is BwN is intervening; we have looked at the resistance it experiences to some extent from a historical institutionalist/policy networks view; and we have incorporated concepts from the governance of unstructured problems when we discussed approaches to project management. Related perspectives should also provide useful insights, e.g. on policy entrepreneurs (Kingdon 1984) and advocacy brokerage (Sabatier and Jenkins-Smith 1993). We clearly need to elaborate and combine these analyses if they are to provide useful and usable insights for BwN.

Our exploration of the roles for social sciences in ecosystem management is not new (e.g. Endter-Wada et al. 1998, Yearley 2009). Difficulties of such cross-disciplinary conversations have been extensively discussed. In addition to epistemological and paradigmatic differences, obstacles include less frequent interactions between social and natural scientists and communication barriers posed by discipline-specific language (e.g. Endter-Wada et al. 1998, Jones and Macdonald 2007, Buller 2008). Our exploration of the roles for social sciences in ecosystem management is not new (e.g. Endter-Wada et al. 1998, Yearley 2009). Difficulties of such cross-disciplinary conversations have been extensively discussed. In addition to epistemological and paradigmatic differences, obstacles include less frequent interactions between social and natural scientists and communication barriers posed by discipline-specific language (e.g. Endter-Wada et al. 1998, Jones and Macdonald 2007, Buller 2008).As explained in Section 2, our main question is to understand why BwN experiences resistance, given the fit of its objectives with current policy framing, and explore how BwN can deal with the challenges it faces. An important part of the answer is the selection of appropriate theoretical frames. To summarize, we want to know what BwN needs to add to its eco-engineering vision to include the socio-political?

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[3] After the educational mission of the Wageningen University Environmental Policy Group, home of one of our respondents Gert Spaargaren http://www.enp.wur.nl/UK/

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