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Creating synergy with boundary chains: Can they improve usability of climate information?

Christine J. Kirchhoff^{a,*}, Maria Carmen Lemos^b, Scott Kalafatis^c^a University of Connecticut, Storrs, CT, United States^b University of Michigan, School of Natural Resources and Environment, Ann Arbor, Michigan, United States^c University of Michigan, School of Natural Resources and Environment, Great Lakes Integrated Sciences + Assessments, Ann Arbor, Michigan, United States

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ABSTRACT

Boundary organizations facilitate and negotiate the interface between science production and use to improve information usability particularly for climate adaptation. To support the increasing demand for usable climate information and enable adaptation, boundary organizations themselves must innovate to foster more efficient production of usable science and more effective networks of producers and users. A recent innovation centers on the idea of boundary chains, whereby boundary organizations work together to increase efficiencies such as leveraging human and social resources. While this idea holds promise, more work is needed to better understand how and why boundary organizations work together to improve information usability and other beneficial outcomes. In this perspective for the special issue, we propose a new conceptual framework for exploring why and how boundary chains form and for evaluating whether or not they are successful. We then apply the framework to case studies that are discussed in more detail in this special issue. Our framework hinges on the notion that boundary chains that are successful are those that create synergy. In turn, synergy depends on a combination of complementarity, putting two kinds of inputs together results in greater output than either each engaging partner could deliver on their own, and embeddedness, the choices and actions on one side are at least partially influenced by and dependent upon the choices and actions of the other side and vice versa.

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Introduction

Boundary organizations are critical players in the effort to advance the usability of science in decision making. Defined as organizations “that facilitate(s) the interaction between science producers and users and that stabilize(s) the science-policy interface” (Kirchhoff et al., 2013, p. 3.2), boundary organizations bridge and broker science to different types of users (e.g., decision makers, policy makers) helping to bridge the gap between the different cultures of knowledge production and use (Guston, 2001). Mostly, boundary organizations bridge or broker different types of knowledge produced by others though sometimes they broker applied knowledge that they produce themselves. Boundary organizations have become increasingly important at negotiating the interface between science production and use in ways that increase information

* Corresponding author at: University of Connecticut, 261 Glenbrook Rd., Unit 3037, Storrs, CT 06269-3037, United States. Tel.: +1 860 486 2771; fax: +1 860 486 2298.

E-mail address: ckirchhoff@engr.uconn.edu (C.J. Kirchhoff).

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usability. Yet, despite this growing role—especially for climate adaptation, there remains a disconnect between the supply of and demand for climate information (McNie, 2007; Pielke et al., 2007). Despite the rapid evolution of research studying the role of boundary organizations in supporting efforts to improve the use of climate information among a growing range of users in the past few decades (Bales et al., 2004; Bidwell et al., 2013; Bolson et al., 2013; Cash et al., 2006; Feldman and Ingram, 2009; Hansen, 2002; Hartmann et al., 2002; Kirchoff, 2013; Lemos and Morehouse, 2005; McNie, 2013), there has been relatively less attention paid to exploring how boundary organizations themselves innovate and adapt to different environments to advance the generation and uptake of climate science for adaptation decision making (but see Kirchoff et al., 2014; Lemos et al., 2014; McNie, 2013).

At the intersection between science and decision-making boundary organizations play multiple and changing roles in different contexts. And while the empirical scholarship focusing on what they are and what they do has grown significantly, their contextual character challenges theory building both in terms of the relationships between their main components (e.g., agents, boundary objects, institutions, rules, processes) and in terms of the outcomes they achieve. For example, there are many organizations that do not formally define themselves as boundary organizations but that for all intents and purposes often carry out these tasks (Boezeman et al., 2013; Franks, 2010; Lemos et al., 2014). If on the one hand, their ability to ‘act like a boundary organization’ may increase capacity for knowledge production and uptake, on the other hand, it may create its own set of problems. Indeed, by operating outside of the normative framework of what boundary organizations should do, these organizations may neglect some of their expected roles such as preserving the boundary between science and policy, controlling the quality of information across the boundary or keeping both sides not only accountable to each other but also accountable to the scientific/political realms of specific decision contexts. While improving the conceptualization and practice of the production of ‘actionable’ scientific knowledge have the potential to dramatically increase the use of science to inform decision-making (Kirchoff et al., 2013), they can also muddy the waters between the normative principles that define what boundary organizations should be and do and their actual practice.

To date, the vast majority of scholarship in this area has focused on two broad categories: (1) improving the information generated by individual boundary organizations (e.g., producing knowledge that is credible, accurate, and salient (Cash et al., 2003; Hulme and Dessai, 2008; McNie, 2007) and (2) improving the boundary spanning process, that is, the way boundary organizations transfer and broker knowledge so that it is eventually applied (Buzier et al., 2010; Cash et al., 2003, 2006; Hegger et al., 2012; Jacobs et al., 2010; van Kerkoff and Szlezak, 2010). We seek to expand the scope of this scholarship by focusing on how boundary organizations themselves innovate in their boundary spanning and brokering roles and in so doing, may both increase the production of usable science and foster networks of producers and users of climate information. We particularly focus on understanding how boundary organizations synergistically work together by building partnerships with other kinds of boundary organizations, that is, by creating “boundary chains.” These boundary chains may reduce the transaction costs of knowledge co-production by ‘saving’ time and leveraging the human and social resources normally required to build trust and legitimacy which is at the core of co-production of knowledge and decision-making (Lemos et al., 2012, 2014). By reducing the costs of knowledge co-production, boundary chains may also help to close the gap between science supply and demand (McNie, 2007; Pielke et al., 2007).

We define boundary chains as an association between boundary organizations that play different roles (e.g., co-producing information, facilitating interaction, brokering or bridging knowledge that gets used by decision makers or, in some cases, applying information themselves). Following on Lemos et al. (2014), in this paper, we focus on two main configurations of boundary chains: the *key chain*, in which boundary organizations link with one other organization focused on knowledge co-production, and the *linked chain*, where several linked organizations continuously intermediate knowledge between producers and users (Fig. 1).

In the next sections, we first discuss the changing role of boundary organizations from maintaining the separation between science and policy to more recent work as knowledge brokers that navigate the science policy divide. Then, we discuss our analytical framework for assessing the conditions necessary for improving climate information production and use. Finally, we apply that framework to a series of case studies and conclude with avenues for future research.

The changing role of boundary organizations

In the 1980s Gieryn (1983) persuasively argued that the problem of demarcating the boundary for science was not about defining its characteristics; rather, it was about efforts by scientists to set their work apart from non-scientific activities. He coined the term “boundary work” to define the efforts that scientists used to protect threats to science from within (e.g., fraud and pseudo-science). Over time, this narrow definition broadened to encompass the factors shaping the boundary between science and non-science and new, related concepts were introduced such as boundary objects and organizations (Guston, 2000). Boundary objects are mechanisms, processes, material things and even epistemologies that transcend the science/non-science divide and provide a means for producers and users of science to work together while maintaining their separate identities (Guston, 1999; Lynch et al., 2008). These objects, abstract or concrete, are malleable enough to satisfy local needs and constraints yet robust enough to sustain a common identity across the boundary (Star and Griesemer 1989). For example, a collection of project resources functions as a boundary object as participants adapt strategies to organize and share them in a usable format (Star and Griesemer 1989).

According to Miller (2001), the boundary organization concept is a peculiarly American construct, one that emerges from the “hyper differentiated” spheres of science and politics that exist in the United States. In practice, much of these early

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