Climate Risk Management 9 (2015) 1–5

Contents lists available at ScienceDirect

Climate Risk Management

journal homepage: www.elsevier.com/locate/crm

Narrowing the gap between climate science and adaptation action: The role of boundary chains

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ARTICLE INFO

Article history:
Available online 24 June 2015

Keywords:
Boundary organization
Boundary chain
Information usability
Climate change adaptation
Synergy
Science and decision-making

ABSTRACT

Boundary organizations play a critical role at the interface between science and decision making. They create, protect and sustain an interactive space for co-production of science and decision-making while simultaneously bridging the two domains. In this special issue we advance the concept of boundary chains, whereby two or more boundary organizations link together synergistically to influence one another and to leverage each other's resources and strengths to achieve shared goals. In this process both the level of complementary and embeddedness between these organizations is critical for achieving these goals. Through a series of case studies focusing primarily but not exclusively on climate information use in the United States, we aim to advance scholarship in the field by examining innovation among boundary organizations and testing the boundary chain concept. In doing so, we focus on boundary chains both as a theoretical construct to re-think the structure, function, and adaptability of boundary organizations and as a practical strategy to further increase the usability of climate knowledge for adaptation action across a wider range of users.

The challenge

Solving the complex environmental problems that society faces requires participatory approaches that produce usable science and link that science to decision making. Empirical research shows that when scientists and information users collaborate in knowledge co-production the information that results is more usable for solving problems and supporting management decisions because the collaborative process helps align what users want with what science has to offer (Cash et al., 2006; McKinley et al., 2012; O'Mahony and Bechky, 2008; Lemos and Morehouse, 2005; Lemos et al. 2012). Beyond generating more usable knowledge, these approaches also open a dialogue between science and society that fosters creative solutions while minimizing the politicization of science and the scientization of policy (Gough, 2003; Guston, 1999).

In many of these interactive processes, intermediary organizations, called boundary organizations, play a critical role supporting interaction and exchange at the interface between science and decision making. By creating, protecting and sustaining an interactive space and by bridging science and society, boundary organizations establish a forum for differing perspectives and knowledge systems to interact and develop a mutual understanding while maintaining their own identities

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http://dx.doi.org/10.1016/j.crm.2015.06.002
2212-0963/

(Guston 1999, 2001). Through this interactive workspace, boundary organizations help to bridge the different cultures of science production and use and broker science to decision-making (Guston, 2001).

Evidence documenting the use of different kinds of scientific knowledge – and climate information in particular – in decision making shows that boundary organizations have been increasingly effective at bridging and brokering usable information in support of decisions. For example, usability is increased through interactions between producers and users of climate information across a range of applications from disaster reduction (Kasperson, 2010) to water management (Kirchhoff et al., 2013). These interactions help to improve understanding, integrate different kinds of knowledge, and build capacity for use (McNie, 2013) as well as reduce barriers to use and reconcile the supply of information with users' demand (Sarewitz and Pielke, 2007).

While considerable research has examined how boundary organizations stabilize the boundary between science and society in general, and how they improve the usability of climate information in particular (see for example Bolson et al., 2013; Huitema and Turnhout, 2009), only recently have scholars turned their attention to the structure and sustainability of boundary organizations themselves and what we can learn from them. Recent advancements in this area suggest, for example, that a reliance on face-to-face interactions, while effective, may limit boundary organizations' potential to increase the production of science that supports the rapidly growing number and diversity of potential users (Kirchhoff et al., 2013). Likewise for users, resource intensive interactions can be burdensome, particularly for those without sufficient capacity to invest in long-term, face-to-face interactions with producers (Dilling et al., 2015; Kasperson, 2010; Kirchhoff, 2013). These findings have led to calls for research exploring innovative ways to sustain and expand interactions between producers and users across space and time that increase usability as much as face-to-face ones, but are less resource intensive and capable of serving a broader suite of potential users. Other recent work supports the notion that boundary organizations themselves innovate in different ways to respond to changing contexts or help shape the space within which they operate. Findings suggest that boundary organizations adapt by re-organizing and reframing problems and by establishing new directions and partnerships (Lemos et al., 2014; Parker and Crona, 2012). From this work emerged the concept of boundary chains which begins to account for the ways in which boundary organizations collaboratively shape their environments and enhance capacity to achieve shared goals.

Boundary chains are formed by purposefully and strategically connecting a series of boundary organizations that span the range between the production of information and its use in decision making (Lemos et al., 2014). As theorized in Lemos et al. (2014), boundary chains advance the work of individual boundary organizations through leveraging the complementary resources and strengths of two or more linked boundary organizations to achieve shared goals. In this configuration, boundary chains are primarily viewed as a means to reduce the resource demands of climate information co-production and to reach a wider range of users more efficiently and effectively than would be possible by a single boundary organization working on its own. Through a series of case studies, Lemos et al. (2014) showed that, at a minimum, linking two or more boundary organizations together decreased transaction costs – the level of effort invested by each organization for co-production and for forming and sustaining connections between scientists and users. For example, rather than having to start from scratch, building trust with different individuals or groups to increase their effectiveness as brokers and bridgers of climate information, organizations such as RISAs in the US or the UKCIP in the UK, could 'contract out' this function to another boundary organization that has already established trust with those potential users. Similarly, other kinds of costs such as distance between producers and users and perceived conflicts can be reduced through boundary chains, where each link, works to reduce or spread the costs across the chain.

And, while boundary chains were conceived in the context of climate information usability, the concept has potential to re-frame the ways in which we think about the structure, function, and adaptability of boundary organizations and the ways in which they build capacity and help solve complex environmental problems. For example, because boundary chains link boundary organizations with different missions and orientations along the continuum of science production to use, there is considerable room for different sorts of boundary interactions to occur that serve different purposes at different links in the chain. Although these links leverage complementary strengths and resources, they also embed science within different communities helping to influence and being influenced by those communities.

Our aim in this special issue is for these cases to provide robust empirical examples of different ways of fostering actionable knowledge for and broadening participation in decision making that critically advance scholarship on boundary organizations and boundary chains. In different ways, the contributions in this special issue reinforce the idea that boundary chains not only narrow climate (and other kinds of scientific knowledge) information gaps in support of adaptation but also build capacity and networks that enhance societal resilience more broadly (Bidwell et al., 2013; Kalafatis et al., 2015). This special issue largely focuses on boundary chains formed with the Great Lakes Integrated Sciences + Assessments (GLISA), a NOAA-funded Regional Integrated Sciences and Assessments Program (RISA) (for more information about RISAs see NRC (2010) and Pulwarty et al. (2009)). GLISA is a boundary organization that works to advance climate science in support of planning for and in response to climate-driven impacts in the Great Lakes region of the US (Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin) and Ontario, Canada. The special issue also includes examples from other regions such as boundary chains on ocean acidification and hypoxia in California, and a boundary chain bridging diverse users across an expansive geography in Alaska.