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A mechanism based transition research methodology: Bridging analytical approaches

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ABSTRACT

This paper is motivated by the discussion in the literature about the strengths and weaknesses of the Multi-Level Perspective framework and aims to provide a response to a number of criticisms.

The paper proposes retroduction as a transition research methodology that is used to identify and test social mechanisms for their explanatory power. The methodology consists in the joint use of case study and system dynamics as modeling and simulation method. The paper discusses how the two methods are used iteratively, and each one complements the strengths and counters the weaknesses of the other. The methodology has particular strengths and implications for the agenda of issues that research on future transitions to sustainability faces currently.

1. Introduction

Sociotechnical transitions research is a relatively new field that places a particular focus on sustainability transitions (Coenen, Benneworth, & Truffer, 2012; Elzen & Wieczorek, 2005; Foxon, 2011; Markard, Raven, & Truffer, 2012; McMeekin & Southerton, 2012; Van den Bergh, Truffer, & Kallis, 2011). One of the most widely adopted transition research frameworks is the Multi-Level Perspective (MLP). MLP originates in the work of Rip and Kemp (1998) and has been developed subsequently in Geels (2002, 2004, 2005, 2010), Geels and Schot (2007), Geels, Kern et al. (2016), Markard and Truffer (2008) and Papachristos et al. (2013). The MLP has received a number of critical remarks some of which emphasize issues of agency and the need to develop its methodology (Genus & Coles, 2008; Smith, Stirling, & Berkhout, 2005; Shove & Walker, 2007; Vasileiadou & Safarzynska, 2010). Such a methodology should also improve the outline and measurement of niches, regimes and landscapes, the comparability of cases, and enable theory development in a cumulative way (Holtz et al., 2015; Smith, Voß, & Grin, 2010).

A number of these critical remarks merit further consideration and motivate this paper: methodological consistency in transition studies, transparency in conveying theory assumptions underlying research, the use of case study data, and the need to maintain the parsimony and tractability of the analysis (Genus & Coles, 2008; Smith et al., 2010). Related to the latter is the need to communicate the researcher's choices and make them more explicit, for example with regard to system boundary definition. The second motivation for the paper is to address the call for reflexive governance (Voss et al., 2006), particularly of future, multi-system transitions to sustainability perspective that requires an iterative process of problem definition, intervention and response.

MLP cases are primarily retrospective (Turnheim et al., 2015), so they must be bridged to other analytical approaches to address the multi-regime processes that may underlie future sustainability transitions (Geels, Berkhout, & van Vuuren, 2016). Reflexive governance requires an endogenous perspective and knowledge of the mechanisms that offer the best leverage to unlock and guide system change towards a desirable direction, anticipate and reorient ongoing transitions, and avoid niche lock-in to unsustainable trajectories (Smith et al., 2010). The need to identify and theorise transition mechanisms was identified early on (Geels, 2002), but

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very little research followed up on this (Geels & Schot, 2010; Papachristos & Adamides, 2016).

In order to address this gap and part of the MLP critique, this paper starts from a detailed conceptualization of transition mechanisms to achieve four aims. First, to address the call to study transition patterns and mechanisms (Geels, 2002). Second, to keep the MLP relevant for contemporary and future transitions by explicitly incorporating mechanisms in transition research, a requirement for reflexive governance. Third, to address a number of critical remarks the MLP received and increase confidence in the use of the framework. Finally, to develop a mechanism based approach that will bridge case studies and modelling and simulation, and provide the necessary prospective character for the study of future sustainability transitions.

The concept of mechanisms is discussed on several literature streams including analytical sociology and critical realism (Archer, 1995; Archer, 2000; Hedstrom & Bearman, 2011; Archer, Bhaskar, Collier, Lawson, & Norrie, 1998; Hedström & Swedberg, 1998; Mingers & Standing, 2017). Transitions unfold under major economic changes, and mechanism based theorizing is an appropriate style of organizational research under such conditions (Davis & Marquis, 2005). Identifying causal mechanisms, or "process tracing", in transitions is an appropriate approach when explanatory and independent variables are temporally separated (Bennett and Checkel, 2014a, 2014b; Mahoney, 2000). The paper proposes retroduction as a research methodology to address the call to identify particular patterns and mechanisms in transition processes (Geels, 2002). Retroduction is a metaprocess through which an explanation for a particular phenomenon is developed by identifying and/or postulating mechanisms that can generate it (Collier, 1994; Bhaskar, 2008; Sayer, 1992, 2000).

The application of retroduction to sociotechnical transitions faces challenges due to their complexity, and the difficulty to identify mechanisms in operation, and deduce their effects (Hedström & Swedberg, 1998; Hedstrom & Bearman, 2011). In this respect, modelling and simulation has been proposed as a complementary methodological tool to transition case studies (Papachristos, 2014). Thus, this paper aims to bridge the rich qualitative case research used at present with deductive simulation research, where inductive theory building from cases produces new theory and deductive theory development tests it, thus completing the cycle (Eisenhardt & Graebner, 2007).

Recent work on scenarios, narratives and modelling points to the potential to bridge research methodologies but does not discuss mechanisms and therefore it is not detailed (Geels, Berkhout et al., 2016; Turnheim et al., 2015). Some papers provide a generic overview (Geels, Berkhout et al., 2016; Turnheim et al., 2015), others use narratives and established linear optimization models rather than simulation models (Mcdowall, 2014), or use a combination of different optimization and simulation models (Trutnevyte et al., 2014), or are domain specific and do not address the fundamentally iterative nature of synchronous narrative and model co-development (Moallemi, Aye, de Haan, & Webb, 2017; Moallemi, de Haan, Kwakkel, Aye, 2017).

The paper argues that the application of the retroductive methodology in sociotechnical transitions research will: (i) help to identify common mechanisms across cases, context and time, (ii) equip the MLP methodologically to address contemporary and future sustainability transitions of multi-energy systems, where small changes in one system may induce major ones in others (Mancarella, 2014), (iii) provide a response to the critique of MLP, and increase confidence in understanding transitions, and (iv) bridge case study and modelling and simulation, and increase the transparency of research design choices, for example with regard to system boundary definition.

The contribution of the paper, along with the retroductive methodology proposed, is the definition and extensive discussion on mechanisms, which in turn enables the provision of guidelines for how to conceptualise, search, and when to stop the search for transition mechanisms in a case. Such guidelines are missing in prior transition research despite the explicit, early call to identify transition patterns and mechanisms (Geels, 2002). The paper outlines the implications, synergies, strengths and weaknesses of bridging case study work and modelling and simulation, induction and deduction (Van de Ven, 2007), and provides a process overview of how the two can work together.

Retroduction with simulation has been applied previously in Papachristos and Adamides (2016) and the argument for using simulation in transition research put forward in Papachristos (2014). The present paper provides a more thoroughly thought out and mature piece on a transition methodology. First, it outlines the criticism that the MLP has received, and that the proposed methodology aims to address. The paper provides an outline of how case studies and modelling and simulation can be combined on pragmatic grounds (Tashakkori & Teddlie, 1998), and co-developed in a transition study, something that previous attempts have not done (e.g. Holtz, 2012; Trutnevyte et al., 2014). System dynamics is considered as a modelling methodology due to its alignment with social science application (Lane, 1999), but the same kind of argument could be developed for agent based modelling. While the paper focuses on the MLP, the proposed methodology may be equally appropriate for application to Functions of Innovations Systems studies (Bergek, Jacobsson, Carlsson, Lindmark, & Rickne, 2008; Hekkert, Suurs, Negro, Kuhlmann, & Smits, 2007).

The rest of the paper is structured as follows. Section 2 offers an overview of the MLP, of the criticism it has received, and singles out the particular points that the proposed methodology aims to address. Then Section 3 sets the scene for the methodology and provides an overview of mechanisms and retroduction. Section 4 discusses retroduction and why modelling and simulation is needed, and 5 discuss the methodology. Section 6 concludes the paper.

2. Sociotechnical transitions: the MLP framework

The MLP is a framework for the study of sociotechnical system change, with a focus on system interconnections and the dynamics of social groups that influence technological change and inertia. The central analytical MLP concept is the sociotechnical regime, which facilitates analysis of what underlies the activities of actors who reproduce system elements. The actors are embedded in interdependent social groups, each with its own regime (set of rules). The MLP distinguishes between technological, culture, science, markets, industry and policy regimes (Geels & Schot, 2007). The sociotechnical regime refers to the inter-regime alignment and