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Real Barriers to Climate Adaptation

A systems approach to learn about new modes of governance

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Abstract

Climate change requires adaptations to the way we deal with our environment and organize our societal relations. Realizing these so called adaptation strategies is not easy due to all kind of institutional and social complexities, like free riders, lack of money, short term policies, fragmented administrative units, and a lack of leadership. The authors assert that jumping to 'easy' solutions like a relapse into central planning or hierarchical directorship won't sustain. Moreover these even run the risk of strengthening institutional barriers and societal resistance. Following a dynamic system approach to governance they present a theoretical framework to understand the social mechanisms perpetuating institutional barriers to climate adaptation. Besides the well known tragedy of the commons, several other mechanisms will be described. Understanding these mechanisms can help policymakers to identify their joint situation, to get more in-depth insights in underlying barriers and to develop levers for intervention. The development of learning arrangements that enable policy makers to act to a joint understanding of social systems is an important step to profound change.

1. Introduction

As confirmed most recently by the IPCC, science provides increasingly agreed upon information about climate change and how it will influence and challenge society (IPPC, 2007; European Commission 2007). As societies worldwide face the challenge of having to cope with its impacts, such as rising sea levels, heat waves, droughts,

storms and extreme precipitation, it becomes increasingly necessary to understand the capacities of governments, businesses and society to deal with such structural changes. The recent Stern reports even suggest that we have less than 15 years left to make radical changes in order to avoid dangerous climate change (Stern, 2007). Whereas mitigation strategies try to restrict the change of the climate, so called adaptation strategies are defined as "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC, 2007). Adaptation strategies focus on anticipating on the impacts of climate change in three terms: moderating potential damages, coping with the consequences or taking advantages of opportunities. Examples of these strategies include using scarce water more efficiently, adapting building codes to future climate conditions and extreme weather events, building flood defenses and raising the levels of dykes, developing drought-tolerant crops, choosing tree species and forestry practices less vulnerable to storms and fires, and setting aside land corridors to help species migrate (European Commission, 2007).

However, developing and implementing adaptation options is not an easy task due to all kind of institutional and social complexities. Explanations or barriers most frequently mentioned in policy debates are that there are: no laws to correct free riders; too many administrative levels; too many policy do mains; different senses of urgency; no leaders; fragmented and inert budgets; election cycles (short term perspective); overly detailed planning procedures; lingering processes of policymaking, too much rights for land owners; European legislation, lack of awareness, and limitations to resources for implementation (e.g. Ader et al 2007; OECD, 2006; Groot et al, 2003, Policy Documents).

As a result of facing these barriers and strengthened by the experienced sense of urgency, scientists, policy makers and policy advisors lean towards solutions like one national emergency plan, one coordinating minister or new centralized procedures. For instance, an influential advice council of Dutch Cabinet, the VROM Council (2007), gives rather straightforward recommendations with a key role for strong leadership. It pertains to new formal instruments hierarchical managers can apply to influence spatial development with a view of water security. Up-scaling and centralizing appear to be attractive policy strategies to deal with climate change.

These solutions largely fit within a hierarchical governance paradigm which' limitations got increasingly emphasized during the last decades. Main limitations have to do with neglecting the interdependency between governments, citizens and firms; problematic processes of implementation; increasing gap between government and society and diminishing the quality of policy proposals needed to deal with wicked problems. Most scholars proclaim a shift from hierarchical and well-institutionalized forms of government towards less formalized forms of governance in which networks and horizontal relations between interdependent actors have gained importance (Hajer & Wagenaar 2003; Rhodes 1997; Pierre 2000; Koppenan & Klijn, 2004). The need for collaboration in networks of various stakeholders operating at different levels has also been identified in the literature about adaptation to ecological change and adaptive governance (e.g Kates et al, 2003; Folke et al, 2005). Schuler and Pahl Wostl (2007) emphasize the importance of social learning in "horizontal" networks and indicate that in a specific river system centralized management creates a barrier

against learning. Requirements for social learning include institutional settings that guarantee some degree of stability and certainty without being rigid and inflexible.

Here, we agree with such authors that in addition to hierarchical governance more is needed. We plead for a more careful and precise institutional analysis before moving to conclusions and recommendations. Jumping to 'easy' solutions won't sustain. Moreover this even runs the risk of strengthening institutional barriers and reinforcing societal resistance. The harder you push the harder the system pushes back (Senge 1990). A common stakeholder reflex to proposals for change is therefore resistance (Hosking 2004). The above mentioned explanations for barriers to adaptation may hold true in many situations, but we will argue that there is also a more complex web of reasons underlying them. Most adaptation strategies require a profound change of the way we are used to deal with our environment, and organize our societal relations. Because climate change will affect all dimensions of human life we will not only encounter existing policy communities concerning climate policy, but also in surrounding fields like housing, land-use planning, water management, agriculture, nature development or energy. These policies are all embedded within their own specific institutions, which, up to now, are at most loosely coupled with the climate system. The dynamics in the governance system, and its interaction with dynamics in the spatial and economic system, should be understood in order to find accessible roads for change, including the critical stagnations on such roads as explained above.

Our hypothesis is that systems theory can develop such insights. This paper therefore fits in a general context of increasing attention for complexity theory in the social sciences, applying systems analysis (Geldof, 2001; Hodgson, 1993; Nooteboom, 2006; Olsson et al., 2006; Zuidema and De Roo, 2005). Systems theory is a generic term for many theories and authors. Senge (1990) might have come closest to a theory that is manageable for all types of policy makers addressing complex problems. He distinguished a number of archetypical patterns, discovered by earlier theorists, which seem to be enough to explain most practical situations. These carry names like tragedy of the commons (Hardin, 1968) and shifting the burden. Such archetypes may be likely to also explain the barriers of climate adaptation, and consequently the interventions which would adequately solve the problem.

Recognizing the need for organizing processes of social learning in networks (e.g. Pahl Wostl e.a., 2007), we are looking for methods to support such processes. We expect the use of Senge's system archetypes to be helpful in developing (joint) insights in the complexities of solving climate adaptation issues.

The research questions, we address in this paper, are : How can system archetypes shed light on interventions to address the barriers of adaptation to climate change experienced in The Netherlands, and how could these archetypes be used to support social learning processes? Such interventions and learning processes may be said to enhance the adaptive capacity of The Netherlands with respect to climate change. By tracing feedback structures and levers and developing possible intervention strategies, we also hope to learn more about the particular mix of horizontal and hierarchical forms of governance which is needed for adaptation to climate change (Koffijberg 2005).

The paper first expands social system theory, system archetypes and some comparable theories. Next, the usefulness of systems analyses with Senge's archetypes will be

examined by two examples of climate adaptation in the Netherlands. Both cases focus on adaptation strategies in the policy field of water. The first case study is about flood risk policies, which are subject of political and societal debate in the Netherlands now. It is shown how undesired system behavior was corrected by various institutional responses in the past, but also how these institutional responses in turn have caused other undesired system behavior. The second case study focuses on the water quantity management in the low-lying western part of the Netherlands. In both cases we use archetypes to analyze how barriers have been identified and resolved in the past, and how the present situation has arisen. This then leads to the question if new avenues for intervention might be considered. Both case studies are based on secondary analyses, and some interviews with key informants. Finally we draw some conclusions as to whether the archetypes adequately can describe the situation, and what this means for interventions and modes of governance required to improve adaptive capacity.

2. Systems theory and archetypes

Senge's systems theory fits in a tradition of cybernetics (systems thinking) which has started in the exact sciences (e.g. Ashby 1956; Wiener 1961). Our focus on developing social interventions, leads us to the organization sciences (e.g. Senge 1990; Axelrod & Cohen 1999; Flood 1999). In these domains systems thinking provides a body of knowledge and tools to help people recognize and understand the full patterns within social systems , and to find the leverage points in a system, there where the smallest efforts can make the biggest differences.

Senge argues that one of the key problems underlying policy failures, is that rather simplistic frameworks are applied to what are actually complex systems. People tend to focus on the parts rather than seeing the whole, and fail to see organizations or even societies as a dynamic process. Thus, the argument goes, a better appreciation of systems will lead to more appropriate action. However, individuals face difficulties to see the whole pattern: 'We learn best from our experience, but we never directly experience the consequences of many of our most important decisions' (Senge 1990: 23). Forrester already stated in 1971 that the human mind is not adapted to interpret the dynamic behavior of the systems of which it has become a part.

Social systems are so complex that the effect of specific institutional solutions may be difficult to foresee (Werkman, 2006). The persistence of many policy problems lays in the well-intended policies designed to alleviate them. Such policies are often designed making use of input-output models. In complex societal systems, doing the obvious thing does not always produce the obvious outcomes, since there are circular causalities and recursive relations. Actions can have intended effects locally but unintended consequences in other parts of the system or actions can have different consequences for the short and the long run etc. These processes resemble to what Forrester called the counterintuitive nature of social systems which causes governments to risk getting entangled in downward spirals such as: Judgment and debate lead to a program that appears to be sound. Next, commitment increases to the apparent solution. If the presumed solution actually makes matters worse, the process by which this happens is not evident. So, at the end of the day when the troubles increase, the efforts are intensified that are actually worsening the problem (Forrrester, 1971).

Forrester concludes that as long as fundamental assumptions differ but are never brought into the open and are never interrelated it is not surprising that policy programs fail in their objectives or produce new difficulties greater than those that have been relieved. Where Forrester pleads for computer modeling to explicit assumptions, we focus on the aspect of social learning by actors involved. In addition to outsiders models of policy change we therefore add that such models ideally should be *applied by those who can implement the changes*. In this paradigm, knowledge is constructed in a social process where the knowledge organizations are only one of the participating domains .We therefore need to understand this social process itself and identify tools that enable its actors to apply dynamic systems analysis: reflecting on their own situation as it develops identifying the patterns of circular causality and looking for interventions in the joint long-term interest. Here, we can use archetypical patterns of circular causality, as summarized by Senge (1990). These carry names like "tragedy of the commons" and "shifting the burden". Such archetypes may be likely to also explain the barriers to climate adaptation, and consequently the interventions which would adequately solve the problem. An added value in using archetypes derives from the fact that a large group of people are able to (un)consciously recognize the archetype, and thus the mechanisms behind.

Senge's archetypes

Archetypes are generalized patterns of reinforcing and balancing feedback loops with delay (Senge 1990). A Reinforcing Loop is a structure which feeds on itself to produce growth or decline. The Balancing Loop attempts to move some current state to a desired or reference state through some action.

It helps seeing interrelationships instead of things, seeing patterns of change rather than static snapshots. It is a perspective for going beyond events, to looking for patterns of behavior, to seeking underlying systemic interrelationships which are responsible for the patterns of behavior and the events. Hereafter we first address Senge's (1990) archetypes, after which we identify other theories that either reconfirm Senge's ideas or suggest additional archetypes:

Balancing with delay: delayed feedback on one's action makes it difficult to adjust the action (balancing loop). Climate adaptation example: urbanization creates economic revenues, but floods are only due in the future. Adequate response: be patient or make the system more responsive. Either slow down spatial development, or build-in shorter balancing loops in the spatial development system (like environmental assessment visualizing flood risk for a large public).

Limits to growth: an innovation has success (reinforcing loop) until it meets restraints (balancing loop). In the case of climate adaptation, the limiting factor could ultimately be space. The adequate response is to identify and change the limiting factor. If space becomes scarce, look for innovations that enable efficient use.

Shifting the burden: only the symptoms of a problem are addressed, shifting the burden to solutions creating side effects. (Two balancing loops, the one with a fundamental solution having a feedback delay.) The adequate response is to focus on the fundamental solution. In the case of climate adaptation, opportunists could blame others for not implementing "obvious" solutions, which for them is the easy solution, whereas the fundamental solution would be to invest in a cooperation process. Other

example: land owners upstream change the function of land, shifting the burden of increased runoff to residents downstream, who eventually will not accept that.

Escalation: Two actors see their welfare as depending on a relative advantage over the other, which brings each of their own actions in a balancing loop with their relative results. Climate adaptation example: two municipalities might want to attract businesses by providing cheaper industrial area than the other at the expense of its water storage capacity. Adequate response: de-escalative action; redefining goals so that both can win. For example, let the industrializing municipality pay for the use of recreational area in the other municipality.

Success to the successful: Two activities compete for limited resources. The more successful one becomes, the more resources one gains, thereby starving the other (two reinforcing loops linked through the relative allocation of resources). Possible climate adaptation case: water management authorities, responsible for creating water storage space, compete for budget with road development authorities. As roads attract cars, road investments must increase to prevent congestion, reducing the water management budget which has poor performance anyway due to lack of political reward of flood prevention. Adequate response: look for the overarching goal for balanced achievement of both choices. Decide how safe you want to be at which cost.

Tragedy of the commons: Individuals use a commonly available but limited resource solely on the basis of individual need (two balancing loops, liked by total activity, with embedded reinforcing loops). Climate adaptation example: in a flood plain individual developments are permitted reducing the total water storage capacity for water in the flood plain. Adequate response: regulate the use of the commons. Create a levy on reducing water storage.

Fixes that fail: a fix, effective in the short term, has unforeseen long-term consequences which may require even more use of the same fix (A balancing loop embedded in a reinforcing loop). Climate adaptation example: raising river dikes to keep out water whilst developing the surrounding land. When the sea level rises the dikes can never be high enough. Adequate response: focus on the long term; create wider river beds and controlled flood plains.

Growth and underinvestment: Growth approaches a limit which can be postponed if the actor invests in extra capacity (the growing action is linked with a reinforcing loop to demand, which is linked with a balancing loop with performance, which is linked with a delayed balancing loop with investment, which is based on a fixed performance standard). Example: public awareness of water safety issues may be growing but needs to grow more before they give support to interventions. Politicians cease to invest in this debate when they have attracted enough attention to get re-elected. Remedy: If there is genuine potential, build capacity in advance of demand. In the climate case: invest more and earlier in dialogue about the “right” problem description before the outcome is widely communicated.

Comparable theories

Senge’s archetypes emerge in different appearances in the literature. For example, “success to the successful” in politics is sometimes referred to as the “bandwagon effect” (e.g. Goidel and Shields, 1994). North (1990) and Pierson (2000) describe

‘increasing return mechanisms’, and institutional lock-ins. This means that ‘the probability of further steps along the same path increases with each move down that path’ (Pierson 2000, p. 252). These also seem a special case of Senge’s ‘success to the successful’. Different paths (or teams proposing paths) compete for limited political support, which is created as a team produces more outcomes visible to politicians stakeholders than its competitors. This continues until the team starts to gain its own resources directly from the market or even the electorate. In transition theory (Geels and Schot, 2007), it is indicated that a political selection mechanism should enable a variety of competing paths, preventing early lock-in, to remain resilient to unexpected disruptions of resources. Betting on one horse makes a society vulnerable.

“Reverberant doubt” (Hofstadter 1985) refers to a situation where in a large group all are aware of a tragedy of the commons, but no action is taken because no individual can develop confidence that his initiative would lead to successful cooperation within a reasonable time investment, as he suspects other potential leaders also doubt that such investment is profitable compared with other possible investments. They don't invest in removing each other’s doubts, which is a kind of second-order tragedy of the commons. The reverse seems to be the “Pygmalion effect”, indicating that a group can become many beautiful things if it only works together and stays focused (van Twist, 2002). This seems to require the pattern ‘success to the successful’.

The idea of levers, i.e. relatively small changes with potentially large impacts, can be found in many institutional theories. Baumgartner and Jones (2002) use the concepts of positive and negative feedback to explain policy stability and change, referring to systems theory. Positive feedback occurs when a change, sometimes a very modest one, causes future change to be amplified. They, among other things, refer to cascades and bandwagon effects as important social mechanisms. Adrian Kay (2005) conceptualizes policy as ‘a vector in policy space, and argues that ‘a seemingly small change of direction ‘may turn out in retrospect to have been a critical juncture’ (Ibid, p. 566). More basically, a lever may be compared with the butterfly that causes a storm, the metaphor that made chaos theory, which later was incorporated into complexity theories, famous. The art, in Senge’s words, is to anticipate the potential of an action to become such a butterfly. This returns the argument to the system analysis. The question is, are Senge’s archetypes, and combinations of them, sufficient to describe the ‘storm system’ in a meaningful way, which could be useful to research?

3. Case 1: Flood risk management in the Netherlands

Institutional responses to undesired system archetypes in the past

If there were no dunes and dikes, 65% of the Netherlands would be flooded daily (Huisman, 2004) These flood prone areas are either situated below sea level or exposed to river floods. The Netherlands has a fascinating history of coping with flood risks. People living in the delta of the Rhine, Meuse and Scheldt rivers, had to live with regular flood events for centuries. At first, they learned to reduce flood vulnerability by building their houses on mounds. Later on they started to build small dikes to protect their houses and land, and they recognized the need for collective action to construct and maintain dikes. As long ago as the early middle ages, the first

water boards, a seminal case of self-organization in producing public goods were established (Toonen et al, 2006). These water boards were assigned tasks to construct and maintain dikes so as to reduce the probability of flooding. Land and property owners were directly involved in decision making on joint investments to be made and flood protection measures to be taken. The water boards were an early institutional response to a situation in which individuals were tempted to behave like free riders, i.e. in which they wanted to enjoy the benefits of flood protection without having to pay for it (Meijerink and Dicke, 2008). Moreover, the water boards were an effective institutional response to Senge's archetype of *'balancing with delay'*. By organizing collective decision making on the construction and financing of flood protection infrastructure, these institutions have been quite effective in anticipating future flood events.

Water awareness presumably was really high in these times, if only because of the frequency of (severe) sea and river floods. In the course of time, due to experiences gained and technological progress made, the quality of the dikes has improved continuously. This technological development was paralleled by a process of institutional learning. The water boards got a sophisticated institutional design, with an elected board which consists of representatives of various groups that have an interest in flood protection, such as land owners, private property owners and owners of industrial estate, and a complex system of water levies. This system was and still is an institutional answer to Senge's archetype *'success to the successful'*. Even if politicians tend to show more interest in constructing roads or building new hospitals, the water boards with their separate system of water levies, are helpful in generating sufficient resources for the maintenance of dikes at least (Dicke and Meijerink, 2006)).

After the French had occupied the Netherlands in 1798, a central water management agency, Rijkswaterstaat, was added to the system of locally developed water boards (Lintsen, 2002). This was an answer to a '*tragedy of the commons'* that emerged when several water management boards did not properly manage major rivers crossing several of their territories. The foundation of Rijkswaterstaat marked the beginning of a long process of centralization in Dutch water policies. Rijkswaterstaat received the main responsibilities for the protection against sea floods and floods along the main rivers. The responsibility for the maintenance of the dikes, however, remained with the Water Boards. The Rijkswaterstaat had an important task in coordinating flood protection policies and safety standards. The ongoing centralization of flood protection, the increasing importance of Rijkswaterstaat, particularly, has also made possible the realization of various large-scale coastal engineering projects, among which the damming of the Zuyderzee in 1932 and the construction of the Delta Works after the 1953 flood disaster (Disco, 2002). Dutch flood policies have proven to be an effective response to the *'balancing with delay-loop'*: short term policies do take into account the probability of future flood events (Dikes have always been constructed to prevent future floodings).

On the regional scale there was an urgent need for such coordination as well, since the local water boards, sometimes comprising just one polder, often *shifted the burden* to other water boards, for example by constructing dikes that are higher than the dikes of the neighboring water boards ('overdijken'). Exactly because of these interdependencies and the tendency to shift the burden to other water boards, a

process of upscaling has taken place in the past century (from 2500 in 1950 to 27 in 2008) *Current debates and newly recognized system*

In the light of this long-standing institutional learning process, and the relative success of the Dutch institutional framework in correcting undesired system behavior and producing water safety, it is quite remarkable that Dutch flood protection policies have become subject to intensive debate around the turn of the century. As is often the case in water management, a series of flood events has been the main trigger for this. The high waters of 1993 and 1995, when 250.000 people had to be evacuated, along with the increasing evidence for the serious consequences which climate change would have for Dutch water management, set the stage for a period of reflection on the Dutch institutional and policy responses to flood risks. Although the first response to the focusing events of 1993 and 1995 was to issue emergency legislation, i.e. to centralize decision making on the implementation of a large scale dike strengthening program, national water management experts started to develop alternative flood protection strategies simultaneously. They developed the new 'room for the river' policies, an ambitious national policy to create more space for the Dutch large rivers. Exactly because the Ministry of Transport, Public Works and Water Management realized it had become increasingly dependent on other parties, mainly on those responsible for spatial planning, it deliberately organized a decentralized planning process in which the Dutch provinces were asked to organize a regional process aimed at developing proposals for spatial measures in their respective jurisdictions (Meijerink, 2004).

Interesting enough, at the beginning of the new century the Dutch government also launched a public campaign in which the public was told (taught) that the Dutch had to learn 'to live with water' again, something the Dutch apparently have unlearned over the past centuries. How come? Had the Dutch not managed to develop effective institutional responses to undesired system behavior? Had the Dutch not gained a reputation as the number one in protecting low-lying river delta areas? Exactly because of this success, the institutional path taken in the Netherlands in itself is an example of the system archetype *'success to the successful'*. First, the Dutch have built continuously on a flood management strategy which was broadly perceived to be successful: the construction of ever higher, broader and more reliable dikes so as to reduce the probability of flooding, whilst neglecting other flood risk management strategies, such as policies aimed at reducing flood exposure or flood vulnerability, at the same time. Secondly, they have followed a path of an ever increasing role of government intervention, and of an ongoing upscaling and centralization of flood management. Again, this is an example of *'success to the successful'*, since the strategy of upscaling the waterboards has been effective in preventing land and property owners to shift the burden to areas downstream, but one that favors government intervention as compared with local self-organization (once the origin of the Dutch water boards) or the involvement of market parties.

The one-sided emphasis on reducing flood probability, has induced other undesired system behavior, which has been recognized by experts and water policy makers only recently. Exactly because of the successful flood protection policies, the newly or better protected lands tend to attract new economic activities. The increased population density and the increase in economic activities, in turn, lead to a demand for better protection, i.e. higher and better dikes. This is an example of *'growth and*

underinvestment', a vicious reinforcing cycle, which elsewhere is described as a 'management paradox' (Remmelzwaal and Vroon, 2000). Loucks et al. (2008, pp 546-547)) likewise argue that 'People live in hazardous areas because it is often to their advantage to do so. Since they do, such areas become developed and hence they become more economically valuable. This in turn justifies protection measures, leading to a cycle of increased development and incrementally increasing levels of protection infrastructure.

Related to this vicious cycle of land development and demand for better flood protection infrastructure, Dutch flood policies have caused another important mechanism, which is known in complex systems analysis as *'self-organized criticality'* (see for example Geldof, 2001), and which is similar to *'the limits to growth'* archetype. Governance systems in which the government takes all responsibility for flood protection, as is case in the Netherlands, inevitably lead to a decrease of water awareness and of the self-organizing capacity to take necessary adaptive measures (this is a re-inforcing loop as well). Since absolute safety does not exist, the crucial point is that in case of a flood event, the probability of such an event being really small, the impact of such an event will be enormous (the potential damage has increased, whilst the capacity to take adaptive measures has diminished). .

There is another interesting paradox in Dutch flood management. The development of a rather autonomous institutional framework for water management, consisting of regional waterboards with their own financing structure, which is supported by the Rijkswaterstaat organization on the national level, serves to guarantee that there always are sufficient resources for maintaining the dikes, regardless of the political mood of the day . Now flood management strategies are changing, and Dutch water managers have recognized the need for reducing flood exposure and flood probability, the technical water safety discourse has become a spatial discourse. As a consequence, water managers have no choice but to give up part of their autonomy in the flood policy domain, and to start cooperation with other government agencies on various levels of government. The other way around, these other agencies, who have become used to leaning on the specialized water management organizations, need to learn more about the nature of the Dutch water problems, and the urgent need for adjusting spatial behavior new.

Possible institutional responses

Summarizing, whilst Dutch flood policies have been extremely effective, the flood management system has moved in the direction of a government-controlled system with a one-sided emphasis on reducing flood probability. Moreover, the water management institutions have gained a relatively autonomous position within Dutch public administration (with a separate system of levies for flood protection). It is interesting to see that whilst these Dutch institutional responses to sea and river floods have been successful in coping with collective action problems, and the undesired archetypical patterns of delayed feedback, success to the successful and shifting the burden, the institutional path taken has induced several new undesired systems patterns and loops, which need to be balanced now. That is why Dutch government actively tries to raise water awareness now, aims to incorporate mitigation planning in its flood risk policies, and discusses possibilities for differentiating safety standards according to the potential impact of a flood event. Interestingly enough, the possibility of a system of flood insurance, which would imply a partial shift of responsibilities

from the government to private parties and individual citizens again, is subject of serious debate now. Moreover, government aims to enhance conditions for self-organization, for example by better communicating flood risks and possibilities for taking adaptive measures, such as waterproofing new urban areas and individual houses. Clearly, the Dutch have recognized the need to re-adjust their strategies for flood management. The challenge, of course, is to design institutions that correct the newly recognized undesired system behavior, without evoking the undesired patterns the Dutch have learned to deal with successfully since the middle ages. The transition from policies aimed at reducing flood probability to the management of the whole safety chain, implies a further differentiation of strategies of coping with flood risk, and enlarges the variety of institutional and technical solutions.

4 Case 2: Water management of the Western Peat Meadows

A patchwork of water tables, problems and solutions

In large parts of the Netherlands, climate adaptation means increasing water retention capacity to store rainwater. This includes the peat meadow areas of the Green Heart, the green open area in-between the main cities of Holland. The Green Heart of Holland used to be built-up of thick layers of peat. Part of this has been used as fuel leaving low polders and some lakes, but a lot has been spared and is in use as agricultural area, nature reserve, or both. Even light agricultural use requires lowering of the water table below ground level, which causes oxidation of the peat and therefore soil subsidence. In many low lying parts, salt ground water now has started to intrude, which will seriously hamper agriculture. The patchwork of different use intensities has created a patchwork of water tables which become increasingly difficult to manage. Natural areas are now high-lying and must stay wet to preserve their biodiversity, whilst the water is draining and there is a risk of local dike failure. Intensive (profitable) agriculture located in the vicinity of the nature reserves scattered around the area therefore creates problems of water management. On top of this, it is foreseen that parts of the Green Heart will have to be flooded in the future in periods of high rainfall, in particular close to cities. The chosen areas must be low-lying parts which are used by intensive agriculture, and here the cost of flooding is relatively high. Finally, there is a strong pressure for urbanization in the Green Heart, which creates more flood risk and goes against objectives of the national government.

This case study further focuses on Groot Mijdrecht Noord (GMN). GMN is a low-lying polder of less then 10 km2 in the Green Heart. It is surrounded by dikes and canals with higher water, and close to Amsterdam. It is mainly used for agriculture, and partly for nature. In the next decades, agriculture is expected to become impossible due to continued soil subsidence, salt intrusion and groundwater bursts. Present pumping of salt and polluted water out of the polder creates increasing problems for nature in the areas around the polder.

The province, the municipality and the waterboard agree that radical change of landuse in GMN is inevitable, sooner or later. The cooperation was initiated by the waterboard, which was worried about as a ‘do-nothing’ scenario would lead to rising water management cost, bankruptcy of farmers and contribute to flood damage to property owners in GMN itself and in Amsterdam (in the absence of retention area).

Several scenarios have been studied, of which one involving a lake for water retention is considered to be most sustainable. However, paradoxically, landowners continue to invest in the polder; e.g. farms are converted to mansions. The cost of a conversion of land use, which entails compensation of property owners for loss of (potential or actual) functions, is slowly rising. A binding decision about conversion depends on both sufficient government funding and political support.

None of the conversion options proposed by the collaborating governments, however, re widely supported. There seem to be different sources of doubt about conversion. Farmers and inhabitants say they don't believe the analysis made by the cooperating governments, and second there is doubt about the size of financial compensation. The latter has two components: will property owners get what is promised, and will it be enough to compensate the present option to convert property to a mansion? Another problem is that one authority should make a formal decision and therefore be financially liable for its effects, whilst depending on the other levels for co-financing. The financial risk is complicated by the long time span of the conversion – more than 15 years. Finally a formal plan is required because nobody in an area serving as retention area can be excluded from a change of land function. All property owners need to participate, even those who are not willing. When the plan would be voluntary, there would always be doubts about actual behaviour of land owners when it is their "turn" – they could demand higher compensation value.

Spring 2008, a stalemate had emerged with a tendency of developing more and more information about the content of the conversion options. However, the process was politicized and knowledge didn't seem to help achieve a political majority in the provincial council for any of the conversion options. Experts agreed that the do nothing scenario is not in the general interest, and there was on paper enough funding available for even the most expensive conversion option. It was said in backrooms that the provincial council should show more "courage".

A systems analysis and archetypes

In a systems analysis, it is clear that many basic feedback levels have been addressed in the management system. The urbanization of Amsterdam into the Green Heart as its *limits to growth* due to increasing flood risk, a process which is sped-up by climate change. The remedy would be to change the limiting factor, which is the retention capacity. More retention capacity reduces the risk. That remedy meets a *tragedy of the commons*: retention capacity is costly and all people in Amsterdam profit, there is no means to exclude those who don't pay. Also, there is *delayed feedback:* investing now will only bring reduced damage in the future. Both are bridged by a national government that has earmarked budgets. This is supported by a waterboard that envisages expensive water management even without climate change. However, the responsible government for making a decision about conversion hesitates. Here, the deeper nature of the feedback structure becomes speculative. There may be *reverberant doubt***,** the sources of doubt being a lack of supportive opinion leaders in the provincial electorate and a seeming unwillingness of the national treasury to provide a long-term financial commitment. The actual political risk is unknown, but there is no process to clarify it; in stead politicians resort to developing more knowledge about content to convince each other.

Possible remedies and responses

Summarizing the peat meadow case study shows that archetypes offer the potential to diagnose the situation in a meaningful way, whilst each dilemma leads to a new dilemma at a higher order level in the process. These dilemmas need to remain speculative in a quick review like this (based on official documents and a few interviews), and therefore the system analysis should preferably be done by those who are *in* that situation themselves.

If this diagnosis is true, the remedy is to develop an alliance to remove the sources of doubt. This would include activating "sleeping" interests of the looming tragedy for the farmers and the long term rise of the cost of water management. The provincial council may feel supported if, for example, consumer organizations or influential farmers would explicitly support conversion and give them political credit for their brave behaviour if they decide for conversion. The second source of doubt is uncertainty about the availability of national funding on the terms of the conversion process. Here, an alliance may be needed between province and financial ministry to see how more certainty can be provided. The deeper barrier may be a paradox that an adaptive society needs flexible financial systems (oddly in this case the system should be flexible enough to be made more reliable – en therefore less flexible - for the inhabitants of GMN), whilst that goes against the belief and traditions of the powerful financial world.

There is also the possibility that inhabitants prefer to speculate that land prices in the vicinity of Amsterdam keep rising, and therefore also their compensation becomes higher. In that case postponing a decision would increase their compensation. However, they are taking the risk that the government turns away and farms go bankrupt and GMN becomes an area with frequent local floods. The waterboard might force a decision by indicating it will not lower the water table anymore after a certain date in the future. However, it too then may become highly criticised.

Finally, there is the knowledge-side: inhabitants may be unaware of their own interest if they don't accept the knowledge that is offered to them. They would remain against conversion despite the fact they would be better off in terms of their own criteria. This could be a standard attitude toward the government, or a cultivated sentiment that the area should stay the same despite the evidence that this is impossible under any circumstances. Any farmer trying to break away from that local culture, and support conversion, would probably lose his friends. This is a devil's dilemma widely described in anthropology, which comes down to a *tragedy of the commons*. It is in the common interest to become more realistic, but each individual has an interest to punish anyone who shows a tendency toward change. The government may help people out of this trap and help a local change alliance to emerge, but this is time consuming and not rewarding in terms of official objectives of governmental organizations. This leads to dilemmas for individual civil servants and their leaders in the elected councils.

5. Results and reflection

Comment [MSOffice1]: Wat mij betreft combineren we de huidige paragrafen 5 en 6

System archetypes inspire

As the cases show, system archetypes enable a shift of focus from events and the behavior of single actors, to patterns of interaction and relationships within complex systems. After describing the main archetypes, and relating them to other literature on institutional and organizational stability and change, two case studies the authors are familiar with were used to apply archetypes. These case studies clearly demonstrate that several archetypes, such as the tragedy of the commons, shifting the burden, and success to the successful, offer a plausible description of the observed patterns. They also help to understand a succession of institutional solutions to overcome the effects of archetypical patterns. It also proves useful to distinguish different interacting levels of processes, like a physical-ecological level, a spatial-economic level and a governance level.

The case of flood risk policies clearly shows how floods produce feedback from the natural system to the social system. Likewise, the case of the Western peat meadows shows how soil subsidence, which is caused by human activities, increasingly limits possibilities for the very same human activities. 'Reverberant doubt' is similar to a tragedy of the commons occurring at governance level. This deadlock prevents proactive policies to intervene in the spatial-economic system, like in the case of the western peat meadows. The result is then that the spatial-economic system incrementally builds-up tension, i.e. self-organized criticality, like scarcety of 'living space safe from flooding' or 'oxidizing and salinizing peat meadows'. This tension may or may not be felt as a creative force in the governance system, acting as a lever to remove reverberant doubt so that action can be taken.

Governance strategies

Looking at the system patterns we have observed, what do we learn about the effectiveness of specific governance strategies? Both cases show that a succession of institutional arrangements reflects, and intervenes in, the observed patterns of interaction. So, there has been a great deal of social learning and awareness about feedback patterns in the past. The cases also show that this learning process is never finished, and hierarchies should continue adapting to new circumstances, for example in the case of self-organized criticality.

Disaster-driven learning proved to be succesfull. Policy makers often plead for governance strategies aimed at reducing complexity based on some dominant rationality, like 'safety first'. After a disaster, these policy makers may receive support. The case of Dutch flood risk policies shows that top down strategies, only under very specific and rare conditions, can not only be adopted, but can also be effective. After the 1953 flood disaster, the sense of urgency for improving flood protection was extremely high, which enabled the Dutch government to get the Delta Plan both approved and implemented. Quite similarly, after the 1993 and 1995 flood events, the government was able to issue emergency legislation and to strengthen the dikes along the Dutch rivers within a relatively short time span. Thus, after a crisis, hierarchical forms of governance can be effective (e.g. Koffijberg, 2005).

However, sense of urgency after a crisis fades, and centralized policies may meet increasing resistance. The patterns of interaction at governance level then change, and hierarchy is then used best to guarantee sufficient progress within horizontal and consensus based decision making process. Decision making on the Room for the river policies in the Netherlands is an interesting example. The provinces were asked to

develop a regional advice on the river widening measures to be taken on their respective territories, but beforehand it was clear that if the provinces would not succeed in developing proposals that meet the central objectives, the national government would have no choice but to take a decision on its own, and impose a centrally defined policy package (Meijerink, 2004). This is what Scharpf (1997) hascalled 'governance in the shadow of hierarchy'.

Hierarchical steering and centrally imposed policies have other drawbacks: they reduce the variety of problem definitions and solutions. The case of Dutch flood risk policies demonstrates how the Dutch have followed one particular policy path, which is characterized by governmental intervention aimed at reducing of flood probability by simply raising dikes, a purely technological solution. As a consequence, the Dutch have 'unlearned to live with water', lost their knowledge on how to reduce flood vulnerability, and their capacities for self-organization.

Climate change may force the Dutch to let the population feel again what it means to live in a major delta below sea level. This may regenerate the willingness to look for creative solutions which are sustainable in the event of climate change, and to support government measures that go with such creative solutions. In the Dutch case, dikes presumably will always be needed, but since absolute safety does not exist, both the reduction of flood exposure and of flood vulnerability should also receive attention. There is a need for more tailor made solutions for specific regions. Whilst in some regions, strengthening dikes is the only serious option, in other regions a higher flood frequency might be acceptable in combination with the creation of mounds or the development of evacuation plans. So far, the national government hesitates to accept such regional differences as this would compromise principles of equality and equity. This once again shows how difficult it is to leave a particular policy path, the ultimate demonstration of the archetype 'success to the successful', leading to 'limits to growth' (i.e. self-organized criticality).

New arrangements for social learning

The challenge is to design governance arrangements combining top down and bottom-up strategies in an intelligent way. Pure bottom-up processes put a bonus on shifting the burden to other regions, whist pure top down processes suffocate creativity and diversity, and might create adverse side effects due to limited knowledge of the local situation. National and regional learning processes are needed, focusing on the patterns of feedback and interactions they need to address and on levers to correct the adverse implications of these patterns. We expect a use of system archetypes to be useful in such processes. The analyses presented in this paper are made by researchers, but in a social learning process, such analyses should be a collaborative enterprise This has two major benefits: first, it mobilizes practical knowledge from the system itself which seems the best source, and second it may be expected to generate more support for the implications of these analyses. This may help the governance system adapt to its newly observed circumstances (Termeer & Kessener, 2007).

How can these learning processes occur? This is not an easy task, since parties have different perceptions of system behavior. Joint sessions in which parties try to gain insight in complex system behavior may be conducive to social learning, hence may contribute to a shared understanding of a particular collective action situation (Kessener & Termeer, 2007). Senge (1990) indicated that if interdependent groups are

prepared to jointly reflect on their common situation, they may discover the laws in their system and interventions, or levers, that would solve the problems they encounter in daily practice.

These ideas are not new. Pahl Wostl et al (2007) and Schuler & Pahl Wostl (2007) indicate resilience of resource management systems to (climate) change is limited by understanding of suitable interventions. Through an agent-based model they contend that in a specific river system centralized management creates a barrier against learning. Pahl Wostl et al (2007), for example, indicates that water management must become more flexible to deal with uncertainty and surprise and it should learn from outcomes to achieve structural changes in regimes. She enumerates several concepts for understanding multilevel water regime properties which may be discussed in actor platforms. Requirements for social learning include institutional settings that guarantee some degree of stability and certainty without being rigid and inflexible. Development of such institutional settings involves continued processes of social learning. Pelling et al (2007) refer to shadow spaces for social learning, Stacey (1996) uses shadow networks and Nooteboom (2006) adaptive networks.

What we add to these ideas is that social learning processes are benefited by a simple language that helps them focus on feedback patterns and system levels. i.e. a practical approach to dynamics system analysis. System archetypes have proven useful to us, as we have tried to demonstrate in the two case studies.

If these processes occur, more shared analyses will emerge about the patterns in the ecological, physical, economic and governance systems. This is by no means a warrant that effective courses of action can be found by learning groups. The true nature of a social system often cannot be identified without experimentation, since the effect of proposed new interventions depends on (ex ante) unknowable responses to these new pressures. Subjects in the system will become exposed to stress, which may lead to defensive behavior (protecting their existing routines) (Argyris. 1990). This of course, may be rephrased as tragedy of the commons: subjects may be prepared to shift their routines if they would be compensated for the associated effort, and that compensation may be justified by the overall benefit of the change. Resistance is often created by the impossibility to prevent that complex change causes real victims, or by traumatic experiences that have created taboos or unchangeable positions. This again, is a different additional loop which may turn out reinforcing or balancing.

6. Conclusions

The exercise with systems thinking shows that this technique enables a simple argument that simple solutions don't work and interventions need to be developed at another (system) level. Systems thinking is likely to help developing such interventions. There is a need to try that out in practice and test if the involved policy makers are enthusiastic about increased understanding and trust across the social cleavages that at present form barriers against action. It should be borne in mind that systems thinking is more difficult than it seems. Each archetypical model of reality is a huge simplification, and alternatives are possible. However, under complex conditions, the urgent thing is that a dialogue can start between stakeholders, and this always must be a simplification. The prime benefit of Senge's and other archetypes is

that they facilitate such dialogue. What we have added is the governance level: one there is some level of agreement about the barriers to climate adaptation in a physical and market sense, why can't we make progress in the social process?

Only people with inside knowledge can assess what might actually happen when a large scale intervention is introduced. The framework we propose therefore consists of desk study and interviews to identify the relevant actors and institutions and workshops to analyze the system dynamics with the help of archetypes and develop suggestions for interventions. These may then be assessed by means of interactive simulations and examples from comparable contexts.

Comment [A2]: Alles vanaf hier mag wat mij betreft weg (SN)

Preliminary conclusions for climate adaptation in the Netherlands: First, there is an urgent need to stop or block the reinforcing loops, which are caused by the ongoing raising of dykes. The Dutch government seems to have realized the need for that. A second one is the need to gain experience with a large variety of flood protection and mitigation strategies. Both a further differentiation of safety standards and a change of governance strategy in the direction of sharing responsibilities (risk sharing) between government and civil society, are needed for that. Finally, Because of the characteristics of water systems, (common pool resources, and shifting the burden), a delicate balance between self-organization and central government steering (hierarchy) is needed.

Comment [A3]: Dit lijkt me niet de kern van ons verhaal – het gaat over archetypen en klimaat is slechts een toepassingsgebied – deze alinea eruit?

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