



The interplay of institutions, actors and technologies in socio-technical systems – An analysis of transformations in the Australian urban water sector



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ABSTRACT

Literature on socio-technical transitions has primarily emphasized the co-determination of institutions and technologies. In this paper, we want to focus on how actors play a mediating role between these two pillars of a socio-technical system. By introducing the theoretical concept of institutional work, we contribute to the conceptualization and empirical assessment of agency processes in socio-technical systems. We illustrate this approach by analyzing recent developments in the Australian urban water sector, where seawater desalination technology has experienced an unexpected, but rapid diffusion to all major cities, often interpreted as a reaction to a major multi-year drought. However, the drought broke and left all but one plant unused. This has led many commentators wonder how such a massive investment – which is likely to limit alternative development trajectories in the sector for the coming decades – could have happened so quickly and why other, potentially more sustainable technologies, have not been able to use the momentum of the crisis to break through. A comparative analysis between seawater desalination and its main rival wastewater recycling in regard to processes of institutional work provides valuable insight into how technology, actors and institutions mutually shaped each other.

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1. Introduction

The question of how to influence socio-technical systems towards more sustainable consumption and production patterns has become a major focus in many industries and is also gaining increasing importance in politics and society in general. In recent years, literature on sustainability transitions has become influential in the analysis of such long-term change processes, taking up a socio-technical systems perspective (Markard et al., 2012; van den Bergh et al., 2011). One of the central theoretical concepts elaborated in this realm is the socio-technical regime (Dosi, 1982; Geels, 2002; Nelson and Winter, 1982; Rip and Kemp, 1998; Smith et al., 2005). It investigates the co-evolution of institutional and technological elements into a highly institutionalized configuration that enables the fulfillment of specific societal functions (e.g. water and energy provision).

In recent years, the theoretical conceptualization of the socio-technical regime has undergone an institutional turn. Scholars have increasingly drawn on concepts from institutional theory in order to describe the norms and rules that stabilize a socio-technical system (Geels, 2004). Using the three institutional pillars by Scott (2001), the regime has been described as the highly institutionalized regulative,

normative and cognitive structures, e.g. norms, standards, values, cultural expectations or regulations, which have evolved in accordance with certain technologies. More recently, the strength of socio-technical regimes, i.e. its structuring effect on actors and technologies, has been analyzed using the concept of institutional logics (Fuenfschilling and Truffer, 2014). As a consequence of the institutional turn in socio-technical regime research, transitions can essentially be interpreted as processes of institutional change with a particular attention to technologies. Formerly dominant regimes are being de-institutionalized and getting gradually replaced by an originally only loosely institutionalized alternative socio-technical configuration.

To date, the focus of many analyses has been on the rigidity and inertia of socio-technical systems that results out of the historically grown co-alignment of technologies and institutions. Radical change, on the other hand, has often been conceptualized as being triggered by extreme events that are expected to lead to an imminent and fundamental destabilization of established structures, which in turn enables the maturation and break-through of alternative technological paradigms (Geels and Schot, 2007; Smith et al., 2005). Recent critical reviews of the transitions literature have suggested that this view is probably only accurate for a few potential transition trajectories. Endogenous and gradual processes taking place within socio-technical systems therefore deserve more attention (Dolata, 2011; Genus and Coles, 2008; Markard and Truffer, 2008; Shove and Gordon, 2007; Smith

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et al., 2010). One of the main current theoretical debates in transition studies thus revolves around the question of how to more explicitly conceptualize and integrate actors and agency into the study of socio-technical transitions.

The challenge inherent in conceptualizing agency without ignoring the obvious effects of highly institutionalized system structures (widely known as the problem of embedded agency) can be regarded as one of the fundamental paradoxes in social sciences. Accordingly, much research has been undertaken that shows how processes of embedded agency could be conceptualized and what effect they have on institutional change. In the following, we will draw on insights from institutional theory to tackle these questions.

Since the seminal work by Berger and Luckmann (1966), it is commonly acknowledged that institutions are socially constructed. By looking at the process of how this social construction unfolds, embedded agency and its relevance for institutional change are put forward. One of the central approaches in this regard has been labeled *institutional work*. It analyses and categorizes actions by actors that aim at the creation, maintenance or disruptions of institutions (Lawrence and Suddaby, 2006; Lawrence et al., 2009) and thus shows how processes of (de-)institutionalization unfold. However, the approach explicitly refrains from adopting a methodological individualism with a rational, hyper-muscular entrepreneur (a problem that haunts much of the institutional entrepreneurship literature). Instead, it focuses on how agency is shaped by the institutional environment but nevertheless effective in processes of change and maintenance. We argue that this concept is therefore fruitful to characterize and analyze the endogenous processes in a socio-technical system. In particular, it shows how actors interact with their institutional context and how they deal with the institutional plurality in a socio-technical regime.¹

By focusing on institutional work, we do not want to state that actors and their actions have so far entirely been neglected in empirical transition studies. Several aspects of embedded agency have been addressed in earlier research. Examples are studies about the role of power or social movements in bringing about change (Avelino and Rotmans, 2011; Ornetzeder and Rohracher, 2013), in work regarding transition management and governance issues (Loorbach and Rotmans, 2010; Smith et al., 2014; Weber and Rohracher, 2012), in the realm of firm strategies that purposefully foster or hinder innovation and change (Musiolik et al., 2012; Turnheim and Geels, 2013) or in the context of influencing sectoral discourses and rationales (Penna and Geels, 2012; Späth and Rohracher, 2010). More fundamentally, many of the theoretical approaches have reiterated constructivist notions of technology development or the idea of a dual structuration cycle à la Giddens (Geels, 2011; Giddens, 1984; Grin et al., 2010). However, so far the different agency processes have not been analyzed regarding their potential to create, change or maintain core institutions of a regime.

The paper illustrates the merits of an institutional work approach with an empirical analysis of the recent 'millennium drought' in Australia and the subsequent diffusion of seawater desalination plants across the country. Triangulating different qualitative methods like expert interviews, document and media analysis, we will show that the rapid diffusion of desalination (and the concomitant standstill of water recycling projects) can only be explained by simultaneously accounting for the interplay of institutions, technologies as well as actors within a system. We will therefore first present an overview of the institutional environment of the sector, i.e. of the prevailing semi-coherent regime. In a second step, we will analyze the different forms of institutional work applied by actors in this environment in order to foster or hinder the diffusion of seawater desalination. We compare

these processes to the non-successful institutional work applied in the case of wastewater recycling technology. We explain the success and failure of these two technological alternatives by their respective fit with the prevailing regime and discuss thereof resulting consequences for future sustainability transitions. Our case thus explicitly demonstrates that socio-technical change neither solely depends on technological innovation, regime particularities or actor strategies, but ultimately on the dynamic interplay between all three pillars.

2. Agency as institutional work: creation, maintenance and disruption of institutions

Institutional theory in organization science and sociology has highly contributed to a better understanding of how actors operate in organizational fields² by stressing the relevance of higher order structures like norms, values, rules or taken-for-granted assumptions and beliefs (Greenwood et al., 2008; Powell and DiMaggio, 1991). It is assumed that social action is heavily shaped by the institutional context of an actor. The theory thus offers unique insights into the relationship between an actor and its environment (Scott and Meyer, 1994).

The focus of many studies has been on the analysis of the influence and persistence of highly institutionalized regulative, normative and cognitive structures (Scott, 1995).³ The cause or process of institutional change, on the other hand, was long secondary. Similar to transition studies, the primary explanation for change was mainly based on the disruptive effect of external shocks and jolts (Fligstein, 1993; Greenwood and Hinings, 2006; Meyer, 1982). It was assumed that extreme events break open rigid institutional settings and lead to a reinterpretation of existing belief systems, habits or norms, which subsequently leads to change. However, what constitutes an extreme event and what exactly happens that enables change remained unclear. As a consequence, scholars have started to take up a more process and practice oriented approach that focuses on the social construction of events (Jarzabkowski et al., 2009; Jarzabkowski, 2004). Studies found that also the significance of an event is not objectively given, but decided in a complex social and political process and that actors actively promote or deny the relevance of an event (Munir, 2005; Munir and Phillips, 2005).

The development of a more endogenous approach to institutional change has only recently regained broader attention, which could be described as a 'practice turn' in the studies of institutions (Jarzabkowski et al., 2009; Lawrence et al., 2009; Zietsma and Lawrence, 2010). One approach that focuses explicitly on how actors shape their institutional context is the concept of institutional work (Lawrence and Suddaby, 2006). It can be interpreted as an advancement of the notion of institutional entrepreneurship (Battilana et al., 2009; Garud et al., 2007; Hardy and Maguire, 2008) containing a less pronounced idea of the importance of a "hypermuscular entrepreneur": "*The concept of institutional work highlights the intentional actions taken in relation to institutions, some highly visible and dramatic, as often illustrated in research on institutional entrepreneurship, but much of it nearly invisible and often mundane, as in the day-to-day adjustments, adaptations, and compromises of actors attempting to maintain institutional arrangements*" (Lawrence et al., 2009, p. 1).

The authors do not ignore the effects of institutions on actors, but put their attention on the consequences of actions for institutions. They propose to focus on the different types of actions that actors engage in to construct meaning, beliefs, rules or standards and thereby

¹ This relates to the question of how to assess the "semi-coherence" of a socio-technical regime. Fuenfschilling and Truffer (2014) propose to assess institutional heterogeneity by analyzing dominant discourses in a system. In the present paper, we want to complement this work by assessing the presence and strengths of institutions through the actual practices of actors.

² An organizational field describes the institutional setting of an actor that consists of "those organizations that, in the aggregate, constitute a recognized area of institutional life: key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar services or products" (DiMaggio and Powell, 1983, p. 148). Transition scholars have defined the level of analysis for socio-technical system to take place on the level of organizational fields (Fuenfschilling and Truffer, 2014, Geels and Schot, 2007).

³ In this paper institutions are defined as highly institutionalized structures. Structure is used as an umbrella term for things that influence an actor's behavior/cognition or the diffusion of practices (Tolbert and Zucker, 1999).

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