Transition Management for Sustainable Development: A Prescriptive, Complexity-Based Governance Framework

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This article introduces transition management as a new governance approach for sustainable development. Sustainable development is used here as a common notion referring to those persistent problems in (Western industrialized) societies that can only be dealt with on the very long term (decades or more) through specific types of network and decision-making processes. Based on interdisciplinary research into complex processes of long term, structural change in society, basic tenets for complexity-based governance are formulated. These tenets are translated into a framework that distinguishes between four different types of governance activities and their respective roles in societal transitions. This framework can be used for implementation of governance strategies and instruments. The approach and framework have been developed deductively and inductively in the Netherlands since 2000. This article presents the theoretical basis of transition management and will be illustrated by examples from transition management practice, especially the Dutch national energy transition program.

Introduction

Over the last decades, we have witnessed a shift from the centralized government-based nation-state toward liberalized, market–based, and decentralized decision-making structures in modernized European democracies. The power of central government to develop and implement policies in a top-down manner has decreased, leading to increasingly diffuse policymaking structures and processes stratified across subnational, national, and supranational levels of government (Hooghe and Marks 2001). Generally referred to with the term "governance" (Kooiman 1993), the current practice of governments in Western European nation-states is increasingly to develop policies in interaction with a diversity of societal actors. In other words, interaction between all sorts of actors in networks often produces (temporary) societal consensus and support upon which policy decisions are based. This development is far from

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trivial in light of the many complex, persistent problems that face Western societies, and for which sustainable development can neither be planned nor emerge spontaneously.

There seems to be an increasing degree of consensus in governance research that both top-down steering by government ("the extent to which social change can be effected by government policies") and the liberal free market approach ("the extent to which social change can be brought about by market forces") are outmoded as effective management mechanisms to generate sustainable solutions at the societal level by themselves, but it is at the same time impossible to govern societal change without them (Jessop 1997; Meadowcroft 2005; Pierre 2000; Scharpf 1999). Therefore, new modes of governance are sought that reduce the lack of direction and coordination associated with governance networks in general, and increase the effect of existing forms of government and planning in the context of long-term change in society. In effect, this implies a new balance between state, market, and society and new ways to facilitate and make as effective as possible the informal network processes through which alternative ideas and agendas are generated that are often seen as important in fueling regular policymaking processes with new problem definitions, ambitions, solutions, and agendas (Héritier 1999).

Although it is not easy to generalize, theories of governance developed over the last 15 years are highly descriptive and analytical and rarely offer a prescriptive basis for governance. Modern industrialized societies are however confronted with many complex and unstructured problems (e.g., in our welfare systems, environment, agriculture, energy, mobility, health care) for which long-term solution strategies need to be developed at the level of the society. We can refer to this as the challenge for (a form of) sustainable development or, to use a sociological concept, as reflexive modernization (Beck 1992): Long-term development that takes in to account the adverse side effects of modernization and fundamentally redefines its own dynamics and workings. Not only does this imply a new paradigm on economic and technology development, it also includes a redefinition of how to govern society. While in this article we focus on Western democracies, this need for reflexive modernization and associated new ways of "reflexive governance" (Voss 2005) are a general need for industrialized and industrializing countries.

Since 2001, a governance experiment is ongoing in the Netherlands under the flag of "transition management" (Rotmans, Kemp, and van Asselt 2001; VROM 2001), of which the so-called Energy Transition Program is best known (www.senternovem.nl/energytransition). It is perhaps not coincidental that this experiment originated in the Netherlands, well known for its collaborative policymaking, long-term planning, and innovative environmental policies. It is, however, also surprising, since many facets of transition management constitute a break with dominant approaches: a focus on frontrunners, the objective of radical innovation, and the selective participatory approach (Van Buuren and Loorbach

2009). The emergence of transition management can in this light perhaps be seen as a break with the consensual tradition of policymaking in the Netherlands, which according to some is a broader and ongoing development (Baumgartner and Jones 1993). On the other hand, the traditional political culture and practices in national and local government seem on the outside to be following new trends and changing quickly, while at closer look, the changes often do not go deeper than the surface (Hendriks and Grin 2007). The future will have to determine whether transition management is a symptom of an emerging new political culture and governance paradigm or another fashionable governance innovation that is being used to cover up that in the meantime, it is still policy as usual.

This being said, governance processes based on transition management have been developed in various sectors and regions over the past 10 years. These are designed to create space for short-term innovation and develop long-term sustainability visions linked to desired societal transitions. These processes are producing broad innovation networks, including business, government, science, and civil society. These networks have shared visions and agendas for social reform and are increasingly influencing regular policies in areas such as the energy supply, mobility, health care, agriculture, and water management (see, e.g., Loorbach 2007; Van der Brugge 2009). Increasingly, it is also seen internationally as an interesting approach to mobilize, guide, and accelerate social innovation rapidly (e.g., Hendriks and Grin 2007; Kern and Smith 2007; Meadowcroft 2007), although the approach itself is still developing.

Transition management as presented in this article is a governance approach based on insights from governance and complex systems theory as much as upon practical experiment and experience (Loorbach 2007). On this basis, a framework is built that discriminates between different types of governance activities that influence long-term change. This framework can be used both to analyze and to structure or "manage" ongoing governance processes in society. Transition management is innovative for two reasons: It offers a prescriptive approach toward governance as a basis for operational policy models, and it is explicitly a normative model by taking sustainable development as long-term goal. Transition management is itself still in development. The new, hybrid research field of transitions in which interdisciplinarity and practice-oriented research are central elements is still in a preparadigmatic stage (Rotmans et al. 2004; Voss, Bauknecht, and Kemp 2006). This means that the thoughts and concepts presented in this article are subject to debate. In fact, it is through scientific and societal debate upon issues addressed in this article that our thinking and practice of governance for sustainable development advances.

Governance and Complexity

Society has become increasingly complex on three levels: the level of society itself, the level of the problems facing our society, and the level of

dealing with these problems (governance). Trends such as economic and demographic growth, internationalization, technology development, and individualization have led to the emergence of the network society (Castells 1996; Teisman 1992; Voss, Bauknecht, and Kemp 2006) and an increasing societal complexity. This modern complex society is at the same time the origin of many problems, as it is the breeding ground for novel approaches to deal with these problems (as we will argue in this article). In this article, we focus on a specific type of problems at the societal level, which cannot be solved with simple, short-term solutions. These problems are defined as persistent problems: They are unstructured (Hisschemöller 1993) and highly complex because They are rooted in different societal domains, occur on varying levels, and involve various actors with dissimilar perspectives, norms, and values. Solutions to such problems are not given, and purely analytical approaches will not suffice. The structural uncertainties surrounding future development necessitate more explorative, experimental, and reflexive approaches.

Policymaking itself has become highly complex in the context of these persistent problems and the related uncertainties, as different actors and perspectives need to be dealt with, and clear solutions or mechanisms to assess progress and success are lacking. In the short term, different new concepts and approaches have emerged concerning how governments can deal with a network society: interactive, participatory, network, and process approaches (see, e.g., Edelenbos 2005; Jaeger et al. 1997; Jessop 1997; Klijn and Koppenjan 2000). These new governance arrangements focus on understanding and sometimes facilitating network processes around formulation and implementation of policy problems in the short and mid term. Dealing with persistent societal problems in the long term will require approaches that give special attention to learning, interaction, integration, and experimentation on the level of society instead of policy alone. This is especially true since every action or solution will lead to changes in the societal structures, in turn transforming the problem itself. A recent and poignant example is the issue of climate change, which clearly can only be addressed through novel forms of government–society interactions across different levels to address a broad complexity of interrelated problems (Prins and Rayner 2007; Rabe 2007).

An emerging paradigm for analysis of persistent problems is complex systems theory (or "systems thinking"). Systems theory refers to a universal language to address complex patterns of interaction between different components in complex adaptive systems (Gell-Man 1994; Gunderson and Holling 2002; Holland 1995; Kauffman 1995). "Systems thinking" quickly gained popularity during the 1990s in the context of organizational sciences and management practice but has emerged since the 1950s in a number of disciplines (Ackoff 1971; Midgley 2000; Varela, Maturana, and Uribe 1974; Von Bertalanffy 1956). Often linked to the evolutionary or co-evolutionary perspective, system theories have been adopted in one form or another as a useful analytical approach in sociol-

ogy (Giddens 1984; Luhmann 1984), economics (Allen 2001; Boulding 1970), ecology (Gunderson and Holling 2002), policy sciences (Kickert 1991; Vickers 1965), and organizational sciences (Senge 1990). Recently, the approach has been explicitly introduced into governance and political sciences (Kemp, Loorbach, and Rotmans 2005; Rotmans, Kemp, and van Asselt 2001) through the concept of transitions and transition management.

Systems theory offers a conceptual lens to analyze and understand both societal and governance complexity. The complexity perspective on society makes it clear that uncertainties, nonlinear processes of change and innovation, and emergence are important features of societal change, but at the same time, there are specific patterns, dynamics, and mechanisms that drive change in societal systems (De Haan 2006). An understanding of these patterns and mechanisms provides greater insight into the dynamics of a complex, adaptive societal system, which offers a basis for improved insight into the feasibility of directing and influencing it and vice versa. The governance- or network-processes actors co-evolve with these broader societal system dynamics. Societal actors (governments, business, scientists, nongovernmental organizations [NGOs], intermediary organizations) create formal and informal networks because they have partially overlapping interests, and they find benefits in temporarily sharing certain resources and working together toward shared objectives—something that they cannot do well without each other and that they can better achieve jointly than individually. Within networks, decisions and strategies are developed, negotiated and implemented that lead to changes in societal structures, which in turn structure the governance patterns. The formal policy process in this view is only part of "governance." The central problem is that policymaking this way has become less transparent; the division of power, as well as the accountability issue, is no longer clear, yet this produces a policy vacuum that needs to be filled with novel strategies to ensure the effective production and implementation of policies without losing democratic legitimacy.

In other words, governance itself is not independent of its surrounding environment, be it political, social, or other. Driven by trends such as European integration, internationalization, and empowerment of societal actors, governance dynamics and structures have emerged in all sectors of the economy and society. Not surprisingly, the interactive policy and network approaches in which government involves societal stakeholders in the policymaking process have recently become widespread. The organization and design of these interactive processes itself has become subject of study (e.g., Edelenbos 1999) and has led to the emergence of the field of process and network management (De Bruijn and Ten Heuvelhof 1997; Eising and Kohler-Koch 1999; Kickert, Klijn, and Koppenjan 1997; Milward and Provan 2000). Besides the government, other societal actors also attempt to direct a process where they have mutual influence (De Bruin, ten Heuvelhof, and in 't Veld 1998).

Based on an overview of the existing literature, we can conclude that "governance" is characterized by diversity, uncertainty, heterogeneity of society, and the decreased possibilities for inducing long-term change by government. In light of the ambition of realizing long-term sustainable development, prescriptive governance models need to take into account that:

- All societal actors exert influence and thus direct social change, being aware of the opportunities as well as the restrictions and limitations of directing. Through agency and interaction in networks, society is shaped as well, to which we conceptually refer as "governance."

- Top-down planning and market dynamics only account for part of societal change; network dynamics and reflexive behavior account for other parts.

- Steering of societal change is a reflexive process of searching, learning, and experimenting.

The general conclusion from this overview is that there is a huge variety and diversity of concepts, analytical models, and theories existing that seem to provide some of the jigsaw pieces. None of the mentioned theories seems to address the societal and steering complexity involved in issues such as climate change, restructuring of energy, and mobility systems, or the transformation of housing stock in long-term, multilevel, and multi-actor terms in a prescriptive manner. We have found that different elements are provided for such a mode of governance: actor–network interaction, different levels, different social domains with specific characteristics, plurality of actor perspectives, and new instruments, practices, and approaches that emerge within the field of steering and government. A shared message seems to be that there is a relationship between the nature of a "system," the specific patterns and dynamics, and the way that actors influence and react to these. Transition management is therefore analytically based on the concept of "transitions" as multilevel, multi-phase processes of structural change in societal systems.

Starting Points for Governance Based on Complexity Theory

Transitions are processes of structural change in societal (sub-) systems such as energy supply, housing, mobility, agriculture, health care, and so on (Geels 2002a; Rotmans et al. 2000). Transitions come about when the dominant structures in society (regimes) are put under pressure by external changes in society, as well as endogenous innovation. Under certain conditions, seemingly stable societal configurations can transform relatively quickly (a societal transition could take decades). Two basic concepts are used to analyze transitions in societal systems. The multilevel model (Rip and Kemp 1998) distinguishes between innovation in niches, a

dominant regime, and an external landscape. Developed in the context of sociotechnical studies, it has been applied to study historical transformations such as those from sail boats to steam engines, from piston engines to jet propulsion aircraft and from horse carriages to automobiles (Geels 2002b). The multiphase or S-curve model (Rotmans, Kemp, and van Asselt 2001), typical for innovation studies, distinguishes between the predevelopment, take-off, acceleration, and stabilization phases. Examples of transitions are the changes in water management (Van der Brugge and Rotmans 2007), waste management (Parto et al. 2007), agriculture (Grin, Felix, and Bos 2004), and energy supply (Loorbach, der Brugge, and Van 2008; Van den Bergh and Bruinsma 2008; Verbong and Geels 2006).

Transitions of societal systems can be considered as a particular case of complex systems dynamics (Grin, Rotmans, and Schot 2009). In a transition, a complex, adaptive system is successfully adjusted to changed internal and external circumstances, and the system thus arrives at a higher order of organization and complexity. In societal systems, structural change is often a result of individual actions as a response to changing societal conditions, as the mentioned historical case studies illustrate. This touches upon the old debate in sociology about structuration (Giddens 1984): How does the interplay between the system level and individual or institutional action (or agency) produce societal change? The transition concept tries to unravel the complex interaction patterns between individuals, organizations, networks, and regimes within a societal context, and how over time, these can lead to nonlinear change in seemingly stable regimes.

Based on this multilevel and multiphase understanding of transitions in complex, adaptive societal systems and insights from the governance literature, the following tenets for a form of governance based on complexity have been formulated (Loorbach 2007; Rotmans and Loorbach 2008):

- The dynamics of the system create feasible and nonfeasible means for steering: This implies that content and process are inseparable. Process management on its own is not sufficient—insight into how the system works is an essential precondition for effective management.

- Long-term thinking (at least 25 years) is a framework for shaping short-term policy in the context of persistent societal problems. This means back and forecasting: the setting of short-term goals based on long-term goals and the reflection on future developments through the use of scenarios.

- Objectives should be flexible and adjustable at the system level. The complexity of the system is at odds with the formulation of specific objectives and blueprint plans. While being directed, the structure and order of the system are also changing, and so the objectives set should change too.

- The timing of the intervention is crucial. Immediate and effective intervention is possible in both desirable and undesirable crisis situations.

- Managing a complex, adaptive system means using disequilibria as well as equilibria. Relatively short periods of nonequilibrium therefore offer opportunities to direct the system in a desirable direction (toward a new attractor).

- Creating space for agents to build up alternative regimes is crucial for innovation. Agents at a certain distance from the regime can effectively create a new regime in a protected environment to permit investment of sufficient time, energy, and resources.

- Steering from "outside" a societal system is not effective: Structures, actors, and practices adapt and anticipate in such a manner that these should also be directed from "inside."

- A focus on (social) learning about different actor perspectives and a variety of options (which requires a wide playing field) is a necessary precondition for change.

- Participation from and interaction between stakeholders is a necessary basis for developing support for policies but also to engage actors in reframing problems and solutions through social learning.

Transition Management: A Descriptive Multilevel Framework

The challenge is obviously to translate these relatively abstract governance tenets into a practical management framework without losing too much of the complexity involved and without becoming too prescriptive. We have attempted this by developing a framework for transition management. This framework has emerged out of theoretical reasoning (following the line of reasoning and conceptual integration described above) combined with practical experiment and observation. It is, in other words, based on "natural" processes of governance that can be observed in society (see, e.g., Kemp 2006; Parto et al. 2007) but then structured and defined based on the characteristics of complex societal transitions. In that sense, it is an analytical lens to assess how societal actors deal with complex societal issues at different levels but consequently also to develop and implement strategies to influence these "natural" governance processes. In the transition management framework, four different types of governance activities (alternatively called "spheres"; Van der Brugge and Van Raak 2007) are identified that are relevant to societal transitions: strategic, tactical, operational, and reflexive (Loorbach 2002, 2007).

Strategic

As strategic activities, we identify processes of vision development, strategic discussions, long-term goal formulation, collective goal and norm

setting, and long-term anticipation. In essence, all activities and developments that deal primarily with the "*culture*" of a societal (sub-) system as a whole: debates on norms and values, identity, ethics, sustainability, and functional and relative importance for society. In the context of regular policies, especially in periods of predevelopment and takeoff, discussions of this nature draw more attention. Think, for example, about the debate about energy supply, in which energy security, climate impact, energy prices, and diversity of resources are central issues for which the buildup of sociopolitical sense of urgency, as well as consensus regarding future development, is ongoing.

In such a sociopolitical context, uncertainty around future developments is high, and opinion leaders and innovative alternatives are able to voice alternatives and influence societal and political debate. However, the way in which future visions, structural reflection on ongoing and future trends and developments, and debate on how innovation should contribute to desired changes is often more implicit than systematically structured. Long-term concerns and governance have no institutionalized place in regular policymaking, which is generally focused on the short and mid term because of political cycles, individual interests, and public pressure. The ambition of transition management is to integrate (in a sense institutionalize, although this is contrary to the nature of transition management) long-term governance activities into the realm of policymaking—not as a regular and formalized activity but as a fundamentally necessary element of policymaking for sustainable development.

Tactical

As tactical activities, we identify steering activities that are interest driven and relate to the dominant *structures* (regime) of a societal (sub-) system. This includes all established patterns and structures, such as rules and regulations, institutions, organizations and networks, infrastructure, and routines. This "sphere" thus includes all actors that are dealing on a daily basis with developing programs, financial and institutional regulation and frameworks, organizing networks and coalitions, and, in general, representing certain interests. The context in which such actors operate is at the level of departments, subsectors, or within specific subthemes. For example, subsystems or themes observed within the energy system could be the different sources of energy (coal, gas, oil, sustainable) or could be different "domains," such as technology, policy, market, and consumption. Activities are focused on achieving goals within a specific context but are almost never concerned with the overall development of the societal system. They generally have a time horizon of 5–15 years, and are generally considered "strategic" at the level of individual actors.

A company or organization will probably have a strategic vision upon the position of the organization in its direct (industrial, institutional, or societal) context, from which it enters the interaction and negotiation with

other actors. But from the perspective of transitions, this leads to fragmentation in governance and suboptimal solutions at the systems level. For the government, the institutional fragmentation in terms of different ministries, departments, executive offices, and directorates is a major barrier for integrative long-term policies. The same might be true for other actors, such as business, science, and NGOs that are operating in networks negotiating change or projects and running their day-to-day operations. Sometimes, these actors are not able or willing to contribute to system innovation, but often they are unaware of the possibility. Not because they are not functioning at their own level, but because an integrative strategic governance level is missing, there are only very limited instances of successfully integrated long-term governance.

Operational

As operational activities, experiments and actions are identified that have a short-term horizon and are often carried out in the context of innovation projects and programs, in business and industry, in politics or in civil society, and are generally referred to as "innovation." In the context of transition management, it is important to emphasize the inclusive definition of innovation as including all societal, technological, institutional, and behavioral *practices* that introduce or operationalize new structures, culture, routines, or actors. Action at this level is often driven by individual ambitions, entrepreneurial skills, or promising innovations. In the innovation and sociotechnical literature, the process of innovation is often presented as an emergent, often random, and uncertain process. In practice, these innovations often seem to emerge in niches (Kemp, Schot, and Hoogma 1998) without any link to broader policies or agendas and can, under specific conditions, develop into mainstream options. From this perspective, innovations almost never lead to system innovations and transitions except by chance.

Reflexive

Reflexive activities relate to monitoring, assessments and evaluation of ongoing policies, and ongoing societal change. In part, they are located within existing institutions established to monitor and evaluate, but in part they are also socially embedded: The media and Internet, for example, have an important role in influencing public opinions and judging the effectiveness of policies and political agendas. A central role is also played here by science: Researchers analyze longer-term societal processes and dynamics and put these on the societal and political agenda. These and other reflexive activities are necessary to prevent lock-in and to enable exploration of new ideas and trajectories. From a transition management perspective, however, the reflexivity needs to be an integrated part of governance processes and not, as is often the case nowadays, either

TABLE 1
Transition Management Types and Their Focus (Loorbach 2007)

Transition Management Types	Focus	Problem Scope	Time Scale	Level of Activities
Strategic	Culture	Abstract/societal system	Long term (30 years)	System
Tactical	Structures	Institutions/regime	Mid term (5–15 years)	Subsystem
Operational	Practices	Concrete/project	Short term (0–5 years)	Concrete

only come afterward or be detached from the actual governance itself. Reflexive activities are related to all three other types of governance (Table 1).

This framework itself is recursive, meaning that it can be applied on the level of a societal system, but as well as on a subsystem or even the project level. The different types of governance are thus identified based on the demarcation of the system; the debate about the future energy supply as a whole can be considered, as well as a debate about the future of biomass. However, the latter is a tactical activity in the context of the whole energy transition and will itself be accompanied by tactical activities related to the competition between different flows of biomass or different competing technologies and their roadmaps. This recursiveness has a certain elegancy because it allows for all sorts of interactions between and within the different types of governance. In transition management practice, these interactions and their effects are unpredictable and not directly managed, but because they fit within the same overall direction and emerge within a network of actors, they can contribute largely to collective goals. In a sense, this type of self-organization is thus indirectly managed: The conditions are created in terms of the structured process and substance under which self-organization arises. The governance system that subsequently develops is a multilevel network in which actors sometimes even unconsciously contribute to shared goals through different types of governance strategies and actions.

The Transition Management Cycle: Linking Descriptive to Prescriptive

"Systemic instruments" need to be developed to influence the different types of activities and to guide them in a specific direction. These instruments need to be designed based on the characteristics of the different types of activities defined above and the types of individuals involved in these. The framework for transition management therefore contains a

process dimension that distinguishes between different clusters of activities that are recognizable throughout any governance processes around long-term societal change. These are the typical phases identified by many policy-process models but fundamentally different in their focus on societal processes, persistent problems, and normative direction. This process model has been developed by Loorbach and Rotmans (Loorbach 2007; Loorbach and Rotmans 2006) based on iteration between theoretical reflection and practical experiments with new systemic instruments. Such experiments include, for example, regional transition arenas,[1] the Dutch national energy transition program,[2] and two transition arenas on resource transition and sustainable housing in Flanders, Belgium.[3]

The systemic instruments are captured in a cyclical process model as a basis for implementing the transition management approach. It thus offers the basis for a normative approach based on the analytical framework and theoretically offers the perspective of actively influencing the "natural" self-steering and governance activities present in society. This so-called transition management cycle consists of the following components (Loorbach 2004): (1) structure the problem in question, develop a long-term sustainability vision and establish and organize the transition arena; (2) develop future images, a transition agenda and derive the necessary transition paths; (3) establish and carry out transition experiments and mobilize the resulting transition networks; (4) monitor, evaluate, and learn lessons from the transition experiments and, based on these, make adjustments in the vision, agenda, and coalitions. In reality, there is no fixed sequence of the steps in transition management. The cycle only visualizes the need to connect activities and presents some possible logical connections but does not suggest a sequential order of activities (Figure 1).

Implementing Transition Management

The transition management framework does provide the basis for managing transitions in an operational sense. Although every transition management process will be unique in terms of context, actors, problems, and solutions, the cycle is flexible enough for adaptation but prescriptive enough to be functional in practice. An integrated analysis of a societal system in transition terms yields a very general idea of the dynamics in society on different levels that are a starting point for governance. Depending on this analysis, a strategy can be designed that, for example, focuses primarily at structuration of societal problems, at envisioning, at scaling up experiments, at political lobby, or a combination of these. Either way, transition management focuses at the frontrunners in society, and related to desired sustainability transitions, these are frontrunners that promote sustainable development. In a sense, it tries to structure and coordinate those informal networks of actors that, collectively and over time, are able to influence regular policy. The important role of outsiders and informal networks on providing innovative ideas and impulses to

FIGURE 1
The Transition Management Cycle
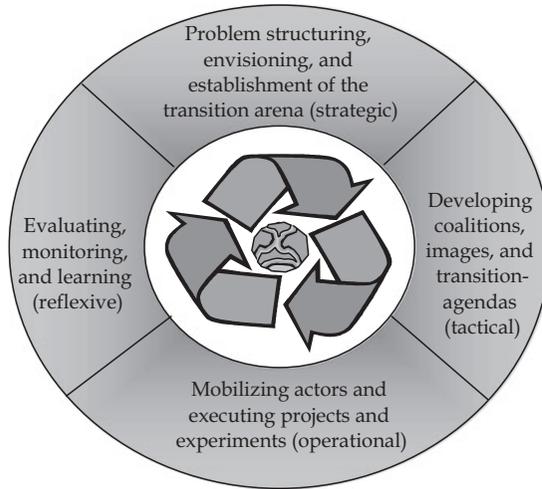
regular policymaking processes has been descriptively identified in many studies (Héritier 1999; Nooteboom 2006; Olsson et al. 2006; Scharpf 1999; Van der Brugge 2009) but so far hardly translated into a prescriptive strategy. The approach described below is, as mentioned, based on theoretical deduction, as well as practical experience, and still in evolution. The implementation in any specific context will lead to specific characteristics and thus specific lessons, which in turn can lead to novel insights regarding the generic model. This approach of learning by doing is a central part of transition management and, in a sense, a way to develop a more experimental and explorative attitude toward social innovation in practice.

Strategic: The Transition Arena

The transition arena is a small network of frontrunners with different backgrounds, within which various perceptions of a specific persistent problem and possible directions for solutions can be deliberately confronted with each other and subsequently integrated. To be involved, the actors have their own perception of the transition issue in question from their specific background and perspective. These people participate on a personal basis and not as a representative of their institution or based on their organizational background (government, business, science, civil society). There should not be too many actors (10–15), and they are identified and selected based on their competencies, interests, and backgrounds. The competencies expected of them and are: (1) ability to consider complex problems at a high level of abstraction, (2) ability to look

beyond the limits of their own discipline and background, (3) enjoy a certain level of authority within various networks, (4) ability to establish and explain visions of sustainable development within their own networks, (5) willingness to think together, and (6) open for innovation instead of already having specific solutions in mind. These frontrunners do not necessarily need to be experts; they can also be networkers or opinion leaders. They should also be prepared to invest time and energy in the process of innovation and commit themselves to it. And finally, it is important that there are an equal number of frontrunners from the societal pentagon: government, companies, NGOs, knowledge institutes, and intermediaries (consulting organizations, project organizations and mediators).

The fundamental issue here is not that the existing establishment and interests (incumbent regime) come together within the transition arena but that innovative individuals who can operate more or less autonomously are involved. Indeed, a certain representation from the existing regime is necessary, also with an eye to the legitimacy and financing of the process of innovation. But a transition arena is not an administrative platform, or a consultative body, but a societal network of innovation (Van Buuren and Loorbach 2009). This demands a critical selection of frontrunners—not by a "gatekeeper" who selects who may or may not participate but by an initiating core group in which experts on the process and on the transition subject are involved—that consider matters carefully. The arena process is an open, evolving process of innovation that implies variation and selection: After a certain period of time, some people drop out and others join in. Management therefore means creating sufficient space and favorable conditions for the frontrunners, such that the envisaged process of innovation begins to take shape. It does not mean gathering together a wide range of bodies around the arena, such as a steering group, a consultation group, or advisory board, because that is exactly the recipe for limiting the space for innovation and management that has just been created.

When such a group of frontrunners has been brought together to focus on a certain transition issue, an attempt is made to reach a joint perception of the problem by means of a strongly interactive process. By deploying a participative integrated systems approach, the complex problem(s) can be structured and made easier to understand (Hisschemöller and Hoppe 1996). The convergence of the various problem perceptions is facilitated from the articulation of diverging perspectives of the actors involved, which in turn will lead to new insights into the nature of the problem(s) and the underlying causal mechanisms. These insights form the prelude to a change in perspective, which is a necessary but insufficient precondition to realizing a transition. Based on this new perspective and through discussion and interaction, sustainability visions are generated, which primarily include the shared basic principles for long-term (sustainable) development, leaving room for dissent upon short and mid-term

solutions, goals, and strategies. While there is an emphasis on consensus or at least a willingness to cooperate within a common framework, this consensus is only valid within the context of the transition network. By necessity, transition visions will oppose expectations and visions of regime actors, and in this sense, transition visions are explicitly seeking conflict with vested interests and powers to establish a fundamental debate upon future development, the necessity of fundamental change, and the possibilities of an envisaged transition.

Visions are an important management instrument for achieving new insights and starting points and, therefore, a change of attractor. The visions created evolve and are instrumental: The process of envisioning is just as important as the ultimate visions themselves. Envisioning processes are very labor intensive and time consuming but are crucial to achieving development in the desired direction. This direction, as long as a sufficiently large group of frontrunners supports it, provides a focus and creates the constraints, which determine the room for maneuver within which the future transition activities can take place. Based on the sustainability vision developed, a process can be initiated in which transition paths are developed and a common transition agenda is drawn up. A common transition agenda contains a number of joint objectives, action points, projects, and instruments to realize these objectives. It should be clear which party is responsible for which type of activity, project, or instrument that is being developed or applied. Where the sustainability visions and the accompanying final transition images and transition objectives form the guidelines for the transition agenda that is to be developed, the transition agenda itself forms the compass for the frontrunners that they can refer to during their research and learning process.

Tactical: The Transition Agenda

The change in perspective, described by the visions and the accompanying transition images of the future, should be further translated to and find root within various networks, organizations, and institutions. Focus at this tactical level is therefore the structural (regime) barriers to development in the desired direction, which can be explored through developing transitions scenarios (Sondeijker et al. 2006; Wiek et al. 2006). Such barriers include regulatory, institutional, and economic conditions but could also involve consumer routines, physical infrastructures, or specific technologies. In an expanding transition network stemming from the transition arena, this vision is further translated by self-formed coalitions into so-called transition paths: routes to a transition image via intermediate objectives, which, as they come closer, can be formulated more quantitatively. Different transition paths can lead to a single transition image, and conversely, a single transition path can lead to several transition images. In this phase, the interests, motives, and policy of the various actors involved (NGOs, governments, knowledge institutes, and intermediaries) come out

into the open; there will be negotiations about investments, and individual plans and strategies will be fine-tuned. The actors who should be involved at this stage are those who represent one of the organizations involved and who are willing and able to operate for more than just a short period of time. Within this tactical layer, actors should be recruited who, in particular, have sufficient authority and room for maneuver within their own organization and who also have insight into the opportunities for their organization to contribute to the envisaged transition process. An important condition for this is that the actors involved have the capacity to "translate" the transition vision and the consequences of this to the transition agenda of their own organization. When the organizations and networks involved start to adjust their own policy and actions in this way, tensions will arise between the transition arena and the everyday policy agendas. Then the direction will have to be reviewed at a strategic level, and if necessary, a new arena will have to be established with some of the existing actors, but also with new ones.

Operational: Experiments

At the operational level of transition management, transition experiments and actions are carried out that try to broaden, deepen, and scale up existing and planned initiatives and actions (Raven, Van den Bosch, and Weterings 2007; Rotmans and Loorbach 2008). The transition experiments need to fit within the context of the vision and transition paths developed. They may compete, complement each other, or investigate various options. Diversity is an important aspect, as long as these experiments at the systems level are in a position to contribute to the envisaged transition. Transition experiments are iconic projects with a high level of risk that can make a potentially large innovative contribution to a transition process. New transition experiments are derived directly from the developed sustainability vision and transition objectives, and they fit within the identified transition paths. On the other hand, experiments can be linked to innovation experiments that are already taking place as long as they fit into the context of the transition. When an experiment has been successful (in terms of evaluating its learning experiences and contributions to the transition challenge), it can be repeated in different contexts (broadening) and scaled up from the micro- to the mesolevel (scaling up). This requires a considerable amount of time—approximately 5–10 years. Transition experiments are often costly and time consuming, so it is important that wherever possible, existing infrastructure (physical, financial, institutional) is used for experiments, and that the experiment's feasibility is continuously monitored. Transition management at this level focuses on creating a portfolio of related transition experiments that complement and strengthen each other, have a contribution to the sustainability objective, can be scaled up, and are significant and measurable.

Reflexive: Monitoring and Evaluation

Continuous monitoring is a vital part of the search and learning process of transitions (Taanman 2008). We distinguish between monitoring the transition process itself and monitoring transition management. Monitoring the transition process involves physical changes in the system in question, slowly changing macrodevelopments, fast niche developments, and seeds of change, as well as movements of individual and collective actors at the regime level. This provides the "enriched context" for transition management. Monitoring of transition management involves different aspects. First, the actors within the transition arena must be monitored with regard to their behavior, networking activities, alliance forming and responsibilities, and also with regard to their activities, projects, and instruments. Next, the transition agenda must be monitored with regard to the actions, goals, projects, and instruments that have been agreed upon. Transition experiments need to be monitored with regard to specific new knowledge and insight and how these are transferred, but also with regard to the aspects of social and institutional learning. Finally, the transition process itself must be monitored with regard to the rate of progress, the barriers and points to be improved, and so forth. Integration of monitoring and evaluation within each phase and at every level of transition management may stimulate a process of social learning that arises from the interaction and cooperation between different actors involved. To ensure this, transition monitoring, much like fourth-generation evaluation (Guba and Lincoln 1989), is about reflecting collectively upon the process and in this way articulating next steps.

Conclusions: Toward Transition Governance?

In this article, we presented a new governance framework for addressing persistent societal problems. This transition management framework is based on common notions from complex systems theory and new forms of governance that are welded into a new governance approach. Understanding the dynamics of complex, adaptive systems provides insight into the opportunities, limitations, and conditions under which it is possible to direct such systems (Van der Brugge 2009). This perspective enables us to reflect upon and analyze actions and strategies of actors in these processes. The combined analysis of system dynamics and actor behavior then allows us to try to influence these in such a way that the changes that result from these are more likely to lead to sustainability in the long run. Transition management in this way provides both an analytical perspective on long-term governance and a basis for actually dealing intelligently with this. To this end, we presented basic governance tenets, a framework for analysis, and the transition management cycle for actually implementing strategies that help to guide and accelerate transitions.

Based on the understanding of transitions in complex societal systems, central tenets of the transition management approach are, for example, the

need for a long-term perspective to guide short-term development, the acknowledgment of uncertainties and surprise, the importance of networks and self-steering, and the necessity of creating space for innovation. These basic tenets are translated into a framework that distinguishes between different types of governance that relate directly to different patterns of change in societal systems. We defined these different types of governance activities (strategic, tactical, and operational) based on their respective time horizons, outcomes, and types of actors involved. This framework, besides that it could be used to assess how actors in general are dealing with long-term changes in society, is the basis for the transition management cycle, which is used to actually implement strategies to influence societal transitions.

The management model is far from deterministic, but rather reflexive. Applying the model implies adjusting the basic tenets and transition management instruments to a specific context, which will change as a result, in turn requiring adaptations in the implementation. Transition management as prescriptive mode of governance could be characterized as a reflexive approach toward long-term social change through small steps based on searching, learning, and experimenting. It is normative in its ambition, prescriptive nature, long-term focus, and analytical basis. Transition management is promising both theoretically and as operational management strategy, but it still develops quickly and largely needs to prove itself. The approach has already been empirically tested in the many transition experiments that are currently going on in the Netherlands and Belgium. More than that, the management framework itself has been the result of experiences within testing grounds.

However, we need to be clear that so far, transition management has been mainly implemented and conceptualized as a "shadow track" in which new visions, ideas, and agendas can be developed in a more innovative way than within the context of regular policy processes. In a sense, transition management tries to systematically organize informal networks and policy processes, which are often found to be an explanation for the innovative and evolving policy at the EU level, in spite of the institutional and cross-national differences and deadlocks (Héritier 1999). As such, transition management in the form presented here will be most effective in early phases of the policymaking processes or in those processes in which a deadlock requires breakthroughs. It leaves open for further research the fascinating question of how the basic ideas and principles underlying transition management could be translated into specific operational models that would be more in tune with other phases in policy- and decision-making processes.

One final key question here is to what extent the approach can be translated to other sociopolitical contexts and cultures. Some research and experiments have been undertaken with the approach in Belgium, and comparative studies have been launched to study similarities and differences in implementation within different sectors and regions in the Neth-

erlands. But diffusing and translating transition management to other countries and contexts poses an inspiring challenge. The ambition is to validate the partly descriptive and partly prescriptive parts of transition management for the coming period empirically, and in such a manner that a scientifically well-grounded concept and framework can be used and further developed in a broad societal context and also internationally.

Acknowledgments

Notes

1. http://www.ontwikkelingsmaatschappij-parkstad.nl/ page.php?pagID=169&men1ParentID=179 (in Dutch).
2. http://www.senternovem.nl/EnergyTransition/Index.asp.
3. http://www.ovam.be/jahia/Jahia/pid/1607 (in Dutch), http://www.lne. be/themas/duurzaam-bouwen-en-wonen/algemeen/ transitiemanagement-duwobo (in Dutch).

References

Ackoff, Russell L. 1971. "Towards a System of Systems Concepts." *Management Science* 17 (11): 661–671.

Allen, Peter M. 2001. "Knowledge, Ignorance, and the Evolution of Complex Systems." In *Frontiers of Evolutionary Economics: Competition and Self-Organization and Innovation Policy*. ed. J. Foster and J. S. Metcalfe. Cheltenham: Edward Elgar.

Baumgartner, Frank, and Bryan Jones. 1993. *Agenda and Instability in American Politics*. Chicago: University of Chicago Press.

Beck, Ulrich. 1992. *Risk Society: Towards a New Modernity*. London: Sage Publications.

Boulding, Kenneth E. 1970. *A Primer on Social Dynamics: History as Dialectics and Development*. New York: Free Press.

Castells, Manuel. 1996. *The Rise of the Network Society*. Malden, MA: Blackwell Publishing.

De Bruijn, Hans A., and Ernst F. Ten Heuvelhof. 1997. *Sturingsinstrument voor de overheid; Over complexe netwerken en een tweede generatie sturingsinstrumenten* [Instrument for government: On complex networks and a second generation policy instruments]. Houten: Stenfert Kroese Educatieve Partners.

De Bruin, Hans, Ernst ten Heuvelhof, and Roel in 't Veld, 1998. *Procesmanagement: over procesontwerp en besluitvorming* [Process management: On process design and decision-making]. Den Haag: Academic Service.

De Haan, Hans. 2006. "How Emergence Arises." *Ecological Complexity* 3 (4): 293–301.

Edelenbos, Jurian. 1999. "Design and Management of Participatory Public Policy Making." *Public Management* 1 (4): 569–578.

———. 2005. "Institutional Implications of Interactive Governance: Insights from Dutch Practice." *Governance* 18 (1): 111–134.

Eising, Renate, and Beate Kohler-Koch. 1999. "Introduction: Network Governance in the European Union." In *The Transformation of Governance in the European Union*. ed. B. Kohler-Koch and R. Eising. London: Routledge.

Geels, Frank W. 2002a. "Technological Transitions as Evolutionary Reconfiguration Processes: A Multi-Level Perspective and a Case-Study." *Research Policy* 31 (8/9): 1257–1274.

———. 2002b. "Understanding the Dynamics of Technological Transitions: A Co-Evolutionary and Socio-Technical Analysis." *Centre for Studies of Science, Technology and Society*. Enschede: Universiteit Twente.

Gell-Man, Murray, ed. 1994. "Complex Adaptive Systems." In *Complexity: Metaphors, Models and Reality*, ed. G. Cowan, D. Pines, and D. Meltzer. Reading, MA: Addison-Wesley.

Giddens, Anthony. 1984. *The Constitution of Society: Outline of the Theory of Structuration*. Cambridge, UK: Polity Press.

Grin, John, Fransisca Felix, and Bram Bos. 2004. "Practices for Reflexive Design: Lessons from a Dutch Programme on Sustainable Agriculture." *International Journal Foresight and Innovation Policy* 1 (1/2): 126–149.

Grin, John, Jan Rotmans, and Johan Schot. 2009. *Transitions to Sustainable Development: New Directions in the Study of Long Term Transformative Change*. New York: Routledge.

Guba, Egon, and Yvonna Lincoln. 1989. *Fourth Generation Evaluation*. Newbury Park, CA: Sage.

Gunderson, Lance H., and Buzz Holling. 2002. *Panarchy: Understanding Transformations in Systems of Humans and Nature*. Washington, DC: Island Press.

Hendriks, Carolyn M., and John Grin. 2007. "Contextualising Reflexive Governance: The Politics of Dutch Transitions to Sustainability." *Journal of Environmental Policy & Planning* 9 (3–4): 333–350.

Héritier, Adrienne 1999. *Policy-Making and Diversity in Europe: Escape from Deadlock*. Cambridge, UK: Cambridge University Press.

Hisschemöller, Matthijs. 1993. *De democratie van problem* [The democracy of problems]. Amsterdam: Vrije Universiteit.

Hisschemöller, Matthijs, and Rob Hoppe. 1996. "Coping with Intractable Controversies: The Case of Problem Structuring in Policy Design and Analysis." *Knowledge and Policy: The International Journal of Knowledge Transfer*. 8: 40–60.

Holland, John H. 1995. *Hidden Order: How Adaptation Builds Complexity*. Cambridge, UK: Helix Books/Perseus Books.

Hooghe, Liesbeth, and Gary Marks. 2001. *Multi-Level Governance and European Integration*. Oxford: Rowman & Littlefield Publishers.

Jaeger, Carlo, Terry Barker, Ottmar Edenhofer, Sylvie Faucheux, Jean-Charles Hourcade, Bernd Kasemir, Martin O'Connor, Martin Parry, Irene Peters, Jerry Ravetz, and Jan Rotmans. 1997. "Procedural Leadership in Climate Policy: A European Task." *Global Environmental Change: Human and Policy Dimensions* 7 (3): 195–203.

Jessop, Bob. 1997. "The Governance of Complexity and the Complexity of Governance: Preliminary Remarks on Some Problems and Limits of Economic Guidance." In *Beyond Market and Hierarchy. Interactive Governance and Social Complexity*, ed. A. Amin, and J. Hausner. Cheltenham: Edward Elgar.

Kauffman, Stuart. 1995. *At Home in the Universe: The Search for Laws of Complexity*. Oxford: Oxford University Press.

Kemp, René. 2006. "An Example of a 'Managed Transition': The Transformation of the Waste Management Subsystem in the Netherlands 1960–2000." In *Sustainability and Innovation*, ed. M. Lehmann-Waffenschmidt. Heidelberg, Germany: Physica-Verlag HD.

Kemp, René, Derk Loorbach, and Jan Rotmans. 2005. "Transition Management as a Model for Managing Processes of Co-Evolution towards Sustainable Development." *International Journal of Sustainable Development and World Ecology*: 1–15.

Kemp, René, Johan Schot, and Remco Hoogma. 1998. "Regime Shifts to Sustainability through Processes of Niche Formation: The Approach of Strategic Niche Management." *Technology Analysis and Strategic Management* 10: 175–196.

Kern, Florian, and Adrian Smith. 2007. *The Transitions Discourse in the Ecological Modernisation of the Netherlands*. SPRU Electronic Working Paper Series.

Kickert, Walter J. M. 1991. *Complexiteit, zelfsturing en dynamiek. Over management van complexe netwerken bij de overheid* [Complexity, self-steering and dynamics: On the management of complex networks in the government]. Rotterdam: Erasmus Universiteit.

Kickert, Walter J. M., Erik-Hans Klijn, and Joop Koppenjan. 1997. *Managing Complex Networks: Strategies for the Public Sector*. London: Sage.

Klijn, Erik-Hans, and Joop F. M. Koppenjan. 2000. "Politicians and Interactive Decision Making: Institutional Spoilsports or Playmakers." *Public Administration Review* 78 (2): 365–387.

Kooiman, Jan. 1993. *Modern Governance: New Government-Society Interactions*. London: Sage.

Loorbach, Derk. 2002. *Transition Management: Governance for Sustainability*. Berlin: International Dimensions of Human Change.

———. 2004. *Governance and Transitions: A Multi-Level Policy-Framework Based on Complex Systems Thinking*. Berlin: Conference on Human Dimensions of Global Environmental Change.

———. 2007. *Transition Management: New Mode of Governance for Sustainable Development*. Utrecht: International Books.

Loorbach, Derk, and Jan Rotmans. 2006. "Managing Transitions for Sustainable Development." In *Understanding Industrial Transformation: Views from Different Disciplines*, ed. X. Olshoorn, and A. J. Wieczorek. Dordrecht: Springer.

Loorbach, Derk, Rutger Van der Brugge, and Mattijs Taanman. 2008. "Governance for the Energy Transition." *International Journal of Environmental Technology and Management IJETM* 9 (2–3): 294–315.

Luhmann, Niklas. 1984. *Soziale Systemen* [Social systems]. Frankfurt: Suhrkampf.

Meadowcroft, James. 2005. "Environmental Political Economy, Technological Transitions and the State." *New Political Economy Volume* 10 (4): 479–498.

———. 2007. *Steering or Muddling Through? Transition Management and the Politics of Socio-Technical Transformation*. Workshop on "Politics and Governance in Sustainable Socio-Technical Transitions" September 19–21, Schloss Blankensee/Berlin.

Midgley, Gerald (ed.). 2000. *Systemic Intervention: Philosophy, Methodology and Practice*. New York: Kluwer Academic Publishers.

Milward, Brinton H. and Keith Provan. 2000. "How Networks Are Governed." In *Governance and Performance*, ed. C. Heinrich and L. Lynn. Washington, DC: Georgetown University Press.

Nooteboom, Sibout. 2006. "Adaptive Networks; The Governance for Sustainable Development." Ph.D. Thesis, Erasmus University Rotterdam.

Olsson, Per, Lance H. Gunderson, Steve R. Carpenter, Paul Ryan, Louis Lebel, Carl Folke, and C. S. Holling. 2006. "Shooting the Rapids: Navigating Transitions to Adaptive Governance of Social-Ecological Systems." *Ecology and Society*. ⟨http://www.ecologyandsociety.org/vol11/iss1/art18/main.html⟩. (November 23, 2009).

Parto, Saeed, Derk Loorbach, Ad Lansink, and René Kemp. 2007. "Transitions and Institutional Change: The Case of the Dutch Waste Subsystem." In *Industrial Innovation and Environmental Regulation*, ed. Saeed Parto and Brent Herbert-Copley. New York: United Nations University Press.

Pierre, John. 2000. *Debating Governance. Authority, Steering and Democracy*. Oxford: Oxford University Press.

Prins, Gwyn, and Steve Rayner. 2007. "Time to Ditch Kyoto. " *Nature* 449: 973–976.

Rabe, Barry G. 2007. "Beyond Kyoto: Climate Change Policy in Multilevel Governance Systems." *Governance* 20 (3): 423–444.

Raven, Rob, Suzanne Van den Bosch, and Rob Weterings. 2007. *Strategic Niche Management and Transition Experiments: From Analytical Tool to a Competence Kit for Practitioners*. 4th Dubrovnic Conference on Sustainable Development of Energy Water and Environment Systems, June 4–8, Dubrovnic, Croatia.

Rip, Arie, and René Kemp. 1998. "Technological Change." In *Human Choice and Climate Change*, Vol. 2. ed. Steve Rayner and Elizabeth Malone. Columbus, OH: Battelle Press.

Rotmans, Jan, and Derk Loorbach. 2008. "Transition Management: Reflexive Steering of Societal Complexity through Searching, Learning and Experimenting." In *The Transition to Renewable Energy: Theory and Practice*, ed. J. Van den Bergh and F. R. Bruinsma. Cheltenham: Edward Elgar.

Rotmans, Jan, John Grin, Johan Schot, and Ruud Smits. 2004. *Multi- Inter- and Transdisciplinary Research Program into Transitions and System Innovations*. Maastricht: Maastricht University.

Rotmans, Jan, René Kemp, and Marjolein van Asselt. 2001. "More Evolution Than Revolution: Transition Management in Public Policy." *Foresight* 03 (01): 17.

Rotmans, Jan, René Kemp, Marjolein van Asselt, Frank Geels, Geert Verbong and Kirsten Molendijk. 2000. *Transities & transitiemanagement: De Casus van een emissiearme energievoorziening* [Transitions and transition management: The case of a sustainable energy supply]. Maastricht: ICIS/MERIT.

Scharpf, Fritz. 1999. *Governing in Europe: Effective and Democratic?* Oxford: Oxford University Press.

Senge, Peter M. 1990. *The Fifth Discipline: The Art & Practice of the Learning Organization*. London: Random House.

Sondeijker, Saartje, Jac Geurts, Jan Rotmans, and Arnold Tukker. 2006. "Imagining Sustainability: The Added Value of Transition Scenarios in Transition Management." *Foresight* 8 (5): 15–30.

Taanman, Mattijs. 2008. *Looking for Transitions: Background, Framework and Application of Transition Monitoring for the Dutch Energy Transition*. Berlin: Berlin Conference on the Human Dimensions of Global Environmental Change.

Teisman, Geert R. 1992. *Complexe besluitvorming, een pluricentrisch perspectief* [Complex decision-making, a pluricentric perspective]. Gravenhage: Elsevier.

Van den Bergh, Jeroen, C. J. M., and Frank R. Bruinsma, ed. 2008. *The Transition to Renewable Energy: Theory and Practice*. Cheltenham: Edward Elgar.

Van der Brugge, Rutger. 2009. "Transition Dynamics in Social-Ecological Systems: The Case of Dutch Water Management." Ph.D. Thesis, Erasmus University Rotterdam.

Van der Brugge, Rutger, and Jan Rotmans. 2007. "Towards Transition Management of European Water Resources." *Water Resources Management* 21 (7): 249–267.

Van der Brugge, Rutger, and Roel Van Raak. 2007. "Facing the Adaptive Management Challenge: Insights from Transition Management." *Ecology and Society* 12 (2): 33.

Van Buuren, Arwin, and Derk Loorbach. 2009. "Policy Innovation in Isolation? Conditions for Policy-Renewal by Transition Arenas and Pilot Projects." *Public Management Review* 11 (3): 375–392.

Varela, Fransisco, Humberto Maturana, and Ricardo Uribe 1974. "Autopoiesis: The Organization of Living Systems, Its Characterization, and a Model." *Biosystems* 5: 187–196.

Verbong, Geert, and Frank Geels. 2006. "The Ongoing Energy Transition: Lessons from a Socio-Technical, Multi-Level Analysis of the Dutch Electricity System (1960–2004)." *Energy Policy* 35 (2): 1025–1037.

Vickers, Geoffrey. 1965. *The Art of Judgment: A Study in Policy Making*. New York: Basic Books.

Von Bertalanffy, Ludwig. 1956. "General Systems Theory." *General Systems* 1: 1–10.

Voss, Jan-Peter, Dierk Bauknecht, and René Kemp (eds.). 2006. *Reflexive Governance for Sustainable Development*. Cheltenham: Edward Elgar.

Voss, Jan-Peter, and René Kemp. 2005. *Reflexive Governance for Sustainable Development: Incorporating Feedback in Social Problem-Solving*. Lisbon: ESEE Conference.

VROM. 2001. *Where There's a Will There's a World*. The Hague: VROM Ministry.

Wiek, Arnim, Claudia Bindera, and Roland W. Scholz. 2006. "Functions of Scenarios in Transition Processes." *Futures* 38: 740–766.