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Explaining sociotechnical transitions: A critical realist perspective

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ABSTRACT

This paper identifies and evaluates the explicit and implicit philosophical assumptions underlying the so-called multilevel perspective on sociotechnical transitions (MLP). These include assumptions about the nature of reality (ontology), the status of claims about that reality (epistemology) and the appropriate choice of research methods. The paper assesses the consistency of these assumptions with the philosophical tradition of critical realism and uses this tradition to highlight a number of potential weaknesses of the MLP. These include: the problematic conception of social structure and the misleading priority given to intangible rules; the tendency to use theory as a heuristic device rather than causal explanation; the ambition to develop an extremely versatile framework rather than testing competing explanations; the relative neglect of the necessity or contingency of particular causal mechanisms; and the reliance upon single, historical case studies with insufficient use of comparative methods. However, the paper also concludes that the flexibility of the MLP allows room for reconciliation, and provides some suggestions on how that could be achieved – including proposing an alternative, critical realist interpretation of sociotechnical systems.

1. Introduction

Research in innovation studies is increasingly focused on the challenge of sustainability – and in particular, the threat posed by climate change. Given the scale of this challenge, it is clear that an effective response will require more than developing and adopting cleaner technologies. Instead, major changes will be required in multiple aspects of the energy, transport, food and other systems that form the basis of industrialised societies. Innovation research has therefore focused increasingly upon how these systems function and how they may undergo far-reaching change (Van den Bergh et al., 2011). The growing literature on these so-called ‘sociotechnical transitions’ has a range of antecedents and takes a variety of forms, but has increasingly coalesced around a particular theoretical framework: the so-called *multilevel perspective on sociotechnical transitions* (MLP) (Geels, 2002a).

The MLP seeks to explain highly complex, non-linear processes that unfold over many decades, involve multiple social groups and technical artefacts; have unclear boundaries in space and time and lead to uncertain and contingent outcomes. It seeks to track changes in complex systems along several dimensions; and to explain those changes as the result of the alignment and mutual reinforcement of a variety of processes operating at a number of levels. To identify those processes, the MLP draws upon a large and growing range of social scientific theories, several of which employ different and potentially incompatible

foundational assumptions (e.g. evolutionary economics and the social construction of technology). This theoretical development informs and is informed by a series of qualitative, historical case studies that typically focus upon single rather than comparative cases and rely primarily upon secondary data (e.g. Geels, 2002a, 2006a).

Since its inception in the early 2000s, the MLP has proved enormously successful, attracting interest from researchers from a wide range of disciplines and stimulating a wealth of theoretical developments and empirical applications.¹ The policy implications of this work have proved more difficult to identify and to communicate, but initial success in the Netherlands (Loorbach and Rotmans, 2010) has been followed by broader interest, including from the OECD (OECD, 2015; EEA, 2016).

Given this range of activity, it is increasingly difficult to keep track of developments and to assess the contribution that the MLP has made. In this context, this paper seeks to take a step back. Instead of applying the MLP to new empirical topics or ‘enriching’ it with new theoretical ideas, the paper seeks to identify and evaluate the philosophical assumptions that underpin the MLP. These include the explicit or implicit assumptions about the nature of reality (ontology) and the status of knowledge claims about that reality (epistemology), together with the corresponding recommendations for research methodology. These assumptions are insufficiently discussed by practitioners or users of MLP-based research, and deserve more consideration.

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¹ Indicators of this interest include the establishment of an academic journal (*Environmental Innovation and Societal Transitions*) and research network (*Sustainability Transitions Research Network*) that prominently feature MLP-based research.

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To achieve this, the paper introduces a particular philosophy of science, known as critical realism (Bhaskar, 1975, 2014). Although widely used within the social sciences, critical realism has had little influence upon innovation studies. In crude terms, critical realism seeks to bridge some long-standing divisions within the social sciences – such as between positivism and interpretivism. More technically, critical realism combines an ‘ontological realism’ (the claim that phenomena exist independently of our knowledge of them) with ‘epistemological relativism’ (the claim that human knowledge is socially produced, historically transient and fallible) and ‘judgemental rationalism’ (the claim that there are rational grounds for preferring some theories and explanations over others). (Bhaskar, 1975). From a critical realist perspective, the primary objective of social scientific research is not to predict or to interpret but to *explain* – in other words, to develop empirically supported theories and hypotheses about how, why and under what conditions particular phenomena occur. Good explanations will include reference to: the (real) physical and social entities that are considered to be relevant; the relationships between the constituent parts of those entities; the causal powers that result from those relationships; and the contingent combinations of entities and powers that are responsible for particular events (Elder-Vass, 2010). Humean models of causation that rely solely upon correlations between observed events do not meet these explanatory criteria (Lawson, 1997). Neither do they the ‘as if’²; models proposed by some economists or the ‘heuristic devices’³; proposed by some sociologists (Lawson, 1997).

The paper argues that critical realism can help to clarify some of the strengths and weaknesses of the MLP, including the validity of claims about the nature and properties of sociotechnical systems, the appropriate criteria for justifying those claims and the relative usefulness of different research methods. Since the MLP is not a homogeneous body of thought, the paper focuses primarily on the work of the leading author in the field – Frank Geels – who has gone further than most in discussing the philosophical foundations of the MLP (e.g. Geels, 2010, 2009). However, the paper is also informed by the broader MLP literature, including studies that have been more critical of its core assumptions (Genus and Coles, 2008; Markard and Truffer, 2008; Shove and Walker, 2007).

The paper organises the evaluation of the MLP around six issues, namely:

1. the distinction between sociotechnical systems and sociotechnical regimes;
2. the conception of social structure and the priority given to ‘rules’;
3. the definition and boundaries of sociotechnical systems and regimes;
4. the status of the MLP as a ‘heuristic device’;
5. the necessity or contingency of particular causal mechanisms; and
6. the validity of narrative explanation.

The first three of these are ontological while the remainder are epistemological and/or methodological. In each case, the paper highlights inconsistencies between the nature and application of the MLP and the philosophy of critical realism and uses this to highlight some limitations of the MLP. But the paper also suggests that the flexibility of the MLP allows room for reconciliation, and provides some suggestions on how that could be achieved.

At the time of submitting this paper, there had been no previous

² Exemplified by the following statement by Milton Friedman “... Consider the problem of predicting the shots made by an expert billiard player. It seems not at all unreasonable that excellent predictions would be yielded by the hypothesis that the billiard player made his shots as if he knew the complicated mathematical formulas that would give the optimum directions of travel, could estimate accurately by eye the angles, etc., describing the location of the balls, could make lightning calculations from the formulas, and could then make the balls travel in the direction indicated by the formulas....” (Friedman, 1953)

³ “... This signifies a concept or idea that is used not so much because it is well supported by the evidence but because it helps us think about the problem...” (Bruce and Yearley, 2006)

evaluation of the MLP from the perspective of critical realism. But during the review process, Svensson and Nikoleris (2018) published a critical realist critique of the ontological foundations of the MLP, focusing in particular on the conception of social structure. As such, Svensson and Nikoleris primarily address point 2 above, although they also make a number of comments on methodology. Their insightful critique is entirely consistent with the arguments that follow, so the two papers should be regarded as complementary. A number of references to Svensson and Nikoleris have therefore been included in what follows.

The remainder of the paper is structured as follows. Section 2 provides an overview of the MLP, illustrating its basic insights and claims with the help of a practical example and summarising its three core analytical concepts – niche, regime and landscape. Section 3 provides an introduction to critical realism, highlighting key ideas such as the concept of emergence. Section 4 identifies the implicit ontology of the MLP and indicates a number of important difficulties, including: the lack of clarity in defining sociotechnical systems and sociotechnical regimes; the problematic attribution of causal priority to the regime; and the reliance upon a theory of social structure (structuration) that effectively conflates structure and agency and downplays the importance of social relations. Section 5 does the same for epistemology and methodology, and highlights the tensions between the use of MLP as a heuristic device and as a causal explanation, the lack of attention to the necessity or contingency of different causal mechanisms and the limitations of ‘narrative explanation’ and ‘process theory’ as a model for MLP-based research. Section 6 summarises the key findings and briefly suggests how future research could address some of these limitations.

2. Sociotechnical systems and transitions

The MLP begins with the observation that ‘societal functions’, such as personal transport, electronic communication, water supply and housing are provided by a cluster of interlinked social and technical entities⁴ that are collectively termed a *sociotechnical system* (Geels, 2002a). Relevant entities include technologies, firms, supply chains, infrastructures, markets and regulations. Sociotechnical systems develop over many decades and the alignment and co-evolution of the different entities and practices leads to mutual dependence and resistance to change (Geels, 2002a, 2012; Geels et al., 2012). However, the primary source of stability in these systems is claimed to be the shared rules, norms, expectations and beliefs that guide the behaviour of the different actors within the system – termed the *sociotechnical regime*. *Sociotechnical transitions* are defined as major transformations in these regimes/systems. These typically involve major changes in the technologies that form the core of the system, but they also – and necessarily – involve interlinked changes in many other parts of the system, together with far-reaching changes in the underlying rules and norms (the regime).

To make these ideas more concrete, take the example of the car-based transport system providing the societal function of personal mobility (Geels et al., 2012; Sorrell, 2015). This system is centred on an individual artefact – the car – but this artefact is linked to and dependent upon multiple social and technical entities at a variety of levels. These include, but are not confined to: the global car industry and its many associated supply chains; the car maintenance and distribution network; the global oil industry and the associated infrastructure of oil wells, refineries, pipelines and fuel stations; the road infrastructure and associated industries; the patterns of land use that have developed around that infrastructure, including amenities and workplaces that are only accessible by car; the multiple institutions, regulations and policies associated with the production and use of cars; the engineering skills and knowledge built up over decades in a variety of domains; the

⁴ The generic term ‘entity’ is not commonly used within the MLP literature, but is used here to facilitate comparison with critical realism.

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