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Dynamic capabilities for water system transitions in Oklahoma

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ABSTRACT

Based on semi-structured interviews with key decision-makers from 38 distinct municipal water utilities in Oklahoma, this paper examines the innovation process that drives water system transitions in response to external pressures, including climate change, policy, and economic trends; and to address internal system needs, such as supply expansion and infrastructure upgrades. A multiple linear regression analysis reveals a strong, positive relationship between innovations and dynamic capabilities, suggesting that dynamic capabilities are crucial to the transition of water systems. The strength of the relationship between sensing, seizing and reconfiguring dynamic capabilities and innovations differs by type of innovation. Water manager awareness of the state-level Water for 2060 Act was shown to have significant influence on the number of innovations generated by municipal water systems, while water manager licensure level was not a reliable predictor of innovation. Recommendations for encouraging much needed radical innovations are outlined.

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1. Introduction

The continued safe operation of water systems is threatened by the slow pace of institutional and infrastructure change, which characterizes not only rural but also urban regions in the United States. Funding pressures, especially budget cuts, have limited the ability of water managers to instigate incremental—let alone radical—changes that would improve the sustainability of water systems. This empirical study examines the innovation process in 38 municipal water systems in Oklahoma. Innovation is defined broadly as the creation and implementation of new or adapted institutional and technological changes that generate value and enhance water system sustainability. The antiquated state of the water system infrastructure in the United States and Oklahoma (American Society of Civil Engineers, 2013), combined with a changing climate (Karl et al., 2009) and increasing consumer demand for water (OWRB, 2015a), provides a window of opportunity for studying innovation in public water systems (Hering et al., 2013; Pahl-Wostl, 2007; Spiller et al., 2015). Addressing the innovation deficit in water systems (Kiparsky et al., 2013) requires understanding how changes to institutions and infrastructures can be encouraged at multiple levels. A key question is how best to initiate and facilitate innovation processes, which lead to water system changes as part of transitions towards sustainability (Lieberherr and Truffer, 2015).

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A recent theme in water governance involves the integration of strategic decision-making theory and methods to help understand how the water sector can implement more sustainable infrastructure (Ashley et al., 2008; Lienert et al., 2015; Scholten et al., 2015). This is particularly true when examining how dynamic capabilities – “the ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments” (Teece et al., 1997, p. 516) – can help water managers in creating value with innovation (Lieberherr and Truffer, 2015). The key feature of dynamic capabilities is that they allow organizations to quickly modify resources or routines in response to opportunities or threats (Zahra et al., 2006). Viewing organizations through a dynamic capabilities lens allows researchers to gain insight into the beginning stages of managerial actions that shape the organization and the innovation process (Lin et al., 2016; Narayanan et al., 2009). Research and development, product development routines, organizational structures, strategic decision-making, human and social capital, and external alliances are examples of dynamic capabilities that are adaptable and have the potential to lead to innovations (Eisenhardt and Martin, 2000).

While incremental and radical innovations are both crucial to the success of utilities, radical innovations increase the long-term viability and capacity of the water system (Kiparsky et al., 2013; Gaziulusoy, 2015). Incremental innovations are more frequently implemented in municipal water systems to ensure system stability (Thenint, 2010), as urban water management is generally averse to risk (Lemos, 2008; Thenint, 2010; Bekkers et al., 2013; Hering et al., 2013). When an innovation involves a drastic change, similar to the application of wastewater reuse, it is considered radical because it requires combinations of specialized ideas, knowledge, expertise, and social acceptance (Damanpour and Schneider, 2009; Gaziulusoy, 2015). Radical innovations in water systems include technologies that change how water is used (e.g. water reuse), measured and billed (e.g. smart meters), as well as management and business models based on strategic planning and adaptive learning mechanisms (Kiparsky et al., 2013).

1.1. Research question

The creation and deployment of sensing, seizing and reconfiguring dynamic capabilities were studied to understand the process of innovation in Oklahoma’s water utilities. Given the importance of dynamic capabilities to innovation (Eisenhardt and Martin, 2000; Lieberherr and Truffer, 2015; Michailova and Zhan, 2015; Weerawardena et al., 2015; Forés and Camisón, 2016; Lin et al., 2016), the identification of green dynamic capabilities (Lepoutre, 2008; Gliedt and Parker, 2010), and the verification of sustainability-oriented sensing, seizing and reconfiguring dynamic capabilities for green technology, knowledge generation, and innovation (Chen et al., 2015), we seek to examine a relationship between *the level and type of dynamic capabilities and the level and type of water system innovations in water utilities*. Various factors are used as controls including average household income, the population size served by the water utility, the licensure level of the water manager for each utility, and awareness of the Water for 2060 Act by the water manager.

Dynamic capabilities offer an empirically testable explanation of change in the water sector because they have been shown to contribute to innovation (Lieberherr and Truffer, 2015). The Oklahoma case study, which is described in the methods section, is particularly useful for studying dynamic capabilities development and use given the historically low rate of innovation that characterizes the water sector (Widener et al., 2016). The remainder of the paper reviews the literature on dynamic capabilities, describes the research question and the methods used to examine it, outlines the results, and concludes with the key findings and recommendations.

2. Literature review

2.1. Contested dimensions of dynamic capabilities

Researchers continue to debate various issues that relate to the understanding of dynamic capabilities as part of innovation processes (Teece and Pisano, 1994; Eisenhardt and Martin, 2000; Lawson and Samson, 2001; Zollo and Winter, 2002; Winter, 2003; Zahra et al., 2006; Teece, 2007; Lepoutre, 2008; Helfat and Peteraf, 2009, 2011; Lieberherr and Truffer, 2015). First, the level at which capabilities are considered dynamic is not always clear, ranging from routines and tacit knowledge, to the underlying capabilities that alter those routines in organizations (Winter, 2003; Helfat and Winter, 2011). Even those underlying capabilities must be created by some combination of resources and capabilities (Eisenhardt and Martin, 2000; Zahra et al., 2006). Dynamic capabilities are essentially the capability to create capabilities (Winter, 2003; Zahra et al., 2006), which in turn help solve problems or foster innovations. Zahra et al. (2006) propose that the effect of dynamic capabilities on performance (in this study performance is considered to be the number and type of innovations created) is related to higher levels of organizational knowledge.

Second, authors have critiqued the focus on structures and routines at the expense of the role of individuals in the innovation process, and in particular, individuals as the micro-foundations of dynamic capabilities (Felin and Foss, 2005; Foss and Lindenberg, 2013). A hybrid view is that a combination of individual leadership and routines/structures create, enable and activate dynamic capabilities (Foss et al., 2012). Structures, including environmental departments, committees, management systems, and formal strategic partnerships, can act as internal or external capabilities and can be used by champions to foster innovations (Gliedt and Parker, 2010; Lepoutre, 2008). Given the uncertainty in the literature, Devinney (2013) calls for research to examine the connections between the individual, and the structural and strategic elements of organizational value creation.

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