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Research, part of a Special Feature on New Methods for Adaptive Water Management

Facing the Adaptive Management Challenge: Insights from Transition Management

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ABSTRACT. Recent research suggests that transitions toward adaptive water management regimes are needed because current water management regimes cannot adequately respond to uncertainty. The pivotal question is how to understand and manage such transitions. The literature on adaptive management addresses this question in part, but must now move beyond the descriptive toward a prescriptive management framework. Transition management theory could help in meeting this challenge. The similarity of the theoretical starting points yet different applications offer fertile conditions for cross-pollination. We investigate three central concepts from the transition management literature for their potential contribution to adaptive management. In particular, the notions of arenas and shadow networks merit further study through joint research.

Key Words: *Adaptive water management; transition management; water management*

INTRODUCTION

Over the last decade, Europe has experienced a number of major river floods and countless minor floods. Arguably, these are a direct effect of climate change, altered land-use patterns in the floodplains, and public unawareness. Fortunately, water is rapidly moving up the political agenda. Gleick (2003), however, argues that a fundamental reconsideration of river basin management is needed. Traditionally, water management has had a strong focus on reducing uncertainty through construction of large infrastructure (dams), control of water levels, and centralized top-down decision making. This approach has had significant adverse ecological effects. Furthermore, the long construction times and high capital costs of water infrastructure require long-term forecasting, something that is at odds with the uncertainties posed by climate change. Therefore, this strategy no longer seems appropriate.

Lee (1999) argued that the key solution is to increase adaptive capacity by strengthening the ability to adequately respond to change, rather than reacting to the adverse impacts of that change. This requires ongoing development of a portfolio of alternative policies that can be implemented quickly if needed. Lee (1999) proposed applying adaptive management (AM) theory to achieve such a style of management.

The necessity and benefits of adaptive water management (AWM) for European river basins has been detailed by Lee (1999) and Pahl-Wostl et al. (2005, submitted). Adaptive management is expected to be better able to deal with the uncertainties associated with climate change. Within AM literature, it is acknowledged that humans will always be partially ignorant of the complex ecosystem dynamics (Geldof 2002, Holling 1978) Therefore, AM is concerned with the establishment of a continuous learning process that attunes to new information by reformulating hypotheses and models, and understanding policy implementation as experiments. This requires river management regimes to be flexible.

Pahl-Wostl (2006) identifies six dimensions along which regime shifts should occur in order to support AWM. These shifts are: (1) from hierarchical, narrow, stakeholder participation to polycentric, horizontal, broad participation; (2) from separate analysis of sectors to cross-sector analysis; (3) from the river (sub)basin scale to a multi-scale approach; (4) from fragmented to integrated comprehensive information management; (5) from centralized

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infrastructure to a diversity of infrastructural designs at appropriate scales; and (6) diversification of financial resources though public and private investments. Huitema et al. (submitted), Raadgever et al. (submitted), and Gleick (2003) argue that, although many of the European water management regimes have adopted adaptive elements, they are still bounded by their infrastructural heritage, a tradition of centralized decision making, and a "predict and control" paradigm. In these respects, the present water management regimes are not sufficiently adaptive. Pahl-Wostl et al. (2005) argue that such fundamental changes might take several decades. This leads to the pivotal question addressed in this article: how to shape this transition?

The subject of transitions has received attention within the AM literature and is referred to as "transformability." Transformability is the capacity in a social–ecological system (SES) to create a fundamentally new system configuration (Walker 2005). Olsson et al. (2006) synthesized the findings of five case studies in which transformation of SESs did or did not occur. Their comparative analysis showed that successful transformation of local governance networks was associated with "shadow networks." Such informal networks seemed to be important in exploring new system constellations. They also found that some leader figures were important, especially in building trust, connecting people, and seizing windows of opportunity.

Despite these insights, it is still an enormous challenge to move from description and explanation to a prescriptive governance framework. Anderies et al. (2006) conclude:

> *The new insights presented here are still based on descriptive accounts (...). These insights must now be incorporated into formal models of governance. Models of this type will allow us to explore different forms of adaptive governance as part of a collaborative adaptive governance process. The development of such models is a major challenge facing social science.*

In this article, we argue that insights from the field of transition management (TM) could help meet this challenge. Transition management is a relatively young interdisciplinary research field that is concerned with the dynamics of structural change in societies, and when and how transformations can be initiated, facilitated, and influenced.

In this paper, we first explore the common ground between AM and TM. After clarifying commonalities and differences, we highlight three central TM concepts that have potential to complement AM. Then, we introduce a descriptive multi-level framework, developed to analyze and understand innovation processes in sociotechnical systems, and now used as a structuring framework to unravel parallel developments at different scales in society. Next, we introduce a categorization of management spheres for structuring the diversity of activities. We argue that interlinking these spheres is crucial, and to this end, we offer a prescriptive framework. We also introduce an important TM tool —the transition arena. Finally, in the conclusion, we discuss the relationship between AM and TM.

Over the past couple of years, there has been only a limited exchange of ideas between the AM and TM communities. We feel there is potential for further cross-pollination between fields, and hope this paper is a helpful contribution. Barriers of jargon may need to be overcome, and to this end, some of the main concepts are juxtaposed where necessary.

COMMON GROUND OF ADAPTIVE MANAGEMENT AND TRANSITION MANAGEMENT

Both AM and TM have roots in complex adaptive systems theory (see Folke (2006) for AM, van der Brugge (2005) for TM). Adaptive management started out with Holling's study of structural change and ecosystem functioning (Holling 1973). His views were a critique of ecosystem management and inspired many, such as Walters (1986), Lee (1999), Scheffer et al. (2001), Gunderson and Holling (2002), Olsson et al. (2004), Walker et al. (2004), Folke et al. (2005), and Cumming et al. (2006). It initiated a shift away from equilibrium thinking into the complex, adaptive, and unpredictable behavior of ecosystems. Holling introduced the notion of ecological resilience, a concept for understanding regime shift (Scheffer et al. 2001). The initial resilience work focused on the buffering capacity of ecosystems to absorb shocks and still maintain function. Later work on social–ecological resilience is concerned with the opportunities that disturbance opens up in terms of recombination, renewal, and emergence of new trajectories (Folke 2006). This line of thinking has created a spectrum between adaptability and transformability. Adaptability is

the capacity of actors in a system to influence ecological resilience, whereas transformability is the capacity to create a fundamentally new SES (Walker et al. 2004). Dietz et al. (2003) argued that this should imply an extended focus to the systems of governance. These forms of adaptive governance emphasize the capacity to deal with surprise, to learn, and to support flexible institutions more than traditional resource management (Folke 2006). In the remainder of this article, both the notions of management and governance are used. The term management is used here to refer to individual activities. Governance refers to the whole system of interrelated actors performing these activities.

Transition management has its roots in environmental studies, technological innovation studies, and integrated assessment; it was developed against a background of failing Dutch environmental policy. Despite the fact that many actors were willing to change to environmentally friendly modes, they were incapable of changing because of the high investment costs associated with such change (Grin et al. 2003). This initiated a shift from individuals and organizations toward the system level. Rotmans et al. (2001) argued that fundamental changes—transitions—were needed in the way societal systems were organized. As a large body of literature proves that sociotechnical systems are difficult to change (Arthur 1989, Dosi 1982, Metcalfe 1997, Nelson and Winter 1982, Rip and Kemp 1998, Rotmans et al. 2001), they argued that there was a need for new management concepts and tools. This led to the development of TM as a governance theory and the associated development of tools, such as transition arenas, transition scenarios, and monitoring.

Despite the fact that both theories have different origins, they have much in common. Both are presented as learning-oriented management theories. Both stress the limits to our knowledge and understanding of complex adaptive systems, and therefore, emphasize the importance of continuous processes of learning and adjusting. Governance systems are understood as polycentric institutional arrangements constituted by nested, multi-actor, decision-making units (Ostrom 1996).

A second commonality is their similar object of study, namely the dynamics and governance of SESs. Understanding the multiple links between the "eco" and the "socio" is what this kind of research aims for. Whereas the focus of AM is traditionally on the "ecological" part, the focus of TM is on the "social" part of the SES. However, over the last decade, AM has paid more attention to the social domain, more specifically to the way governance regimes are organized. Both fields of research attempt to understand the interplay between existing societal structures, ecosystem functioning, disturbances, and renewal.

A third commonality is that both theories address multi-scale dynamics. In AM, this is known as panarchy, which refers to the interaction of adaptive cycles at various scale levels (Gunderson and Holling 2002). The TM literature deals with cross-scale interactions by the so-called "multi-level framework" (Rip and Kemp 1998).

The fourth and arguably most important commonality is the concept of "self-organizing regimes" and the possibility of regime shifts. Self-organization is generally understood as the process in which the internal organization of open systems increases in complexity without being guided or managed by an outside source (Prigogine 1987). Walker (2005) refers to it as "the spontaneous organizational outcome of interacting negative and positive feedbacks." Changes in the feedback regime happen when certain thresholds are crossed. The notion of regime shifts and multiple stability domains is what makes both theories closely linked, and in fact, has been used by van der Brugge and Rotmans (2007) as a starting point for the development of a framework to understand transition processes in society. In TM theory, the behavior of different societal regimes can be described by stability domains that emerge from interdependencies, shared paradigms, and the distribution of power and responsibilities. Van der Brugge (2005) argues that, as in ecosystems, essential feedback processes in societal systems only persist within a certain critical range. After a threshold is crossed, the societal system shifts into a new regime of feedback processes. Transition governance is about initiating and organizing trajectories toward new systems, and as such, is concerned with transformability.

In summary, AM and TM have similar theoretical foundations and views on dynamic systems, but differ in the systems they study, which are, respectively, ecosystems and societal systems. This different application of more or less the same fundamentals holds promise for cross-pollination, especially with regard to the recent focal shift

toward SESs. Therefore, the next three sections highlight three different concepts from the field of TM that are of interest to AM scientists and practitioners in general, and water managers in particular.

MULTI-LEVEL FRAMEWORK FOR TRANSITION DYNAMICS

The first concept is the multi-level framework (MLF). Transition theory aims to explain why and how societal systems transform. Within TM literature—and as is stated in Olsson et al. (2006)—the dynamics of transitional periods are not yet well understood. Empirical studies, however, indicate that the range of developments that create transition patterns have different speeds and magnitudes (Rip and Kemp 1998). Therefore, it is necessary to take different scale levels into account.

Rip and Kemp (1998) developed a MLF that is widely used within the TM literature. They distinguished between three levels, and at each level, they make a distinction between the technological artifact and the social network in which the artifact is embedded (the so-called seamless web). The MLF suggests that artifacts and seamless webs merge at the micro-level into user-scripts and fixations on specific technologies. This constitutes a regime of technical systems, sectoral structures, and strategic games at the aggregated meso-level. Patterns of societal transformation that play out on long time scales, such as globalization or climate change, are located at the macro-level. The MLF aims at understanding technological innovation in a social context. According to Rip and Kemp (1998), novelty originates at the micro-level of local practices. Technologies are introduced against the backdrop of existing regimes and landscapes, following diffusion trajectories in which the technology and social context co-evolve under the influence of large-scale trends.

Various adaptations within the TM literature have resulted in a more generalized notion of the MLF. In these approaches, innovation is not necessarily bottom-up or technological in nature. Berkhout et al. (2004) redefined regimes as the dominant cluster of actors, artifacts, rules, and norms assembled and maintained to perform economic and social activities. The MLF has evolved into a heuristic to analyze: (1) the regime at the meso-level, (2) alternatives (innovations) at the micro-level, and (3) long-term trends at the macro-level.

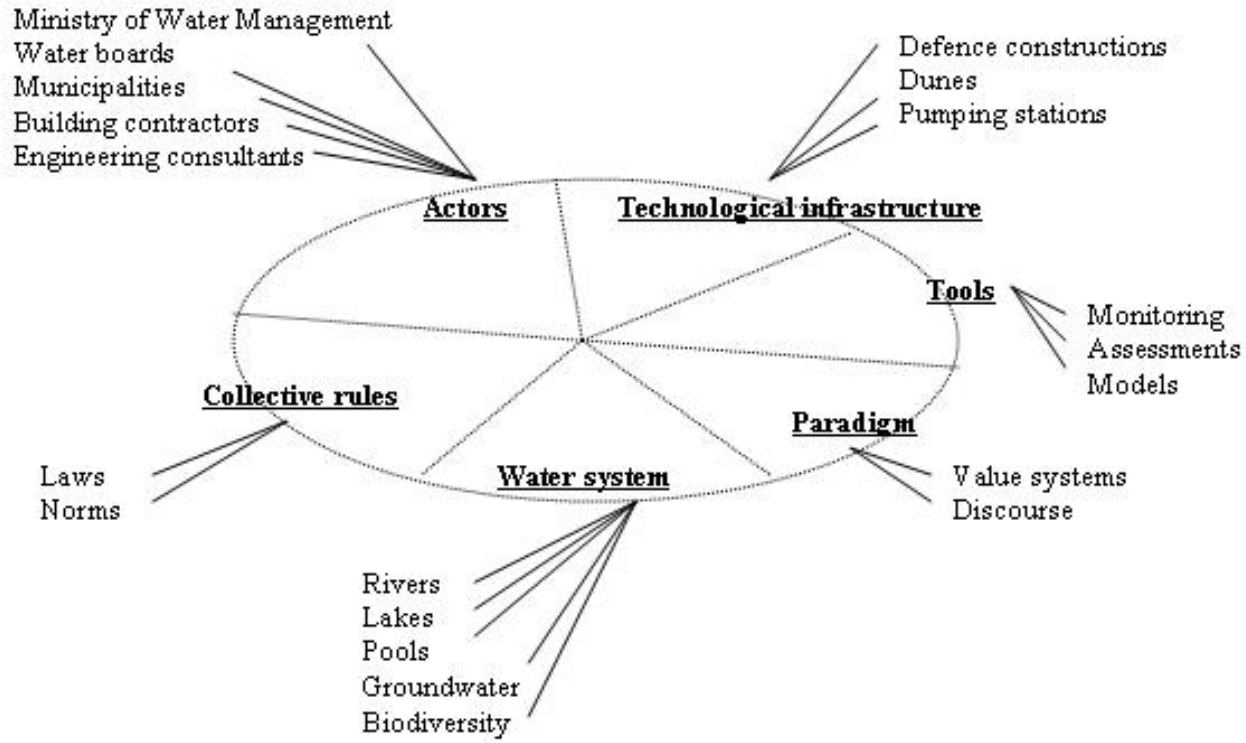
Within the TM literature, four transition phases are distinguished: (1) during the "pre-development" phase, large-scale trends put pressure on the regime. Innovations are developed, but strong selection pressures within the regime do not allow them to break through. (2) During the "take-off" phase, the innovations break through and a new regime starts to arise. (3) During the "acceleration" phase, the internal structure of the system is reorganized. Finally, during the "stabilization" phase, that new organization is made more efficient by optimizing internal processes.

These phases have similarities with the three-phased transition pattern described by Olsson et al. (2006). The predevelopment phase is similar to their preparatory phase, in which the system is being prepared for changes that are about to occur. The acceleration phase is similar to their transitional phase, and the stabilization phase is comparable to the phase in which they observe the resilience build-up of the new system. The pivotal take-off phase can be positioned as the shift from the preparatory to the transitional phase.

The framework has been applied to various historical cases relating to energy (Verbong and Geels 2006), transport (Schot et al. 2000), aviation (Geels 2006), waste management (Parto et al. 2006), and water management (van der Brugge et al. 2005). Applied to water management, the notion of a regime refers to the belief systems of actors and sector organization. Figure 1 illustrates the elements of the Dutch water management regime. This regime consists of actors (i.e., policy departments, water management boards, engineering offices, and scholars) and artifacts. The belief systems determine the kind of artifacts that are used, the water infrastructures that are built, and the water flows that manipulated. Actors are responsible for managing certain water-related issues. They do so by observing the water system and comparing it to norms. If norms are not met, defense constructions are strengthened, or pumping capacity is increased. If the problem is solved, underlying beliefs are re-confirmed. Over time, efficiency and stability of this regime has increased. The regime concept emphasizes that connectivity and interdependence.

In response to signals of failure and anticipated climate change, a new paradigm started to emerge and is now aiming for more resilient water systems by creating extra room for water and river ecosystems (van der Brugge et al. 2005). The multi-level developments that have contributed to this

Fig. 1. Schematic conceptualization of the Dutch water management regime. The regime refers to the web of actors, pardigms, collective rules, infrastructure, and tools. There is a powerful alignment and internal logic between elements, which both enable and constrain interventions in the water system.



transition are listed in Table 1. In short, the water management regime changed as a result of visionary plans (developed at the micro-level), changing macro-conditions e.g., climate change, urbanization, EU agricultural reform, and ongoing soil subsidence), and crises (e.g., ecosystem degradation and floods). The actual take-off was a combination of the existence of alternative ideas and charismatic promoters at the micro-level; a crisis requiring response; an official advisory committee, which emphasized the need for structural change; and meso-level revisions of policy and new institutional arrangements.

Applying the MLF to the transition to AWM regimes, the actual practice of AWM in Europe still seems to be a micro-level phenomenon compared with the way management regimes in general are operating. Although many of the regimes have incorporated some aspects of AWM, the underlying philosophy needs to be further articulated and translated into local and institutional practices. The MLF could be used to analyze the barriers and windows of opportunity for this transition.

Based on the above, we argue that the MLF could be of interest to the AM community for three reasons. First, this MLF is sociologically oriented and specifically designed to explain the spread of novelty and dynamics of regime transformation. The MLF implies that some general patterns can be distinguished. For instance, de Haan (2007) argues

Table 1. Scheme of developments at three levels of scale (macro, meso, micro) that have influenced the system state of water management in The Netherlands over a time period (1975–2004). System states are described in terms of management concept, approach, and priorities (1975, 1985, 1995, 2004). Taken from (van der Brugge et al. 2005).

System state 1975	Events	System state 1985	Events	System state 1995	Events	System state 2004
Macro developments						
Supranational:	Growing environmental awareness		Rio Summit (1992)		Johannesburg summit (2002)	
National:	Economic growth Limits to growth				Climate Change Sea level rise EU Water Framework Directive	
Delta Works Calamities (ecological impact)		1st National Environmental Policy Plan 1st Nature Policy Plan Floods (1993, 1995)		National Environmental Policy Plan 2, 3, 4 (NMP2-4) Environmental Management Act		
Meso developments						
Technocratic water management	Delta Works 2nd National Policy Memorandum Water Management Protests against water management approach	*Water System management*	3rd National Policy Memorandum Water Management (1989) Reorganization Rijkswaterstaat Reorganization Regional water boards Decentralization	*Integral water management*	WB21 (1999) 4th National Policy Memorandum Water Management (1998) Delta Plan Rivers	*Adaptive water management*
Engineering approach Hierarchical organization (top-down)		Engineering approach Hierarchical organization (top-down)		Room for Water Democratic organization (Stakeholder participation)		Adaptation and retention Participatory Policy process
Priorities: *Safety* *Agriculture*		Priorities: Safety Agriculture Ecology		Priorities: Safety Nature development Agriculture Spatial Planning		Priorities: Safety Spatial Planning Nature development Agriculture

(con'd)

Micro developments	Environment Dept. in Delta Dienst dealing with water (1985) Restoration projects	Plan Ooievaar (1987) Living Rivers (1992) Dealing with the surrounding area (1992)	Room for Rivers (1995) Tackling flooding (1998)

that there are three innovation patterns (reconstellation, adaptation, and empowerment) that are associated with three distinct transition paths. Schot and Geels (2007) distinguish different novelty adoption mechanisms under different multi-level conditions. Underlying each kind of transition is a different mechanism dominating and driving the transition. Second, the MLF is a useful analytical tool to unravel the multitude of developments that play out at different scales. The framework is often used in a retrospective way to explain how transformation occurred and to assess which phase a transition is in. Third, the MLF is useful for deriving insights for management.

In the context of European water management, the MLF is useful to inform river-basin policy makers about the macro-trends (such as climate change and European institutional structures) and micro-developments (such as local innovations and land-use change) that confront them. This may help them make sense of the world around them and learn to anticipate and adapt to macro-change through stimulating innovations instead of enforcing new rules.

FROM THE DESCRIPTIVE TO A PRESCRIPTIVE FRAMEWORK

The previous section outlined the framework that is used to unravel transition dynamics. This section shifts the focus to management. The TM framework discussed here is a prescriptive framework, developed on the basis of descriptive accounts of case-study applications of the MLF, experiences in action research, integrated assessment, and participatory methods.

One of the main premises of the TM concept is the necessity of a "shadow track" to the normal everyday short-term decision-making process. In this sense, the starting point of TM is close to the shadow networks described by Olsson et al. (2006). They state that: "the emergence of shadow networks for adaptive governance is a self-organizing process often triggered by a social or ecological crisis. The impetus for this is often the recognition of the need for an alternative approach for governing SESs." In a way, TM attempts to aid this self-organizing process with prescriptive frameworks and tools to initiate, stimulate, and facilitate such networks.

The TM framework consists of two basic concepts: a descriptive distinction into strategic, tactical, and operational innovation spheres, and a prescriptive design of activities connecting these spheres (Loorbach 2007). As it has been developed through action research, it has practical credibility, however, there is insufficient traditional scientific evidence for the concept as yet (Loorbach and van Raak 2006). This challenge is currently being addressed.

Innovation spheres (also referred to as networks or TM layers (Loorbach 2007)) are distinguished because associated activities focus on different elements. In the strategic sphere, all activities and developments that aim to change the culture of a societal system are identified: dialogues on norms and values, identity, ethics, or sustainability. These processes include vision development, strategic discussions, long-term goal formulation, collective goal and norm setting, and long-term anticipation. In the tactical sphere, activities relate to change of structures, such as investments and other resource distributions, rules, incentives, and underlying infrastructure. Negotiations regarding interests are more common in this sphere. The context in which

actors generally operate within this sphere is the institutional domain. The operational sphere includes activities and experiments that constitute actual new practices and connections between these practices. They often work with short time horizons embedded in innovation programs. In each of these spheres, people have a different focus, problem scope, and time scale (Table 2). Table 3 lists the competences required in each sphere.

In practice, all activities run in parallel, but an important insight from this descriptive distinction is that there is need for coordinated activities across spheres in order to scale up micro-level innovations. This is anything but trivial in practice. If the spheres interact too little, alternative practices remain isolated. Often, innovation is not properly embedded because there is a tension between cultural or structural elements (Bijker et al. 1987).

Authors such as Rotmans, Loorbach, and Kemp have developed an operational TM process cycle to structure and coordinate between these activity spheres (Loorbach 2007, Rotmans et al. 2001). The TM cycle consists of four activity clusters (Fig. 2): (1) the establishment and development of a transition arena; (2) the creation of a shared problem perception, long-term integrated visions, transition pathways, and agendas; (3) the mobilization of actors, and knowledge development through experimentation; and (4) the monitoring and evaluation of the transition process, resulting in adjustment of the problem perception and potential solution paths in a next cycle. Central to the cycle is learning-by-doing.

The TM cycle is not meant as a blueprint for action, but more as a guideline of the logical order of "reasoning." In practice, the activities run largely parallel instead of sequentially. Therefore, the TM cycle must always be adapted to local circumstances. For instance, TM processes usually start with strategic arenas, then link up with tactical and operational networks. However, if operational networks already exist, then the strategic arena could be useful in evaluating whether all topics are already covered, or which kind of learning experiences might also be worthwhile. Regardless of its starting point, throughout the cycle, communication between the clusters is important.

The TM cycle has been used by the Dutch Ministry of Economic Affairs to organize the Energy Transition program, which aims to stimulate the transition to a sustainable energy system. Governance strategies were developed for all three spheres. Best developed is the tactical sphere, in which platforms develop agendas. The step toward the operational sphere, in which experiments are carried out through public–private funding, is difficult. The program is still ongoing. Preliminary findings indicate that, despite major hurdles, the program has successfully set out a new governance approach focusing on long-term and structural change (Loorbach 2007). From a handful of people, the innovation network has grown to over 100 people who have committed themselves to sustainable energy. In time, empirical research will show whether it has indeed stimulated the take-off to sustainable energy.

The Dutch Ministry of Water Management (Ministerie van Verkoor en Waterstaat (MVW)) has recently developed a mission statement (MVW 2006) clarifying where the sector is heading in the long run, and what the role of the ministry should be in this trajectory. Although this was not a formal TM process, they used transition theory as the backbone of the report. Linking the strategic sphere to the tactical sphere, they organized discussions with experts from different backgrounds. More recently, in a vision statement on the water sector, parliament identified five transition paths that will shape the future water sector (MVW 2007).

The distinction in spheres—and connecting them in a cyclical approach—is of interest to AM in two ways. First, the distinction of strategic, tactical, and operational TM spheres may help AM refine and elaborate the concept of shadow networks (Olsson et al. 2006) and arenas of discourse (Gunderson et al. 2006). The distinction allows reflection and analysis of their activities and the links between them and formal structures. The next section explores similarities between the TA and shadow networks.

Second, the translation of the activities into a cyclic process design has led to a prescriptive management framework. The TM cycle has already provided those involved in transitions some guidance beyond rules of thumb. First, empirical findings indicate that it helped policy makers as it offered them a structure along which activities could be organized (Loorbach 2007). Ongoing research by scientists and practitioners (http://www.ksinetwork.nl) will strengthen the theoretical and empirical ground over the next few years.

Table 2.. Management spheres distinguished within transition management literature. Between the spheres, management activities differ in focus, scope, and time scale, based on (Loorbach and van Raak 2006).

TM sphere	Focus	Problem scope	Time scale
Strategic	Culture	Abstract/societal system	Long-term (30 years)
Tactical	Structures	Institutions/regime	Mid-term (5–15 years)
Operational	Practices	Concrete/project	Short-term (0–5 years)

TRANSITION ARENAS AS A TRANSITION MANAGEMENT TOOL

Whereas the previous section addressed the prescriptive TM process design, this section will address tools. Transition management tools that are currently being developed are the transition arena (TA) (Loorbach 2007, Rotmans et al. 2001), transition scenarios (Sondeijker et al. 2006), transition experiments (Kemp and van den Bosch 2006, van den Bosch and Taanman 2006), and a transition monitor (Taanman et al. submitted). A discussion of all these tools is beyond the scope of this article; we focus only on the TA. The TA is referred to as a systemic tool, a tool to change systems (Rotmans et al. 2004). Transition arenas resemble the notions of arenas for discourse (Gunderson et al. 2006) and shadow networks (Olsson et al. 2006) that circle within the AM community, and refer to groups of people who explore new system constellations. Such groups have been identified in Dutch water management by van der Brugge et al. (2005). In this section, the starting point, the empirical basis, design, and practical experiences of TAs are discussed.

The initial idea of the TA was born from the experience that sustainability issues could not be adequately addressed within normal policy arenas (Rotmans et al. 2001). Therefore, transition scholars argued that long-term sustainability required a TA as a counterpart for the normal short-term, interest-driven policy arena. A TA can be defined as "a group of people that reach consensus with each other about the need and opportunity for systemic change and coordinate amongst themselves to promote and develop an alternative" (based on Rotmans et al. 2001).

Empirical historical accounts of transitions showed that such small groups could play significant roles by developing new ideas (van der Brugge et al. 2005). For example, in The Netherlands, the shift toward integrated water resource management was strongly stimulated by a group of ecologists in the environmental department of the Dutch Delta-works. The Delta-works were supposed to close off the estuary of the Rhine basin. It was an emblematic "grand design" in the control-and-command tradition, which required multi-billion dollar infrastructural investments. However, shutting off salt water intrusion and tidal movement triggered a collapse of ecosystems and related economic and social systems (i.e., the fishery). The environmental department investigated the ecological consequences and initiated a number of restoration projects. In retrospect, this group could be viewed as a TA. For them, water was the most important carrier of the ecosystem in the estuary. They developed a perspective that was thus quite different from that of their civil engineer counterparts. During that period, the idea of integrated water management was developed and published in the report *Dealing with Water* in 1985 (MVW 1985). For years after, this report was the foundation for the official national memorandum on water management. This new formal paradigm proposed water as integral part of an ecosystem and a community, instead of merely a civil engineering issue. Through this specific path, the group was effective in promoting the new discourse; however, a much slower mechanism was also operating: namely the introduction of ecologists into the sector showed civil engineers new ways of dealing with water.

Another arena example from Dutch water management is that of a group of six people who

Table 3. Distinctive capabilities of actors for each TM sphere (based on Loorbach 2004). Note that some capabilities, such as communication learning and leadership skills are present in all spheres, see Loorbach (2007) for complete table.

Sphere	Distinctive capabilities of actors
Strategic	Systems thinking, creativity, and integrative skills
Tactical	Co-production, negotiation, consensus building, and networking skills.
Operational	Project management and entrepreneurial skills.

developed a new perspective on the river Mheuse. This river had been slowly transformed from a natural meandering river into a canal to facilitate navigation; its floodplains were used for agriculture. In 1987, the group won a national contest for the future of Dutch rivers. Their plan—plan "Ooiveaar"—suggested that land use should better reflect the form and function of ecological and morphological processes, including safeguarding river floodplains for nature preservation (Bruijn et al. 1987). This idea was picked up by the Minister and used as an argument in discussions about dike enhancements. Nowadays, it is an approved river protection strategy, but then it posed an alternative to agricultural activity in the floodplains.

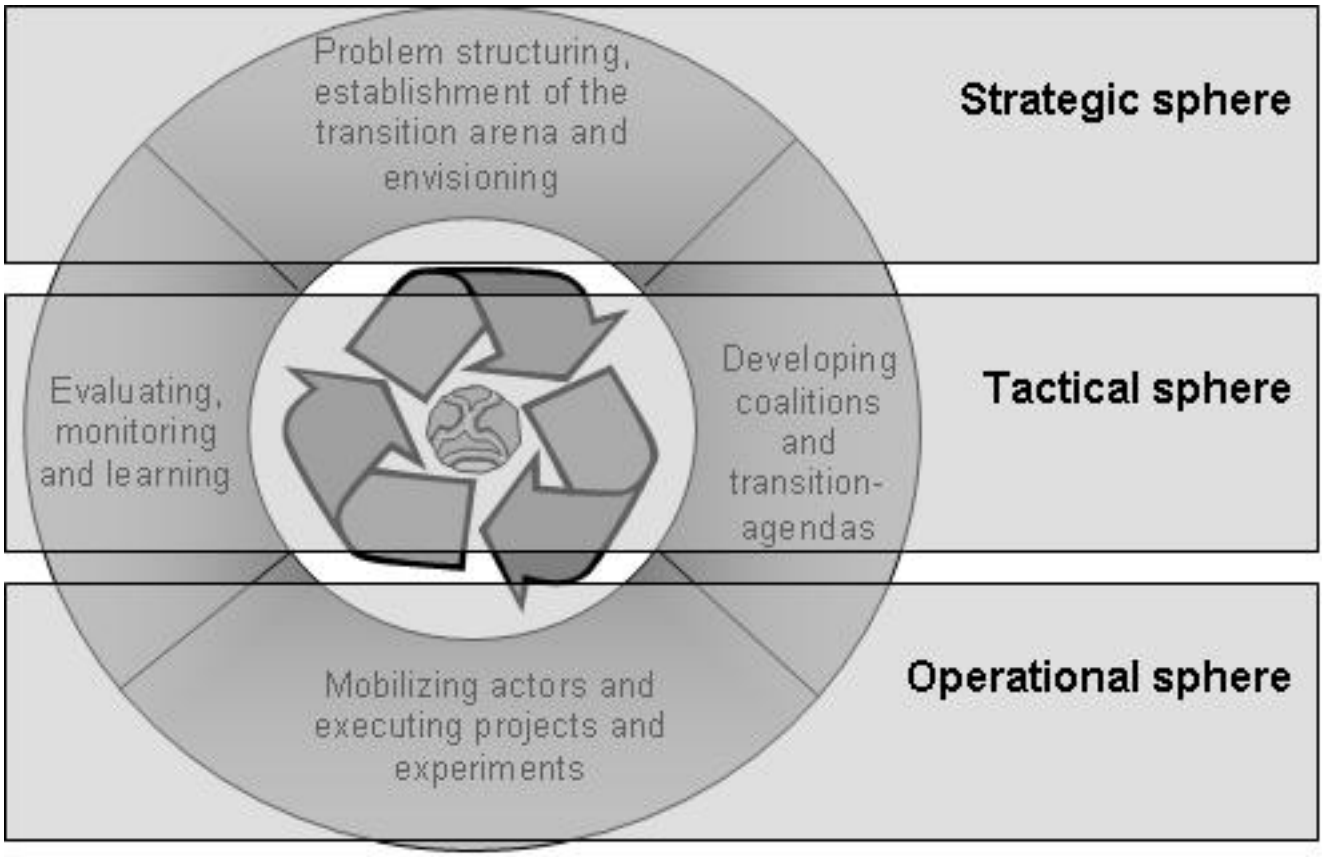
These two examples demonstrate the potential of TAs to bring about change, as they can be successful in preparing the ground for paradigm change. These arenas bear a strong resemblance to the above-mentioned shadow networks or arenas for discourse. Olsson et al. (2006) state that "Successful transformations toward adaptive governance seem to be preceded by the emergence of informal networks [....] where new ideas arise and flourish [....] Because the members of these networks are not always under scrutiny or the obligations of their agencies or constituencies, they are freer to develop alternative policies...." There is also a strong resemblance to the idea of adaptive networks mentioned by Nooteboom (2006). Although the actual manifestation of such networks is quite diverse, all these scientists note the importance of informal groups, which seek solutions outside the formal day-to-day machinery and participate in informal networks to reflect on the workings of the system.

So far, AM has documented these networks as a basis for future research. Within TM, similar observations have been translated into prescription. The TA could be used as a tool by manipulating group composition and the amount of freedom they are given. It is not a typical democratic stakeholder process, but a participatory network of innovators, and selection is based on capabilities and knowledge rather than on power or authority. Initially, only a relatively small number of forerunners from various fields are involved. They are expected to have capabilities such as: (1) being able to reflect on a high level of abstraction; (2) being able to look beyond the limits of their own working field; (iii) being able to propagate ideas in their home network; (3) being visionary; and (4) being able to work creatively in a team (Loorbach and van Raak 2006).

Bringing such a group together is difficult, but can work if trust is built. Personal views must be articulated in an interactive process toward a shared problem perception. A systems approach could be used as it structures the complex problem at hand and makes it understandable (Hisschemöller 1993). The articulation of diverging perspectives and the convergence afterward is thought to promote common ground and the construction of new knowledge (Beers 2005). The reframing process is at least as important as the paper products. Often information is carried by personal communication, and therefore, it seems wise to actively support them in transferring knowledge back to their home affiliations.

Transition management researchers and policy makers have experimented with the design of the arena over the past few years, although not yet in

Fig. 2. Transition management is a cyclical, coordinated, multi-actor process at strategic, tactical, and operational levels and is organized around four co-evolving activity clusters (1) the establishment and development of a transition arena, (2) the creation of long-term integrated visions, transition pathways, and agendas, (3) the mobilization of actors and knowledge development through experimentation, and (4) the monitoring and evaluation of the transition process (Loorbach and Rotmans 2007).



water management. The earliest experiment was the "Parkstad Limburg"-case in southeast Limburg, The Netherlands (Loorbach 2007). Parkstad Limburg is a cooperative initiative of nine municipalities. Conflicts hampered joint efforts to stop the downward economic, social, and ecological spiral since the coal mines closed during the 1960s. When the regional plan needed revision in 2000, some officials seized the opportunity to abandon traditional procedures and run a TM experiment instead.

Instead of inviting the usual suspects, the group of scientists from Maastricht University supporting the process and the officials decided to select people based on their ability to develop new perspectives. During the first phase, 15 people were invited to participate. It was the first application of the TM cycle. During the next 7 months, a regional vision was developed in which seven sustainability images and several short-term actions were identified. The reframing was triggered by the recognition that, in order to preserve local culture and social structure, the municipalities had to anticipate and adapt to international trends instead of ignoring them, and active cooperation was crucial in this scheme. One of the most direct results from the process was a renewed regional cooperative treaty previously thought impossible and an agenda for several public–private projects (Loorbach 2007).

Currently, several other TAs are set up in other regions (Zeeland Province) and sectors (e.g., the Dutch construction sector and health care sector and the Belgian waste management sector). The results from these TM processes will be reported in the coming years, but early findings indicate that, although participants often experience the process as a struggle, they reframe the problem, adopt new perspectives, and expect a follow-up (Loorbach and van Raak 2006).

The first indications are that the TA is a potentially powerful systemic tool for initiating change and facilitating and guiding transitions. These arenas are promising ways to explore what AWM would look like in the local river basin and to further embed AWM principles in the existing water management regimes. An important variable is group composition, and this should be carefully prepared. Reframing requires a group in which people with different backgrounds are put together and are challenged to develop a shared problem perception.

CONCLUSION

This article has explored the potential for cross-pollination between AM and TM, especially with regard to the transition to AWM regimes in the European context. The similarity of theoretical starting points, but different orientations, seems worthy of further exploration. Some notions (e.g., resilience) from AM have already been incorporated into TM. In turn, TM theory may contribute to AM theory in two ways: in understanding how societal transitions unfold, and by sharing management insights with regard to transformability.

More specifically, three of the concepts used in TM were addressed here, and investigated for their potential contributions. The MLF is specifically geared toward explaining multi-scale innovation processes and regime shifts. It is helpful as a heuristic framework to unravel the multitude of societal developments that give rise to transitions. Its application is useful for informing AM scholars and river basin managers about different kinds of strategies and the timing thereof. Up to now, it is still a heuristic tool, but attempts are being made to develop formal computational models.

The TM framework provided two types of insights to complement AM. First, it emphasized the importance of connecting the different types of management spheres. If the strategic, tactical, or operational networks are not properly linked, innovations are doomed to fail. Second, by connecting the activities and ordering them according to the TM cycle, these barriers can be resolved early. This will increase the chance that a variety of innovative activities will be selected and will reinforce each other.

The TA seems to be a potentially powerful systemic tool for initiating change and stimulating transition processes. The TA is very close to what has been described previously as arenas for discourse or shadow networks. As we have seen in the empirical observations of such arenas in the Dutch water management history, they can voice new perspectives that resonate for decades, and change goals about good water management. However, in order to increase the transformative power, such visions need to be tuned into real-life experiments and their promoters need to be empowered. Arenas could be very useful for exploring what AWM means in the context of a specific river basin, and for further embedding AWM principles in national water management regimes.

The three concepts discussed here demonstrate the huge potential for learning that exists between AM and TM, although there are differences in jargon and methodology. A fruitful way to proceed seems to be in the direction of a joint research agenda concerned with arenas, or shadow networks. The authors hope this article will initiate further discussion between the two research communities.

Responses to this article can be read online at:
http://www.ecologyandsociety.org/vol12/iss2/art33/responses/

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