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The structuration of socio-technical regimes—Conceptual foundations from institutional theory

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ABSTRACT

In recent years, socio-technical transitions literature has gained importance in addressing long-term, transformative change in various industries. In order to account for the inertia and path-dependency experienced in these sectors, the concept of the socio-technical regime has been formulated. Socio-technical regimes denote the paradigmatic core of a sector, which results from the co-evolution of institutions and technologies over time. Despite its widespread acceptance, the regime concept has repeatedly been criticized for lacking a clear operationalization. As a consequence, empirical applications tend to depict regimes as too 'monolithic' and 'homogenous', not adequately considering persistent institutional tensions and contradictions. These are however crucial for assessing transition dynamics. In this paper, we revisit two concepts from institutional theory that enable an explicit identification of socio-technical regimes and more generally a specification of the 'semi-coherence' of socio-technical systems. First, we will show that 'levels of structuration' can be conceptualized as degrees of institutionalization, thereby treating institutionalization as a variable with different effects on actors, the stability of the system and thus the potential for change. Secondly, we draw on the institutional logics approach to characterize the content of various structural elements present in a system and to trace conflicts and contradictions between them. We illustrate this approach with an empirical in-depth analysis of the transformation of the Australian urban water sector since the 1970ies.

1. Introduction

The emergence of persistent environmental problems worldwide has raised the question of how to induce a societal and industrial transformation towards more sustainable production and consumption processes. Especially utility sectors, such as water, energy or transportation, are confronted with problems of resource scarcity, climate change and environmental degradation and are therefore facing a growing number of transformation pressures. New technologies or governance modes, economic deregulation and changes in consumer behavior have been introduced in many places to relief pressing problems. However, in most cases, transformation is slow or even failing. Technologies do not diffuse, governance concepts are implemented on paper only, deregulation causes high uncertainties and consumers do not act as planned.

In recent years a scientific community has evolved that deals with questions regarding transitions towards sustainability (Markard et al., 2012; van den Bergh et al., 2011). Research has shown that change in these sectors is a complex and intertwined long-term process that affects actors, technologies and institutions at the same time. Based on insights from evolutionary economics, science and technology studies and sociology, various approaches have been developed that analyze and conceptualize change from a socio-technical systems perspective.[1] The systems concept emphasizes the interdependence and co-evolution of material and social structures, such as policies, culture, technologies or markets, which over time evolve into a stable configuration that enables the fulfillment of a societal function like water or energy provision. The main challenges for a transition are thus to overcome the rigidities

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[1] The field of sustainability transition studies that is referred to in this paper mainly includes the following four research strands: strategic niche management (Kemp et al., 1998), transition management (Loorbach, 2007; Rotmans et al., 2001), multi-level perspective (Geels, 2002, 2004), and technological innovation systems (Bergek et al., 2008; Hekkert et al., 2007). Other transition research, for instance in the field of political science (e.g. policy regime change) or the management and transition framework for the analysis of water governance regimes (e.g. Pahl-Wostl et al., 2010) are not considered.

and path-dependencies of already existing, highly institutionalized system structures and to build up new, more sustainable ones.

One of the central approaches that describes and analyzes such complex transformation processes is the multi-level perspective (MLP) (Geels, 2004; Geels and Schot, 2007; Smith et al., 2005). The model envisions socio-technical transitions to unfold through developments on three analytical 'levels': socio-technical regime, technological niche, and landscape. Based on evolutionary economic concepts, such as technological trajectories, routines or path-dependency (Dosi, 1982; Nelson and Winter, 1982), as well as sociological insights on institutions and structure (Giddens, 1984; Powell and DiMaggio, 1991), the concept of the regime accounts for the persistence and rigidity of structures within a system:

> "*The socio-technical regime forms the 'deep structure' that accounts for the stability of an existing socio-technical system. It refers to the semi-coherent set of rules that orient and coordinate the activities of the social groups that reproduce the various elements of socio-technical systems*" (Geels, 2011, p. 5).[2]

The regime thus represents the so-called 'grammar' of the system, i.e. the highly institutionalized, yet not necessarily coherent formal and informal rules (e.g. shared beliefs and values, routines, regulations, institutionalized practices, capabilities, etc.) that mutually construct and are constructed by actors in a system (Geels, 2004, 2011). Due to the high level of alignment among the technical and social elements of a regime, innovations are typically incremental and develop along rather narrow trajectories. Radical innovations, on the other hand, only occur if they are protected from the structural pressures of a regime. The protected spaces in which the maturation of new technologies and the alignment with a suitable institutional context can take place have been called technological niches. Protection can for instance be provided by regulatory support (e.g. subsidies, research grants, etc.), adapted preference patterns of specific user segments or by other specially tailored institutional contexts (see Smith and Raven, 2012). A typical means for creating niches is the setup of experimental implementation projects (Hoogma et al., 2002). In the MLP, niches thus represent alternative socio-technical configurations, which have not (yet) achieved a strong degree of institutionalization, but potentially represent embryonic nuclei for future (radically different) regime structures. At last, regimes are also influenced and stabilized by external and often slowly changing societal structures (called landscape forces), which include things like cultural values, political ideologies, climate change or demographic transitions.

Landscape forces, regimes and niches can thus be differentiated by their degrees of structuration (very strong, strong and weak, respectively) and have therefore been called 'levels' (of structuration) in the MLP framework. The dynamic interplay between these 'levels' then leads to a whole set of different pathways of system transformation, ranging from incremental innovations to radical transitions (Geels and Schot, 2007; Smith et al., 2005). In simplified terms, it is assumed that (a) niche-innovations can increasingly create a sound institutional environment capable of competing with the established regime, (b) landscape developments put pressure on the regime and (c) as a consequence of these two developments, regimes may destabilize and give way to new socio-technical configurations. However, depending on the timing of these processes, the adaptive capacity of the regime and the nature of the niche and landscape pressures (reinforcing vs. disruptive), change unfolds differently (Geels and Schot, 2007). A transition is ultimately conceived of as a shift from one regime to another, i.e. from one highly structured socio-technical configuration to a new one. Classical examples are the reorganization of laws, technologies, business models and use patterns that occurred during the replacement of sailing ships by steam ships in the international sea transport sector, the change from horse-drawn carriages to cars as the dominant mode of land-bound transport, or the implementation of sewer systems to replace cesspool based evacuation of waste water (Geels, 2005a,b, 2006).

Since the MLP accounts for many aspects of societal and technological change simultaneously, it has become a popular framework to analyze transitions towards sustainability in many sectors, e.g. energy (Loorbach and Rotmans, 2010; Verbong and Geels, 2007), water (Brown and Keath, 2008) or transport (Geels, 2012). At the same time, various criticisms have been voiced by scholars, leading to a constructive discourse about merits and weaknesses of the model.[3] Scholars have particularly criticized the rather unsystematic operationalization and delineation of the 'levels' in most MLP studies as well as the conceptualization of regimes as too 'monolithic' and 'homogenous', not taking into account tensions, conflicts and incoherencies within systems (Berkhout et al., 2004; Genus and Coles, 2008; Markard and Truffer, 2008; Shove and Walker, 2010; Smith et al., 2005). In this paper, we thus want to elaborate on the operationalization and empirical assessment of socio-technical regimes in order to "*make the strength, homogeneity and internal alignment of regimes an empirical question rather than an assumption*" (Geels, 2011, p. 31).

In theory, the 'levels' are defined as "*(. . .) heterogeneous socio-technical configurations*" that "*(. . .) provide different kinds of coordination and structuration to activities in local practices*" and that "*(. . .) thus differ in terms of stability (and size)*" (Geels and Schot, 2010, p. 18). In other words, they represent "different degrees of structuration" (Geels, 2011) and therefore differ regarding their potential to influence actors and their activities. However, despite their key role in the conceptual set-up, the issues of structures and structuration have not attracted much attention in most previous MLP studies. Since the methodology for identifying 'levels' has not been spelled out explicitly, the empirical application of the model was repeatedly criticized as being fuzzy and sometimes rather arbitrary. For instance, scholars tend to delineate niches and regimes according to the maturity of technologies and actors (e.g. niche as synonym for emerging technologies and their supporters; regime coinciding with established technologies and incumbent actors), thereby assuming, rather than empirically assessing a low or high structuration for niches and regimes (Smith et al., 2005). In addition, most studies disregard a thorough description of the structures in a socio-technical system and how these structures interact or affect actors and activities. Since such an analysis is however necessary in order to display the tensions, conflicts and debates in a system, the presentation of the 'levels', and especially of the regime, has a tendency to be too homogenous and harmonious in the empirical accounts. As a consequence, transitions are too often depicted as linear stories of small scale, alternative technological innovations having to overthrow a unified block of regime

[2] While some scholars define the regime as to entail material and institutional elements of structures (Hoogma et al., 2002; Rip and Kemp, 1998), others have tended to mainly emphasize the institutional aspects in terms of semi-coherent rule sets (Geels, 2004). Either way, the original idea of the regime is to account for a high degree of structuration within a system. In this paper we thus understand the regime as referring to highly institutionalized structures which have a considerable effect on actors. For a critique on the incoherence of the regime definition see Smith et al. (2010) and Markard and Truffer (2008).

[3] Major criticisms include the flawed conceptualization of agency, inconsistent operationalization of regimes, over-emphasis of niche as driver for change, unclear conceptualization of landscape level, a misleading representation of levels as hierarchy and an implicit treatment of spatial dimensions. For an elaboration of these criticisms see Coenen et al. (2012); Genus and Coles (2008); Markard and Truffer (2008); Smith et al. (2005, 2010). For a summary and response to these criticisms see Geels and Schot (2007); Geels (2011).