



The thorny road to technology legitimation – Institutional work for potable water reuse in California



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ABSTRACT

Technological innovation that is incongruous with established social rules and practices is often confronted with strong skepticism and a lack of societal legitimacy. Yet, how the early actors in a new technological field create legitimacy for new products is not well researched. This paper addresses this gap by proposing an analytical framework for the early technology legitimation phase that combines recent insights from innovation studies and institutional sociology. Both literatures agree that technology legitimation depends on a complex alignment process in which the technology and its institutional context mutually shape each other. Innovation system studies recently proposed to explore these processes in more detail. So far, this literature has mainly treated legitimacy as an outcome of overall system maturation and has not ventured into assessing legitimacy as an active process. The framework we put forward in this paper conceptualizes technology legitimation as being enacted by different actors in a technological innovation system through specific forms of institutional work. This framework is illustrated with a case study on potable water reuse, in this case the injection of treated wastewater into drinking water reservoirs – a technology most consumers confront with revulsion. California is among very few regions worldwide where this technology is becoming common practice. Interviews with 20 key stakeholders and content analysis of 124 newspaper articles reveal how technology proponents worked on legitimizing this controversial technology by engaging in system building and institutional work at various levels. We outline how the legitimation process interrelates with other core development processes of a technological innovation system and discuss how our framework informs recent work in innovation and transition studies.

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1. Introduction

Technological innovation and new industries struggle with a crucial problem in their early development phases: the “liability of newness” (Freeman et al., 1983; Suchman, 1995). New technologies that are in conflict with established norms and regulations, incomprehensible to a wider audience, or provide intangible benefits to end users, are likely confronted with major doubts about their utility and reliability (Freeman et al., 1983). The proponents of such innovation have to spend considerable energy in translating and explaining their visionary ideas and in challenging and shaping taken-for-granted beliefs to overcome these barriers. This process can be conceptualized as the creation of technology legitimacy (Markard et al., 2015; Aldrich and Fiol, 1994).

Technology legitimation is more complex than simply marketing beneficial qualities of a new product to end users – which is often associated with creating user acceptance (Wuestenhagen et al., 2007; Venkatesh et al., 2003; Dolnicar et al., 2011). Whereas established technologies are strongly aligned with institutional structures to form ‘configurations that work’ (Rip and Kemp, 1998) or ‘socio-technical regimes’ (Geels, 2002), new technologies are often incongruous with these structures. The degree of incongruence depends proportionally to how strongly a new technology contradicts established worldviews, norms and societal roles of users, regulators, or engineers.

Proponents of an institutionally incongruous new technology can react to this problem in two ways: either by adapting the technology's characteristics to match existing rules or by attempting to change the rules to fit the requirements of the technology (Smith and Raven, 2012). Technology studies have presented evidence that both processes often take place simultaneously over the course of the development of a new technology. Major innovations in modern history, like bicycles,

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electric lighting, steamships, and cars, were profoundly incongruent with the dominant regimes at their time of introduction. The historical trajectory of these technologies illustrates how legitimacy was gradually established in a long phase of social contestation and collective sense-making, and how this legitimation process directly influenced the development of the technology (Geels, 2002; Bijker, 1995; Hargadon and Douglas, 2001).

Given legitimacy's key role in the innovation process, innovation studies have increasingly endorsed it as a central explanatory factor for the success or failure of new technologies and industries (Markard et al., 2015; Geels and Verhees, 2011; Bergek et al., 2008a; Hekkert et al., 2007; Bork et al., 2015). Existing accounts broadly characterize legitimacy as a match (or mismatch) of a technology with institutional structures in the relevant societal peer groups (Markard et al., 2015; Aldrich and Fiol, 1994).¹ In innovation studies, the legitimation process has so far mainly been analyzed at a macro-level, e.g. through framing struggles in public discourse (Geels and Verhees, 2011), as the outcome of actor accumulation in a wider innovation system build-up process (Bergek et al., 2008a; Hekkert et al., 2007) or as the interplay of new technological fields with wider institutional 'contexts' (Markard et al., 2015). These approaches provide useful macro-indicators for the existence or absence of legitimacy in new technological fields, but tend to treat legitimacy as an aggregate state variable, which is often almost synonymous with overall success or failure of an innovation. How legitimacy is actively built up through the interplay of different actor groups in the early stage of a new technology and industry, however, is much less analyzed. In the present paper, we attempt to address this gap by developing a more micro-level understanding of technology legitimation. We will accomplish this by specifying the innovation system function 'creation of legitimacy' into several sub-processes that are available to actors in a technological innovation system (TIS). By this we will present an operationalization of this otherwise rather broad process category in TIS research.

The proposed analytical framework builds on recent insights from organizational institutionalism, which has developed detailed conceptual perspectives on how legitimacy is created and maintained for organizations, social structures or individuals (Suchman, 1995; Zelditch, 2001; Jost and Major, 2001; Johnson et al., 2006). We argue in line with this literature that technology legitimation has to be conceptualized as a process in which heterogeneous actor networks fight over, construct and deconstruct alignments between a new technology and prevailing institutional contexts (widely held social norms, preferences and cognitive associations). The relevant actions and strategies can be conceptualized as different forms of institutional work (Lawrence et al., 2009; Fuenfschilling and Truffer, 2016). Combining the practice-focused perspective of institutional work with the more meso-level oriented technological innovation system literature allows us to derive detailed, process-based explanations on how technology legitimacy is constructed during the industry formation process. In contrast to existing TIS studies, which often treat legitimation as synonymous with system maturation, it also enables a more fine-grained analysis on how legitimation impacts other core innovation system build-up processes. In more general terms, this publication is thus a first attempt to explicitly bridge innovation system studies and the literature on institutional work.

Our framework is illustrated with a case study in the field of potable water reuse in California. Potable water reuse can be considered an institutionally highly incongruent innovation that contradicts strongly held social beliefs and norms. Potable water reuse is technically defined as the "augmentation of a drinking water source with reclaimed wastewater" (National Research Council, 2012). The innovation comprises purifying wastewater (including sewage) and introducing it into drinking water supplies like groundwater basins, surface reservoirs or drinking water networks. Especially in arid regions, this technology promises significant environmental and economic benefits compared to more energy-

intensive alternatives like seawater desalination or long-distance water transfer (Tchobanoglous et al., 2011; Leverenz et al., 2011; Schroeder et al., 2012). Yet, due in part to the strong social stigma related to sewage (the 'yuck-factor'), potable reuse projects oftentimes raise fervent public opposition (Hurlimann and Dolnicar, 2010a). In a related paper, we analyze the basic conditions that may encourage or hinder organized opposition (Harris-Lovett et al., 2015). In this paper, we focus on the process through which actors in Southern California aimed at establishing purified wastewater as a legitimate source of drinking water. The analysis builds on in-depth interviews with 20 key experts in California's potable water reuse sector, content analysis of 124 local newspaper articles, and a comprehensive review of secondary data sources. The case study examines how the actors in an emerging innovation system engaged in collective system building, as well as long-term and multi-dimensional institutional work to legitimize this innovation.

The remainder of the paper is structured as follows: we first present innovation studies' and institutional theory's take on legitimation and argue why a more elaborate conceptualization of the technology legitimation processes is needed. Section 2 combines these perspectives into a conceptual framework emphasizing system building and institutional work. We then introduce our empirical case study and methods, and scrutinize the legitimation of potable water reuse in California in more detail. Sections 4 and 4.4.3 discuss the proposed framework, outline its contribution to innovation and transition studies, and derive stylized lessons for policy makers.

2. Theoretical background and analytical framework

Legitimacy is a key concept in sociology, political sciences and organization studies (Zelditch, 2001; Jost and Major, 2001). It is commonly defined as "a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (Suchman, 1995: 574). This definition locates the source of legitimacy beyond the boundaries of individual actors or organization in widely shared social belief systems (Johnson et al., 2006) and institutional contexts (Scott, 2008). Technology legitimation accordingly depends not on single actors, but on collective action among different organizations that "exert major pressures on the normative order by joining together to actively proselytize for a morality in which their outputs, procedures, structures and personnel occupy positions of honor and respect" (Aldrich and Fiol, 1994). Collective action in emerging technological fields has been analyzed in depth by innovation system studies (Bergek et al., 2008b), whereas the processes that lead to change in existing social structures are the hallmark of institutional sociology (Lawrence et al., 2009). In the remainder of this section, we put these two views in dialogue with each other to develop a more comprehensive analytical framework for technology legitimation.

2.1. Technology legitimation in innovation system studies

Innovation studies, socio-technical transition literature, and in particular the literature on technological innovation systems (TIS), recently started scrutinizing technology legitimation in some detail (Markard et al., 2015; Geels and Verhees, 2011; Bergek et al., 2008a; Hekkert et al., 2007; Bergek et al., 2008b).² In a TIS conceptualization, an emerging industry's success in diffusing its new products depends on the emergence of a supportive innovation system around the new technology. Especially in radically new technological fields, innovators are confronted with a complex systemic innovation problem: Knowledge about the innovation is not readily available, markets and user groups are not well-articulated, investment and social capital are scarce and the innovation lacks legitimacy. Early entrepreneurs thus have to engage in collective

¹ Institutions are understood not as organizations, but as the regulative, normative and cultural-cognitive 'rules of the game' in social structure (Scott, 2008).

² TIS are defined as "a network of agents interacting in a specific economic/industrial area under a particular institutional infrastructure or set of infrastructures and involved in the generation, diffusion, and utilization of technology" (Carlsson and Stankiewicz, 1991).

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