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What kind of leadership do we need for climate adaptation? A framework for analyzing leadership functions and tasks in climate change adaptation

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Abstract

This paper explores the relevance of various leadership concepts for climate change adaptation. After defining four main leadership challenges which are derived from the key characteristics of climate adaptation issues, a review of modern leadership theories addressing these challenges is presented. Based on this review we develop an integrative framework for analyzing leadership for climate change adaptation. It distinguishes between various leadership functions which together contribute to climate change adaptation: the political-administrative, adaptive, enabling, connective and dissemination functions. Each function requires the execution of specific leadership tasks which can be performed by different types of leaders, such as positional leaders, ideational leaders, sponsors, boundary workers, policy entrepreneurs or champions. The framework can be used to analyze or monitor the emergence and realization of specific leadership functions, and to specify the need for strengthening particular functions in practices of climate adaptation.

Keywords

Climate adaptation, leadership, leadership functions, leadership tasks, adaptability

1. Introduction

Climate change is undoubtedly one of the most urgent policy issues of our times. There is now a general recognition that climate change will occur and that nearly all countries will be affected. This is because past and current international efforts to mitigate climate change through a significant reduction of global carbon dioxide emissions are not sufficient. In this light, one of the major objectives of the International Panel on Climate Change (IPCC) is to study and report on vulnerability and adaptability of countries' environment and socioeconomic systems. Climate adaptation comprises '[...] all spontaneous responses and planned action taken to cope with the impacts of, or reduce vulnerability to, a changing climate. Such adaptation is needed to tackle current problems or anticipate possible future changes, with the aim of reducing risk and damage cost effectively, and perhaps even exploiting potential benefits' (Swart et al, 2009). In more general terms, adaptation to climate change involves adjustments of infrastructure, agriculture, urban and regional planning and issues of nature preservation and energy supply (Van Nieuwaal, Driessen, Spit and Termeer, 2009).

In his classical study of the differences between management and leadership, Kotter (1990) argues that where management is needed to produce orderly results efficiently, leadership is needed for realizing useful change. Since adaptation to climate change often requires a change in existing policies, practices and institutions, this contribution departs from the view that there is a substantial need for leadership to devise and implement adaptation policies. A search of the literature in the context of adaptation to climate change¹ reveals that first most journal publications on leadership and climate change deal with leadership in the context of mitigation policies (e.g. Gupta and Grubb, 2000, Schreurs and Tiberghien, 2007). Second, contributions which refer to leadership in the context of climate change adaptation tend to identify it as only one of the factors needed for successful adaptation (e.g. Burch, 2010; Gupta et al, 2010) or to manage local-level conflicts between mitigation and adaptation measures (e.g. Laukkonen, Blanco, Lenhart et al, 2009). Others consider leadership only at a high level of abstraction like Underdal (2010), who compares the merits of the collective action model (involving centralized leadership) versus adaptive governance in responding to complex governance challenges such as climate change. These examples do not take leadership as their main focus and fail to address it in a theoretically informed and systematic way. This article aims to fill this apparent gap by exploring the relevance of modern leadership concepts for climate change adaptation.

As there is an impressive body of current literature on leadership in general (for a good general review see for example Aviolo et al, 2009), we necessarily had to make a selection of leadership theories that are particularly useful for studying leadership for climate adaptation. We have based our selection on the key characteristics and related leadership challenges of climate change adaptation. First, when considering climate adaptation, we observe an important role for government actors and public policy (Biesbroek et al, 2010). Although private actors and civil society may play a crucial role in designing and implementing adaptation measures, many government actors at national, regional and local levels are involved in the development and implementation of policies that deal with adaptation. In a way, this is unsurprising, since many of the proposed policy options for adaptation, for

¹ Our searches concentrated on scientific journals in the ISI Web of Knowledge and Scopus databases. In a first round of searches, we used the keywords 'climate change' AND 'leadership' (OR entrepreneurship OR policy entrepreneur OR leader OR change agents). Subsequently, in a second round, we added to these a third keyword, 'adaptation' (OR 'adaptive capacity' OR 'adaptability' OR 'resilience').

instance the strengthening of dykes or the creation of space for rivers, are collective action problems that need to be addressed by public policy. Second, climate adaptation creates a need for coordinating different levels, actors and sectors (Pahl-Wostl, 2009). As is the case in many other policy areas, knowledge and other resources are disseminated amongst a network of actors. In a ‘shared power’ world, there is a need for coordination between various levels of government, policy sectors, and public and private actors. Third, the phenomenon of climate change is characterized by a high level of uncertainty, probably more than any other policy issue. There is uncertainty about (a) the speed and degree of climate change, (b) the impacts of climate change, such as variability of river discharges and sea-level rise, and (c) about the impacts of various adaptation policies. Because of these uncertainties, the parties involved in realizing climate adaptation policies and strategies need to be able to learn and to adjust their objectives and/or policies if necessary (Gupta et al, 2010). Finally, policies of climate change adaptation need to take into account the relevance of the interactions between social and ecological systems (Folke et al, 2005). Most adaptation options have an impact on natural or ecological systems, such as water systems, agricultural land, or nature, and feedback from the natural system, such as flood events, periods of drought or heat waves, plays an important role in the adaptation process. Because of these interactions between social and ecological systems, there is a need to be sensitive to feedback mechanisms, and to anticipate long term consequences of climate change. The need for using a long term perspective in developing and implementing adaptation options is obvious. New dikes are being designed to guarantee safety for at least a few decades, and to be able to accommodate a future increase in peak river discharges, we need to make spatial reservations now.

These four characteristics of climate change adaptation lead to four main challenges which leadership needs to address. Leadership in climate adaptation needs to:

1. influence the policy process as to get adaptation policies accepted and implemented;
2. enhance connectivity across different policy-making levels, sectors and actors;
3. increase the adaptive capacity (adaptability) of governance networks concerned with climate adaptation;
4. enhance the capacity of society to learn in response to feedback from the natural system in particular, and to anticipate long term impacts of climate change.

Since these leadership challenges relate to multiple disciplines within the social sciences, including policy science and public administration, organizational and management science, business ethics, and beyond (i.e. the life sciences, regarding the fourth challenge), the following sections will introduce leadership concepts from four different bodies of literature: (1) theories on leadership in the policy process (e.g. policy entrepreneurship and ideational leadership); (2) leadership for connectivity (collaborative, catalytic or integrative leadership); (3) complexity leadership theory; and (4) sustainability leadership theory (theories on eco-leadership and socio-ecological systems). After describing the essence of each leadership concept, we will present a systematic comparison looking for overlapping and complementary insights. Finally, drawing on the different leadership concepts and the comparative analysis, we present an integrative framework for analyzing leadership for climate change adaptation.

2. Leadership in the policy process: policy entrepreneurs and ideational leaders

Both private and public parties may play a crucial role in realizing climate adaptation. Citizens, industries or farmers may adapt autonomously, for example by moving out of flood prone areas or by growing new crops. However, in modern societies public policy is crucial to climate adaptation. Governments prepare and implement new flood risk policies, try to

climate proof spatial planning, develop policies for coping with heat waves and so on. Therefore, we first turn to the role of leadership in the policy process. In various models of policy change, agency plays an important role, both in the event of significant changes and during processes which gradually modify policies. As one specific dimension of agency, leadership has been studied across the social sciences (see for a general overview Goethals and Sorenson, 2006) and, unsurprisingly, in political science (Friedrich, 1961; Burns, 1978). In policy studies, the discipline dealing with how policy is made and how it changes, there is often a focus on the entrepreneurial activities of agency. Such *policy entrepreneurs* (PE) advocate policy change and try to get specific policy solutions adopted. PE are capable of discovering new needs and solutions, of dealing with a high degree of uncertainty, and of resolving problems of collective coordination (Mintrom and Vergari, 1996). Furthermore, they are catalysts for policy innovation (Roberts and King, 1991), they connect problems with solutions (Kingdon, 1984), and they find new venues for policy-making (Baumgartner and Jones, 1993). To be sure, PE can hold a variety of positions, but are often found among politicians, bureaucrats, experts and representatives of interest groups.

Lately, Mintrom and Norman (2009) have pleaded for integrating policy entrepreneurship into explanations of policy change. In doing so, they synthesize the dimensions of the concept by drawing on earlier theoretical and empirical work by various scholars. PE (1) display high levels of social acuity (or perceptiveness), (2) they pay close attention to problem definition, (3), engage in team-building activities, and (4) lead by example. The first dimension involves making good use of policy networks, getting along well with others and being well connected in local policy contexts (Ibid: 652). Paying attention to problem definition may include presenting a situation as a crisis, highlighting failures of current policies, or drawing support from actors beyond the immediate scope of a policy problem (Ibid.). Next, team-building presupposes working with teams that bring together individuals with different skills and knowledge and thus complement each other in their pursuit of change. This also means to draw on one's existing networks in order to support initiatives for change. Finally, team-building PE acknowledge the need to develop and work with coalitions to promote their objectives (Ibid: 653). Leading by example serves to reduce risk aversion among policy makers and involves demonstrating that a particular proposal is workable in practice. Turning ideas into action by, for instance, pilot projects, entrepreneurs demonstrate their commitment, build momentum for change, and sometimes lure policy-makers into taking action themselves (Ibid: 653-654). A recent comparative study of water policy transitions and the role of PE (Meijerink and Huitema, 2010) confirms that they can be found anywhere; that they share certain characteristics; and that collective entrepreneurship linking several individuals is a common phenomenon. The study identifies a wealth of frequently used strategies of PE including developing and disseminating new ideas; building coalitions (using advocacy and brokerage); anticipating, manipulating and exploiting windows of opportunity; and exploiting, manipulating and creating venues. A famous example of a policy entrepreneur in global climate change policies is Al Gore, who used his reputation to attract attention to the issue of global warming. There are many other examples of (albeit less well-known) policy entrepreneurs working on national, regional and local adaptation issues (Ibid.).

Turning from policy entrepreneurs to the role of political leaders, we point to a concept that is specifically directed at effecting policy change, *ideational leadership* (IL). IL concretizes some of the fairly general characteristics of policy entrepreneurs found in the earlier literature (e.g. Mintrom, 1997) and further specifies their organizational and personal resources (Stiller, 2009). IL was developed in the context of change-resistant welfare states, where innovation is typically set into motion by legislation proposed by political executives with the formal

authority to initiate policy, such as ministers. Moreover, it directs attention towards the role of ideas in policy change, stressing that reform-minded policy-makers have the will to innovate as well as persuasive skills. As for its origins, IL draws on features of other policy-relevant concepts such as *policy leadership* (Luke, 2000), *innovative leadership* (Moon, 1995) and *reformist leadership* (Goldfinch and 't Hart, 2003) and on the literature on ideas in relation to policy change (Ross, 2000, Schmidt, 2002). Ideational leaders execute four sorts of tasks, which combined may overcome opposition to far-reaching reforms. They include (1) exposing the drawbacks of the policy status-quo; (2) legitimizing new policy by arguments about its appropriateness and problem-solving capacity ; (3) framing reform resistance as 'problematic', (4) building political consensus for a reform proposal. Ideational leaders may be very helpful in creating momentum for change.

3. Leadership for connectivity

Because parties involved in climate adaptation are part of multi-level governance networks, they face the challenge of attuning policies and strategies and synchronizing agendas of different levels of government, policy sectors and public and private actors. Hence, we expect leadership for connectivity to be highly relevant for climate change adaptation. The concepts of catalytic leadership (Luke, 1998), collaborative leadership (Chrislip, 2002), and integrative leadership (Crosby and Bryson, 2010) share the assumption that the traditional hierarchical leadership paradigm is no longer effective in a highly interdependent, 'shared power' world. According to these theories, the management and organization of interactions between interdependent agents is indispensable to solving organizational or societal problems.

The theory on *catalytic leadership* (Luke, 1998) focuses explicitly on public leadership: leadership for solving public problems. Referring to geographical, functional and generational interdependencies, the theory acknowledges the interconnecting and boundary-crossing nature of public problems. Interdependencies are caused by different problem definitions, a fragmentation of authority amongst levels of government and policy sectors, and the involvement of a wide range of stakeholders. Luke (1998) distinguishes between four catalytic tasks of public leadership. The first catalytic task is to promote problems rather than solutions, and to mobilize actors to search for possible solutions. Leaders may strategically use stories, anecdotes, images, focusing events and data to gain attention for a particular problem. Problem framing is an essential catalytic task. It is relevant to create a sense of urgency, and to make people believe that the problem can be addressed. The second task is to bring people together to address the problem. This task is about identification of all relevant stakeholders, the composition of working groups and convening first meetings (Luke, 1998). Thirdly, catalytic leaders should stimulate the development of multiple strategies and options for action. This task is about building trust, fostering joint learning processes, and translation of desired outcomes into multiple strategies. The fourth leadership task of catalytic leaders is to implement strategies and maintain momentum. Gaining small successes, commitment to learning, and brokerage strategies are all relevant here.

The theory on *collaborative leadership* (Chrislip and Larson, 1994, Chrislip, 2002) emphasizes the need to focus on problems rather than solutions as well. Problem-solving should be the result of a collaborative process in which relevant stakeholders have the opportunity to express their concerns, interests and ideas about an issue. The theory distinguishes between four steps in a process of successful cooperation (Chrislip, 2002: 55), which show much resemblance with the four tasks of catalytic leadership described above. The first step is to get started by analyzing the context for collaboration and deciding on a

collaborative strategy. The result of this step is clarity about the purpose, scope and focus of cooperation. The next step is ‘setting up for success’ by identifying and convening stakeholders, designing a constructive process, defining information needs and critical roles, managing the process and finding resources. The third step is ‘working together’, which includes capacity building, various ways of engaging stakeholders, informing stakeholders and deciding on what needs to be done. The final step is ‘moving to action’, which is about engaging with decision makers, the development of action plans, and the organization and management of implementation.

Crisby and Bryson (2010: 211) define *integrative leadership* as ‘bringing diverse groups and organizations together in semi-permanent ways – and typically across sector boundaries – to remedy complex public problems and achieve the common good’. Just like the theory on catalytic leadership, the theory on integrative leadership focuses on public problems, and like the concepts of catalytic, and collaborative leadership, the concept of integrative leadership acknowledges that problem solving capacity is fragmented and shared between different sectors and organizations. The theory points to the crucial role of powerful champions and sponsors in realizing cross-sector collaborations, where a champion is defined as ‘a person who is a tireless, process-savvy organizer and promoter of the change effort’ (Ibid: 219), and a sponsor as someone who is ‘[...] less involved in the process, but deploys authority, money, or connections to move the change effort forward’ (Ibid). Champions resemble the policy entrepreneurs that we have described before. According to the theory on integrative leadership, important leadership strategies are ‘the wise design and use of forums, arenas, and courts, including creating effective boundary-spanning groups, boundary experiences, and objects, building leadership capacity, forging agreement, building trust, and building legitimacy’ (Ibid: 219). Although these leadership strategies show overlap with the strategies of policy entrepreneurs that we discussed in the section on leadership in the policy process, they focus more on coordinative and integrative elements than the latter.

4. Complexity leadership theory

Because of the many uncertainties surrounding climate change, its impacts and the effectiveness of particular adaptation options, climate change adaptation requires a high level of adaptive capacity of the parties involved. They need to be able to incorporate new insights, information and lessons learned, and to adjust their policy objectives and strategies. A basic assumption of Complexity Leadership Theory (CLT) is that in knowledge-oriented economies organizations need to be able to learn, to be creative and to adapt to changing circumstances, hence leadership should be aimed at increasing the adaptability of an organization (Uhl-Bien et al, 2007). It is argued that the traditional leader-follower model of leadership will not enhance the adaptability of an organization, since most information is being processed by people who do not have an official leadership position. To be able to process the numerous signals and feedback from an organization’s environment, there is a need to broaden the scope of leadership beyond traditional position based leadership. Building on complexity theory, the main units of analysis in CLT are Complex Adaptive Systems (CAS), which are networks of interacting and interdependent agents who try to solve problems collectively or try to reach common goals. CLT makes an analytical distinction between three leadership functions: an adaptive, administrative and enabling function (Ibid), as seen in Figure 1.

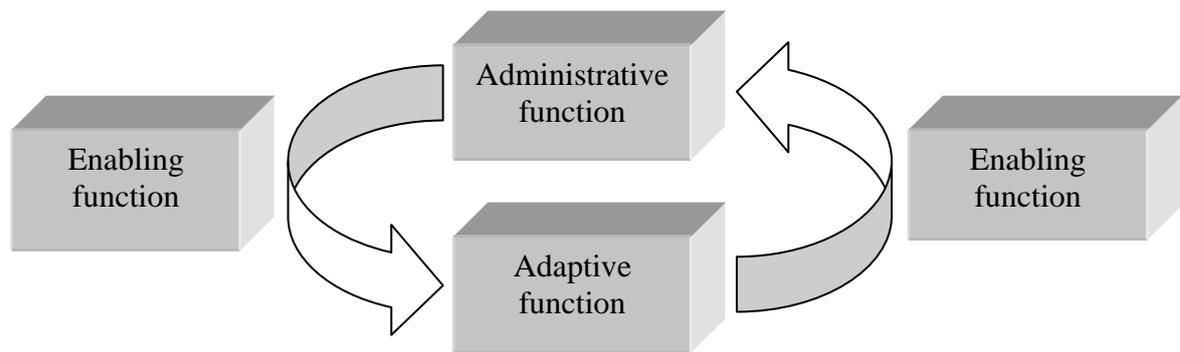


Figure 1: Leadership functions in Complexity Leadership Theory (Based on Uhl-Bien et al, 2007)

Adaptive leadership is defined as an emergent property of a complex adaptive system: it is a collaborative change movement that emerges nonlinearly from the patterns of interaction between agents. Adaptive leadership is ‘a complex dynamic rather than a person (although people are, importantly, involved); we label it leadership because it is a, and, arguably, the proximal sources of change in an organization’ (Uhl-Bien et al, 2007: 306). Uhl-Bien et al. distinguish between the significance and impact of adaptive leadership, where significance refers to the ‘[...] potential usefulness of new, creative knowledge or adaptive ideas’ (Ibid.: 307), and impact to ‘the degree to which other agents external to the generative set embrace and use the new knowledge or idea’ (Ibid.). Significance is dependent on expertise and creativity, impact on authority and reputation of the people developing the new ideas. To better understand the emergence of adaptive leadership, CLT argues we need to better understand complex networks. In these networks ‘ideas emerge, combine, diverge, become extinct, conflict with one another, adapt and change, and increase in complexity’ (Ibid.). The output of this ongoing dynamics is adaptability, creativity and learning. Adaptive leadership may emerge on different hierarchical levels of an organization.

Administrative leadership refers to the more common notion of leadership as the actions of individuals in formal managerial positions. It is a form of top-down, hierarchical, leadership which is based on authority. The focus of administrative leadership is different for different hierarchical levels. Administrative leaders on the strategic level may engage in vision building, planning, coordination and resource acquisition (Osborn and Hunt, 2007), on the organizational level they implement more focused plans or manage resource allocation. Because of their formal roles, administrative leaders have a position to unilaterally take decisions and impose policies. Acknowledging the important role of administrative leadership in and for most organizations, CLT suggests that administrative leadership should leave space and create opportunities for joint learning processes.

The key roles of *enabling leadership* are to create the necessary conditions for emergence, i.e. to enable adaptive leadership, and to manage the entanglement between administrative and adaptive leadership. First, enabling leadership may enable adaptive leadership by fostering interaction and interdependency, and by injecting ‘adaptive tension to help motivate and coordinate the interactive dynamic’ (Uhl-Bien et. al, 2007: 309). Interaction can be stimulated

by (electronic) working groups, open work places and the stimulation of interactions with other CASs and the organization's environment. Agents who are a part of adaptive networks may demonstrate enabling leadership by enlarging their personal networks or by monitoring the environment. Interdependency is a condition to joint action, and may be stimulated by enforcing parties to cooperate. Tension may stimulate creativity and learning. That is why enabling leaders should enhance tensions within a system, for example by stimulating heterogeneity of ideas, skills and preferences. Moreover, they may inject tension by imposing certain objectives. According to CLT, positional leaders may demonstrate enabling leadership, but enabling leadership may also be found within a CAS (Ibid: 311). Some agents within a CAS may be boundary spanners, others may try to establish interdependencies.

The second main function of enabling leadership is to manage the 'innovation-to-organization interface' (Uhl-Bien et al, 2007). The objective is to disseminate new knowledge produced in adaptive networks to the organization at large. According to Howell & Boies (2004) cited in Uhl-Bien et al. (2007), champions play a crucial role in this process. Champions are persons who use their skills and resources to advocate and try get accepted a new idea. To that end they need to establish good contacts with positional leaders.

5. Sustainability leadership

The final leadership challenge is to enhance the capacity of society to learn in response to feedback from the natural system, and to anticipate long-term impacts of climate change. In the following, we discuss two theories responding to these challenges: Eco-leadership theory (ELT) and the theory on leadership in social-ecological systems.

Eco-leadership theory (ELT) is a relatively new theory which shares many characteristics with the concept of complexity leadership. ELT is based on six premises (Wielkiewicz and Stelzner, 2010; Allen et al, 1998). The first premise is that leadership is an emergent process. This is to say that '[...] leadership does not consist of the actions of individuals. Instead, leadership emerges from the interactions *among* individuals' (Wielkiewicz and Stelzner, 2010:22). Positional leaders should create the necessary conditions for such interactions to develop. Second, 'the cognitive task of organization members is to optimize the tension between the "old school"/ industrial perspective and the "new school"/ ecological perspective' (Ibid: 23). This is to say that positional leaders should balance the need for structure and stability and the need for emerging new ideas and adaptability. According to Wielkiewicz and Stelzner, this is but another example of the need for balancing competing values, such as openness and closeness or democratic versus autocratic leadership. Third, leadership occurs in a web of interdependent social and biological systems. Organizations are faced with many interrelated adaptive challenges, among which the need to cope with an ever increasing flow of new information and the need to adjust our behavior to the limits of our natural environment. On the one hand, organizations need to devote resources to develop a better understanding of the complex systems they are part of. On the other hand, this should not prevent them from taking action now. Fourth, the adaptability of an organization is determined by the '[...] richness and variability of feedback loops allowed to influence leadership processes' (Ibid: 25). Because of the highly complex and dynamic environment of modern organizations, there is a need for a variety of feedback loops. That is why, according to ELT, organizations relying on authoritative leadership only will fail. Such organizations develop a necessarily limited understanding of their environment since this understanding is based on the feedback loops which are recognized by its positional leaders only. Collaborative or interactive decision making processes are expected to increase the richness and variability

of feedback loops. Again, there is a tension between the number and variety of feedback loops which are required for learning processes to develop, and the need for taking decisions which inevitably are based on an incomplete understanding of complex systems. Fifth, ‘a tension exists between a need for human and social diversity within the organization versus single-minded pursuit of common goals and objectives’ (Ibid: 27). The basic assumption is that the more variety an organization displays, the more adaptive the organization will be. A large variety of agents and ideas enables an organization to develop a wide array of adaptation strategies. But once again ELT argues that this need for variety needs to be balanced with the need to focus resources upon selected adaptation strategies. The sixth and final premise of ELT is that ‘leadership processes need to be evaluated in terms of how adaptively an organization responds to its long-term challenges’ (Ibid: 29). Path-dependency, which may be caused by sunk costs or legal barriers, characterizes the development of many organizations. A central argument of ELT is that such organizations are not able to adapt to rapid or radical changes in their environment and that organizations which are able to detect adaptive challenges are more likely to succeed. Using a long-term perspective is an important condition for detecting such adaptive challenges. ELT implies that in order to understand leadership, the focus should be shifted from the actions of individuals to patterns of interaction. At the same time, the theory recognizes that individuals may play a crucial role. According to Western (2010: 49), ‘eco-leadership focuses on designing, shaping, influencing, and creating spaces and structures to enable the self-organizing and self-regulating systems of an organization at work’, which is similar to the enabling leadership function in CLT.

Although the focus in the theory on *social-ecological systems* is not on leadership exclusively, it acknowledges the crucial role of leadership in realizing transitions to adaptive governance of social-ecological systems (Folke et al, 2005; Olsson et al, 2006). According to Folke et al. (2005: 451) ‘leaders can provide key functions for adaptive governance, such as building trust, making sense, managing conflict, linking actors, initiating partnership among actor groups, compiling and generating knowledge, and mobilizing broad support for change’. This theory points to the crucial role that key individuals or policy entrepreneurs may play in preparing a system for change by building a community of practitioners which share the ideas of adaptive management, and in navigating transitions by seizing policy windows. Successful leaders have the ability to ‘reconceptualize issues; generate and integrate a diversity of ideas, viewpoint, and solutions; communicate and engage with key individuals in different sectors; move across levels of governance and politics, i.e. span scales; promote and steward experimentation at smaller scales; recognize or create windows of opportunity; and promote novelty by combining different networks, experiences, and social memories’ (Olsson et al, 2006). These leadership tasks show overlap with the tasks of policy entrepreneurs and champions discussed earlier, and the enabling leadership function in Complexity Leadership Theory.

6. Towards an integrative framework of leadership for climate adaptation

In the previous sections we have summarized the basic assumptions and key features of recent leadership concepts and theories which we consider particularly relevant to climate change adaptation and related challenges. This section first compares the key features of the theories discussed before drawing the contours of a generic framework of leadership for climate adaptation. Table 1 identifies and compares four key features of the leadership theories discussed: (1) the locus of leadership, i.e. who fulfills leadership roles, (2) leadership

objectives, (3) leadership style (bottom-up and/or or top down), and (4) leadership tasks or activities.

Table 1. Comparing features of leadership theories (IL = Ideational Leader, PE = Policy Entrepreneur, ELT = Eco Leadership Theory, SES = Social-Ecological System)

	POLICY LEADERSHIP	CONNECTIVITY LEADERSHIP	COMPLEXITY LEADERSHIP	SUSTAINABILITY LEADERSHIP
Locus of leadership	IL: Politicians PE: Key individuals (policy entrepreneurs)	Positional leaders Key individuals (e.g. sponsors, champions)	Administrative function: Positional leaders Enabling function: Positional leaders, key-individuals (boundary workers, champions) Adaptive function: Complex Adaptive System	ELT: Positional leaders, Complex Adaptive System Leadership in SES: key individuals (entrepreneurial leaders)
Objective	initiate and realize policy change	collaboration	enhance adaptive capacity	realize adaptive management of social-ecological systems
Style of leadership	IL: Top down PE: Top down and/or bottom-up	Bottom-up	Top-down and bottom-up	Top down and bottom-up
Tasks	<ul style="list-style-type: none"> - display social acuity - pay attention to problem definition/legitimize policy solutions - engage in team-building/consensus-building/and with reform resistance - lead by example 	<ul style="list-style-type: none"> - promote problems and mobilize actors to search for solutions - bring people together/agree on a collaborative strategy - stimulate multiple action options/working together/building trust and legitimacy - forging agreement/moving to action 	<ul style="list-style-type: none"> - enabling: enable adaptive leadership by creating spaces for joint learning, fostering interaction and adaptive tension; disseminating knowledge from adaptive networks to overall organization - administrative: on the strategic level: vision-building, generation of resources; planning etc., on the organizational level: implementing plans or manage resources 	<ul style="list-style-type: none"> - positional leaders: create necessary conditions for interaction to produce leadership; balance the need for structure and emerging new ideas; designing, influencing, creating spaces/structures to enable self-regulating systems in an organization - entrepreneurial leaders: re-conceptualize issues; generate and integrate diverse ideas/viewpoints/ solutions; communicate and engage with key individuals in different sectors; move across levels of governance and politics (span scales); promote and steward experimentation; recognize/create windows of opportunity; promote novelty by combing different networks, experiences and social memories

On the locus of leadership, a first overarching observation is that, except for the theory on ideational leadership, all theories go beyond the traditional hierarchical or positional leadership paradigm based on the leader and his followers (e.g. Burns, 1974). It is argued that next to positional leadership, there are more forms of relevant leadership. There is some conceptual overlap across theories in terms of individuals who fulfill certain leadership tasks, more specifically the concepts of a policy entrepreneur and a champion, who may play a crucial role in the development of new ideas and the management of the innovation-to- organization interface. Moreover, the sponsors mentioned in the theory on integrative leadership can be conceived of as positional leaders fulfilling an enabling leadership function within the CLT-framework. A second observation on the locus of leadership is that both CLT and ELT argue that leadership in part *emerges* from the interactions between interdependent agents. The locus of leadership, then, is not an individual but a complex adaptive system.

The four families of leadership concepts emphasize different leadership objectives. Whereas the literature on policy leadership tells us that the objective of leadership activity is to get particular policy ideas accepted and implemented, leadership theories for connectivity emphasize the need to focus attention to a particular problem and to develop a shared interpretation and to reach consensus or a negotiated agreement on policies. Leadership in CLT aims at increasing creativity and learning, hence the adaptability of an organization. Finally, eco-leadership and leadership in the theory on social-ecological systems is aimed at realizing adaptive management of social-ecological systems. Returning to the fourfold challenge inherent in climate change adaptation (see Introduction), we find that the theories we reviewed have different foci in terms of their objectives. The four challenges can be described by asking the following four questions about networks of climate change adaptation, which typically include governmental agencies and non-state actors (NGO's and businesses):

1. How to influence policy processes relevant to the network?
2. How to establish cooperation and integration within the network?
3. How to enhance adaptive or learning capacity within the network?
4. How to enhance adaptive management of social-ecological systems through activities of the network?

We argue that theories which 'speak to' to questions 1 and 4 have a substantive focus. Leadership in the policy process assumes a certain policy idea or sets of idea that need(s) to be translated into policies and to be implemented. Similarly, eco-leaders and leaders in social-ecological systems aim at realizing an adaptive social-ecological system, which is coupled to a vision about how this future should look like. Questions 2 and 3 and the leadership theories that 'correspond' to them are much more process-oriented in nature. Leadership is either aimed at establishing shared meanings and collaboration (2), as expressed through leadership theories about connectivity or at increasing the adaptive or learning capacity of an organization or governance network (3), as expressed in CLT.

The leadership theories also differ in the emphasis put on top down and/or bottom-up styles of leadership. While theories on leadership for connectivity present themselves as a clear alternative to leadership based on authority, both CLT and ELT hold that organizations need to balance top-down steering and bottom-up dynamics. Where CLT acknowledges the importance of the

administrative leadership function next to the adaptive leadership function, ELT consistently argues that organizations should search for a balance between structure and stability and emergent adaptive activity. With policy leadership theories, the picture is mixed: a PE may pursue bottom-up or top-down styles of leadership depending on their position in a network, while an IL tries to push policy ideas (his/her own or from other sources) in part by virtue of a formal leadership position within a network. Table 1 shows that even though there is much overlap in leadership tasks, these theories offer complementary insights as well, and together suggest a wide range of leadership activities needed for climate change adaptation.

Unlike the other theoretical frameworks, CLT focuses on various leadership *functions* that need to be fulfilled within a complex adaptive system. For three reasons we think that a focus on and distinction between different leadership functions offers the best perspective for integrating insights produced by the leadership theories discussed in this paper. First, by distinguishing administrative, adaptive and enabling functions of leadership, we acknowledge the relevance of both top-down and bottom-up styles of leadership for climate change adaptation and are able to capture top-down/ bottom-up dynamics. Second, an analytical focus on functions explicitly acknowledges the relevance of both positional and non-positional leaders. Finally, and following from the latter, expanding analytical focus from leaders to leadership functions helps to recognize that individual leaders may contribute to the realization of several leadership functions and that leadership functions can be fulfilled by several individuals. For these reasons, we propose an integrative framework, which is based on various leadership functions that need to be fulfilled for realizing climate adaptation (See Figure 2).

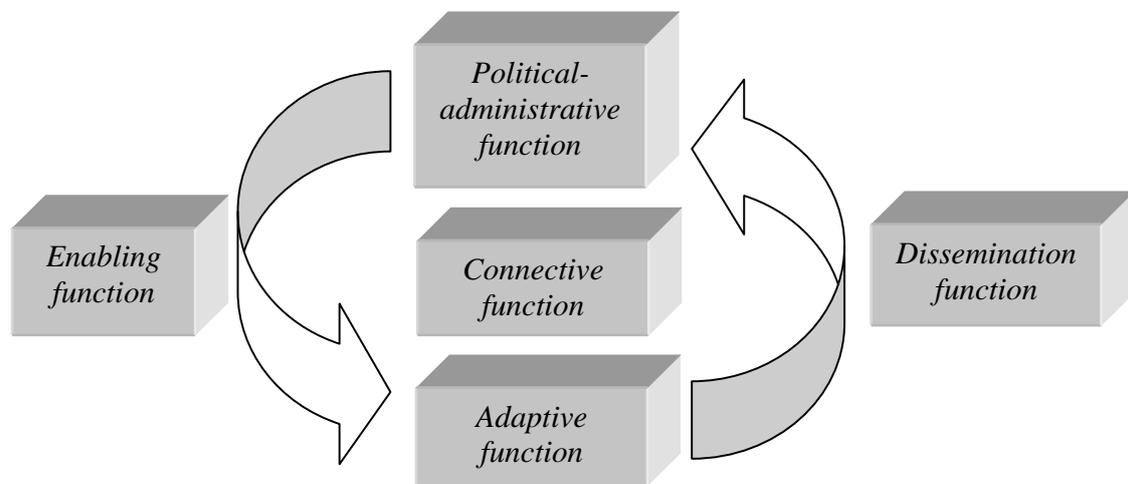


Figure 2: Leadership functions for climate change adaptation

The framework is composed of several leadership functions, which play a central role in CLT. Yet the framework includes a number of additional functions which have their origin in other families of leadership theories. Although the framework is inspired by CLT as an organizational theory, we think that it can be usefully applied to networks dealing with climate adaptation that are composed of various organizations, including public and private actors.

First, at the top of the model we find the ‘political-administrative’ leadership function. This function is based on the administrative function of CLT but amends it in important ways to be suitable for the domain of climate adaptation, where public policy plays an important role and at least part of the decision-making process is subject to political processes (for instance, adaptation measures that require approval by cabinets or parliaments). The political-administrative function, among other things, entails the development and communication of visions on climate change adaptation, and the generation and allocation of resources which are needed for realizing them. This function can only be fulfilled by positional leaders, such as elected politicians or those having management positions in other organizations within networks. In short, while the administrative function in the CLT framework is directed at vision-building and planning within organizations, the political-administrative function fulfills a similar role. However, it is directed at the political context in which policy is made within the network of actors who deal with climate adaptation. As we have seen in our review of theories on leadership in the policy process, ideational leaders and some policy entrepreneurs (as a specific category of political leaders) may contribute to this function by pushing the adaptation agenda and associated ideas.

Second, the adaptive function – similar to the same function in CLT and ELT- entails the generation of new and innovative ideas and approaches which do not always fit organizational objectives and routines. This function, which emerges from the interactions within adaptive networks, is crucial to be able to adapt to changing circumstances. It is exactly because of the high level of uncertainty surrounding adaptation issues that there should be sufficient room for experimenting with new adaptation options.

Third, our framework distinguishes two dimensions of what CLT calls the enabling leadership function. The first one, shown on the left-hand side, which we also label as ‘enabling’, aims at creating the conditions for the emergence of new knowledge and innovation, that is, the adaptive leadership function, within the network. Positional leaders may contribute to the enabling function by tolerating a variety and diversity of approaches, fostering interaction, inserting adaptive tension or creating a sense of urgency. Sponsors, as they are referred to in the theory on integrative leadership, contribute to the enabling function as well. Non-positional leaders, such as boundary workers, policy entrepreneurs and champions may contribute to the enabling function by stimulating interaction. The other dimension, shown on the right-hand side, is called the ‘dissemination’ function. It includes all activities aimed at disseminating innovative ideas and approaches which are developed through the adaptive function within the network. Champions or policy entrepreneurs play a crucial role in spreading newly developed ideas and in linking shadow networks to formal decision making arenas.

Finally, in the central part of the model, the connective leadership function is located. This function entails all leadership activities aimed at realizing connectivity across different levels of government, policy sectors and a large variety of actors. This is a prerequisite for realizing the administrative function within multi-level governance networks since parties need to reach an agreement on a shared vision and the pooling of resources which are needed for realizing that vision. The literature on leadership for connectivity suggests that a focus on problems rather than solutions is key to realizing such coordinated action. Connectivity is beneficial to the adaptive function as well. As an example, eco-leadership theory and the literature on leadership in social-ecological systems suggest that the involvement of a large variety of parties enhances

possibilities of incorporating feedback from the natural system. In sum, the pursuit of suitable adaptation measures demands leadership that is capable of connecting and integrating the actions of a variety of actors within the network, thereby supporting the other four leadership functions; hence its central position. Table 2 presents a summary of the five leadership functions, the type of leader which may fulfill these functions (the locus of leadership), and the associated leadership tasks.

Table 2: Leadership functions, their locus and associated tasks

Leadership function	Locus of leadership	Leadership tasks
Political-Administrative	<ul style="list-style-type: none"> - positional leaders - (elected) politicians and/or public managers 	<ul style="list-style-type: none"> - develop, communicate and monitor the realization of a shared vision on climate adaptation - generate and allocate necessary resources for climate adaptation
Adaptive	<ul style="list-style-type: none"> - Complex Adaptive System 	<ul style="list-style-type: none"> - NA (Adaptive function is emergent property of the CAS)
Enabling	<ul style="list-style-type: none"> - positional leaders - key individuals (sponsors, boundary spanners, policy entrepreneurs, champions) 	<ul style="list-style-type: none"> - allow for and stimulate a variety of adaptation strategies and options - create a sense of urgency, e.g. by setting deadlines - insert adaptive tension - foster interaction
Dissemination	<ul style="list-style-type: none"> - positional leaders - key individuals (boundary spanners, policy entrepreneurs, champions) 	<ul style="list-style-type: none"> - insert newly developed ideas (within the CAS) into the network of positional leaders - get accepted newly developed ideas
Connective	<ul style="list-style-type: none"> - positional leaders - key individuals (sponsors, boundary spanners, 	<ul style="list-style-type: none"> - promote problems and mobilize actors to search for solutions - bring people together/agree on a

	policy entrepreneurs, champions)	collaborative strategy - stimulate multiple action options/working together/building trust and legitimacy - forge agreement/move to action/implement strategies
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5. Conclusion

There seems to be a lack of theoretically informed and systematic research on leadership for climate adaptation. A scan of the literature on leadership and climate change revealed that only few scholarly articles so far have dealt with leadership for climate adaptation and that these articles only mention leadership as but one of the many factors relevant to developing and implementing adaptation policies. Four key characteristics of climate change adaptation formed the point of departure for this paper and together form a strong rationale for zooming in on leadership: (1) the important if not crucial role played by governmental actors and public policies, (2) the involvement of a large variety of actors from different policy sectors and on various levels of government, (3) the high level of uncertainty surrounding climate change and adaptation options, and (4) the need to consider the interactions between social and ecological systems and to take a long-term perspective. We proposed that the challenges for climate change adaptation corresponding to these characteristics can be ‘matched’ by contemporary families of leadership theories.

A review of these theories has shown that there is a striking similarity between leadership concepts in that they all indicate that traditional, hierarchical leadership, based on the leader-follower model, still plays an important role but is no longer effective on its own. Leadership is increasingly conceived of as a dispersed phenomenon, and some theories treat it as an emergent property of interacting agents rather than as the behavior of any one individual. In spite of their similarities, the theories produced different yet complementary insights as well, which can be explained by their different foci. While theories on IL, PE and ELT focus on substantive objectives of leadership (e.g. seeking to change and implement public policies or realizing sustainability), theories on leadership for connectivity and CLT focus more on procedural objectives, (e.g. enhancing cooperation or organizations’ adaptability).

Drawing on various recent leadership concepts we have developed an integrative framework distinguishing five leadership functions (political-administrative, adaptive, enabling, connective and dissemination functions), each relating to specific leadership tasks, which we think are crucial to the adaptability of climate adaptation networks. Adaptability suggests a balance between the need for learning and generating a diversity of ideas, and the need for focusing action right now. The framework may be used to both analyze and monitor leadership for climate adaptation, and to detect and potentially remedy possible deficits of leadership in specific cases of climate adaptation. The next step in this research endeavor will be to operationalize leadership functions and tasks, with an eye to applying the framework to empirical cases of

climate change adaptation and existing governance networks. In addition, more work needs to be done to specify how the framework relates to different political-institutional contexts and given different policy legacies regarding climate adaptation.

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