



Can cities shape socio-technical transitions and how would we know if they were?

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ABSTRACT

This paper asks two – relatively simple – questions: can cities shape socio-technical transitions? And how would we know if they were? There are three key objectives. The first of these is to set out emerging, and in our view, convincing evidence, that large world cities have political aspirations to develop purposive and managed change in the socio-technical organisation of infrastructure networks that can be characterised as ‘systemic’ transitions. The second objective is conceptual in orientation and seeks to address how we understand transitions at the scale of the city, the role of ‘the city’ in undertaking transitions, and review both the strengths and shortcomings of the multi-level perspective (MLP) on socio-technical transitions in addressing this. The third objective is to identify what an urban transition would look like, and then constructs a new framework to conceptualise and research urban transitions. The paper then summarises the key aspects and implications of our argument.

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1. Introduction

In the last two decades cities have been transformed in ways which have been characterised as their ‘re-emergence’, ‘renaissance’ and ‘entrepreneurialism’ (see Harvey, 1989; Jessop, 1997). Critical infrastructures of energy, water, waste and transport have been fundamental in supporting this ‘re-emergence’. Until recent decades the provision and organisation of these critical infrastructures was largely perceived unproblematically, and taken for granted as largely engineering challenges and administrative issues (Graham and Marvin, 2001). More recently, however, a series of economic, ecological, population and institutional constraints have produced new challenges and pressures on urban growth and to the management of cities’ critical infrastructures. Though these pressures are generic their presence may be experienced differentially across cities and also within cities. In particular we are interested in the urban responses to these pressures and what this means for the future configurations of the social and technical organisation of infrastructure systems in cities.

In this paper, therefore, we critically examine the under-explored relationship between the multi-level perspective (MLP) on socio-technical transitions (Geels, 2004; Elzen et al., 2004) and a particular class of world cities (Sassen, 2001) where pressures to undertake socio-technical transitions in infrastructure systems, we

argue, are particularly pronounced. We draw upon examples from world cities as there is strong evidence of expectations, aspirations and plans to undertake purposive socio-technical transitions in a number of these cities. In doing this we specifically examine the complementarities and the shortcomings of the MLP’s conceptualisation of long-term transitions in socio-technical systems with a relational and multi-level governance informed understanding of the production and re-production of cities. Addressing these issues requires that we understand the generic pressures contemporary cities are faced with, outline the dominant urban strategic responses to these pressures, and ask how they are constituted and with what consequences. It also means that we do not merely accept the ‘obviousness’ of these strategies. This necessitates that we detail alternative ways to constitute responses at a city-scale which recognises that urban infrastructure transitions require new and effective forms of urban knowledge to be interactively produced, communicated and appropriated.

We do this in order to more clearly conceptualise the role of cities within systemic socio-technical transitions and to enhance our understanding of this. Consequently, the paper seeks to answer the following question: can cities configure systemic change in socio-technical networks and how would we as researchers know? The paper is structured in four sections. The first section sets out convincing evidence that world cities are seeking to develop ‘systemic’ transitions in ‘their’ infrastructures. The second section outlines the key concepts of socio-technical transitions, the role of the MLP in understanding transitions and assesses the strengths and limits of what the MLP has to say about cities and socio-technical transitions. It does this to provide a context for the third

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section which is conceptual in orientation and seeks to address how we understand the role of 'the city' in undertaking urban transitions and, in doing so, proposes a researchers framework for how we would conceptualise and understand urban transitions. Finally the last section sets out the key conclusions of the paper.

2. Emerging purposive and systemic transitions in world cities' infrastructures?

Through research work that we have undertaken in London, New York, Tokyo, San Francisco and Melbourne (between 2006 and 2009) there is evidence of attempts to purposively reconfigure socio-technical systems of infrastructure provision at the scale of these large cities. Through programmes of systematic documentary analysis of policy and strategy documents in each city and over 60 interviews with policymakers, representatives of utilities, developers and NGOs we have sought to understand how 'cities' are developing and endeavouring to enact strategic responses to a set of 'landscape' pressures through the managed reconfiguration of socio-technical infrastructures both within the metropolitan areas and externally through their relations with other scales.

Through our work, not only in these cities but also at a national level, it is becoming increasingly clear that a series of 'new' socio-economic and political problems are pushing issues of ecological security up the agenda of national governments. This includes challenges posed by, for example, climate change such as the growth of new diseases, and constraints on water resources and questions around energy security. The critical issue for national governments is the ability to ensure that they have secure and continued access to the resources needed to ensure their economic and social reproduction. Questions about the security of ecological resources have become internalised and intertwined with national states' priorities and responsibilities for social welfare and economic competitiveness. Yet these are also increasingly becoming issues at an urban scale. In an era of intensified economic globalisation national states increasingly have strategic, variable and multiple relationships with their territories (Brenner, 2004).

This then provides the wider context within which we need to understand a set of contemporary pressures facing cities. These can be understood as a series of interrelated issues, which includes attempts to maintain economic growth in a context of economic globalisation where 'competition' between places is encouraged. Furthermore, this push for 'competitiveness' and place-based competition is occurring whilst established energy, water, waste and food resources that underpin economic growth are increasingly constrained and the basis of re-continued geo-political struggle and subject to securitisation (Dalby, 2007). It is no accident that these challenges are emerging at a time where the majority of the world's population, for the first time in human history, now lives in cities. This is a trend that is predicted to increase to over 60 per cent by 2030 (United Nations, 2006). Yet, these trends towards encouraging urban economic growth in a context of constrained resources and climate change meet infrastructural systems and legacies that were frequently developed a century and more ago in many western contexts.

Additionally with (the variable) privatisation and the liberalisation of many infrastructures and the opening up to competition of infrastructure provision – a wide range of distributed stakeholders and social interests are now involved in the functioning of socio-technical infrastructure systems (Graham and Marvin, 2001). The functioning of infrastructures is often seen from very many different viewpoints and positions – including utilities, local authorities, regulators, consumers, citizens, businesses, etc. – in respect of different issues – such as economic growth, climate change, resource

consumption – at many different levels – supranational political institutions, national government, regional agencies, local authorities, business, households and so on. 'Effective' responses to these pressures are thus predicated on multiple challenges, multiple actors and multiple levels that require effective coordination to inform control of infrastructure systems.

Increasingly it is particular coalitions of social interests – often and usually involving urban political, policy and business elites and decision-makers and to a lesser extent including NGOs and environmental justice groups – working within and/or through the world's largest and most powerful cities (e.g. London, New York, cities of the C40) that are developing a more strategic orientation towards critical questions about their future resource requirements and infrastructural implications. A new dimension of cities' competitive positioning is their ability to internalise, bound and control their resource requirements as they seek to ensure the security of their systems of collective provision. Cities are attempting to 'enclose' resources. The strategic response is leading to the development of new styles of infrastructure development that privilege particular spatial and socio-technical configurations of infrastructure. In a period of resource constraint and climate change the world's largest cities are beginning to translate their strategic concern about their ability to guarantee resources into strategies designed to reshape the city and its relations with resources and other spaces. From the research that we have undertaken we set out four propositions to highlight new style of infrastructure provision emerging in these world cities and to open up the debate about how we understand socio-technical transitions and the role of cities within them.

2.1. 'Managed socio-technical transitions at the level of world cities'

What this then means is that coalitions of interest alluding to world cities become strategically concerned – but not necessarily responsible in governance terms – for the longer-term security and resilience of socio-technical systems at a city-scale. These new pressures then translate into strategic responses as world cities and national government seek to develop particular types of systemic responses that reconfigure the city and socio-technical systems. Central to this we argue are five facets of these responses. First, there is a critical and particular concern for understanding the impact of climate change and resource constraint at the scale of the world city. Second, there is national prioritisation of world cities in national and other scalar responses to protect cities from the effects of climate change. Third, there is constant concern and anxiety about how global infrastructural agglomerations critical to world cities' logistics and aviation are dealt with in climate change terms. Fourth, world cities themselves become critically concerned with securing their own resources within their own national context. Fifth, world cities are positioned by national states and their own collaborative networks as contexts for developing innovative responses (i.e. urban transitions) to these issues with an aligned view that these responses can collectively be 'passed down' or 'transferred' to other cities in the urban system (Hodson and Marvin, 2009a). We argue that there are three emblematic configurations that are being developed in response to these pressures.

2.2. 'Ensuring the strategic protection of cities'

Central to the strategies of 'world cities' are investment in generating a systemic understanding of the city-specific and long-term effects of climate change, especially in relation to flood risk and temperature rise and the development of systemic responses through strategic flood protection, green infrastructure and retrofitting to deal with increased temperatures. Given the significant uncertainties about precisely how climate change-induced

effects will impact on particular places a premium is increasingly placed on how 'cities' develop the networks and relationships to develop new knowledge and intelligence (Luke, 2003). Significantly it is in the context of world cities that the most significant progress in generating such contextual knowledge, where climate change may shape the context within which the city develops but also more critically how longer-term access to critical resources and materials may be reshaped. Particularly emblematic of such approaches is the Thames Estuary 2100 study which aims to determine the appropriate level of flood protection needed for London and the Thames Estuary for the next 100 years.

2.3. 'Constructing self-reliant infrastructure'

Cities have sought to guarantee their reproduction by seeking out resources and sinks from locations usually ever more distant. Yet this traditional approach is now being challenged as cities seek to re-internalise resource endowments and create the re-circulation of wastes as they withdraw from reliance on international, national and regional infrastructures. Key examples are New York's strategy of energy independence, the recent doubling of decentralised energy targets in London and Melbourne's development of renewable powered desalination. Alongside such strategies, cities are attempting to reduce reliance through water and energy conservation and waste minimisation schemes, and by developing pricing mechanisms for car-based mobility and reducing reliance on 'external resources'. The new socio-technical configuration is similar to the concept of the autarkic or autonomous city. This new strategy is no longer based on stretching networks to search out resources more distant from cities but by a strategy of withdrawal and seeking greater independence through developing local resources. Such a socio-technical strategy combines both ecological and security priorities in a new strategy of attempts to guarantee secure urbanism and resilient infrastructure.

2.4. 'New networks of global urban agglomerations'

New networks of social interests speaking on behalf of world cities are constituting their interests in initiatives like the C40 and the Clinton Climate Initiative. Collectively these cities are working together to develop self-reliant urbanism. For example, they are developing common measurement tools so that cities can establish a baseline on their greenhouse gas emissions, track reductions and share best practice to inform mitigation and evaluation activities. By mobilising and networking expert assistance the self-stated objective is to help cities develop and implement programmes that will lead to reduced energy use and lower greenhouse gas emissions in areas including building efficiency, cleaner transport, renewable energy production, waste management, and water and sanitation systems. These 'world cities' are collectively building new global urban agglomerations of new mobility systems. At the same time as focusing on the protected space, bounding and enclosing resources, they seek to guarantee intra-city and inter-world city mobility through new technologies including pricing, transport informatics and new fuel systems based on hydrogen, bio fuels or complex hybrids. Cities like New York, Paris and Berlin are working collaboratively to develop new markets for testing and 'rolling-out' global agglomerations designed for world cities in order to guarantee mobility. Emerging socio-technical conceptions of the closed city seem to resonate unhelpfully with the increasing interconnectedness of cities, especially world cities, through global agglomerations of communications, airline and international shipping networks. Such networks are responsible for the most rapid growth in carbon emissions and because of the difficulty of dealing with such networks at the scale of a single city such emissions are usually excluded from local policy action (cf. London).

3. Socio-technical transitions, the MLP and cities

Consequently, we argue that there is emerging but convincing evidence that world cities are seeking to respond strategically to generic pressures by developing managed systemic change in the socio-technical organisation of key aspects of their infrastructure. Now we will examine how the multi-level perspective on socio-technical transitions can help us to understand the role of cities, identify the critical gaps that are not addressed and assess where the MLP would benefit from additional development.

3.1. MLP and system innovation

The MLP provides an ambitious attempt to develop understanding of 'system innovation' (Geels, 2002a,b). In doing this it situates technological transformation in relation to wider socio-political-economic 'systems'. Analytic understanding of these processes of 'system innovation' and socio-technical transitions is predicated on an interrelated three-level framework of landscape (macro), regime (meso) and niche (micro).

Socio-technical regimes, situate existing or incumbent technologies within a 'dynamically stable' (Geels and Schot, 2007) configuration of institutions, practices, regulations and so on, where configurations impose a logic, regularity and varying degrees of path dependencies on technological change. Regimes are seen as socio-technical in that technologies and technological functions co-evolve with social functions and social interests where technological development is seen to be shaped and potentially shaped by a broad constituency of not only technologists and engineers but also policymakers, business interests, NGOs, consumers and so on where the interrelationships of these interests through regulations, policy priorities, consumption patterns, investment decisions, amongst other things, hold together to stabilise socio-technical regimes and their existing trajectories (Geels and Schot, 2007). The emphasis on regimes, therefore, highlights the enablement and constraints on new technologies breaking through where 'reconfiguration processes do not occur easily, because the elements in a socio-technical configuration are linked and aligned to each other. Radically new technologies have a hard time to break through, because regulations, infrastructure, user practices, maintenance networks are aligned to the existing technology' (Geels, 2002a, p. 1258). Regime we may see not only as interrelated in the nested hierarchy of levels but also through patchworks of related regimes (Geels, 2002a,b), including, for example, science regimes, policy regimes, technological and product regimes, etc. (Geels, 2004).

The concept of 'landscape' is important in the MLP in seeking to understand the broader 'conditions', 'environment' and 'pressures' for transitions. The landscape operates at the macrolevel, focuses on issues such as political cultures, economic growth, macroeconomic trends, land use, utility infrastructures and so on (Geels, 2002b, p. 369) and applies pressures on existing socio-technical regimes creating windows of opportunities for responses (Geels and Schot, 2007). Landscapes are characterised as being 'external' pressures that have the potential to impinge upon but do not determine the constitution of regimes and niches. They create a broader context of opportunities and constraints within which actors and coalitions of actors operate:

The sociotechnical landscape is a broad context that sustains action and makes some actions easier than others. These external landscape developments do not mechanically impact niches and regimes, but need to be perceived and translated by actors to exert influence (Geels and Schot, 2007, p. 404).

The idea of socio-technical niches, which operate at a microlevel, is one of 'protected' spaces, usually encompassing small networks of actors learning about new and novel technologies and their uses, and seeking to get new technologies on to 'the agenda', where innovation and processes of learning by trying keep alive novel technological developments which otherwise may be 'unsustainable' (Geels, 2002b; Hoogma et al., 2002). The constitution of networks and the expectations of a technology they present are important in the creation of niches.

Adrian Smith and colleagues (Smith et al., 2005; Berkhout et al., 2003), whilst acknowledging the strengths of transitions approaches, make a thoughtful and constructive contribution to this debate. They question the view that regime change begins in niches and works upwards arguing that this underplays the importance of the relationship between landscape pressures and regimes. In particular they characterise regime change as being predicated on the ways in which shifting pressures impinge on a regime and the extent of the coordination of responses to these pressures both from inside and outside the regime.

In doing this they open up the issue of the governance (rather than government) of regime transformation in respect of agency and intervention in relation to both landscape and regime. They point out that landscape pressures can be articulated differently both in very general terms or in relation to specific regimes. It is not only the articulation of these pressures but also the adaptive capacity, or the relationships, resources and their levels of coordination that constitute a response to these pressures. The processes of these efforts to enact adaptive capacity can be seen as the governance of regime transformation and in doing so addresses the extent to which regime transformation is purposively informed or the outcome of historical processes (in effect the balance of the relationship between structure and agency). Highlighting the context of the regime in transitions, the importance of governance processes and the coordination of adaptive capacity opens up the possibilities for understanding a variety of transition pathways and in doing so raises the issue of the extent to which the pressures on the regime are responded to through resources and relationships incumbent within the regime or co-opted from outside the regime.

In working through these issues Smith et al. characterise four 'ideal types' of transition contexts as a means of thinking about regime changes. First, 'endogenous renewal' is characterised by highly coordinated responses of incumbent regime actors to perceived pressures on the regime, drawing upon endogenous or incumbent regime resources where regime change tends to be incremental. Second, a 're-orientation of trajectories' refers to regimes which encounter radical re-orientation, either from inside or outside the regime, not through the coordinated radical reconfiguring of regime relationships in anticipation of pressures on the regime but through what they term a 'shock' or a radical shift 'where governance focuses on internal regime functions, under situations in which pressures are poorly articulated and responses uncoordinated, regime transformations may tend to take this form' (Smith et al., 2005, p. 1501). Third, 'emergent transformations' appear to demonstrate an autonomous logic and occur through uncoordinated pressures for change and responses external to the incumbent regime. Where from a 'governance perspective, an emergent transition corresponds in an analytical sense to situations where poorly articulated selection pressures meet with uncoordinated responses' (Smith et al., 2005, p. 1502). Fourth, purposive transitions demonstrate a strong degree of intention in pursuing regime transition but largely involving coordinating actors and resources from outside the regime. Empirically regimes operate at different scales and levels of aggregation where at high levels of aggregation the regime may be seen as a 'spanning' or overarching regime constituted by numerous 'nested regimes' (Smith et al., 2005).

3.2. The absence of cities in multi-level transitions approaches

The multi-level perspective on transitions thus highlights the importance of the nested interrelationships of wider landscape 'environments', the stability and interrelationships of regimes and the innovative possibilities of niches. It outlines a way of thinking about the relationships, resources and practices, including technologies, institutions, skills, etc., which sustain existing configurations and regimes but also addresses processes of adapting and evolving such a regime in relation to 'pressures' for, and contexts of, new technological possibilities and innovations. In addition, the work of Adrian Smith and colleagues sensitises the MLP to different transition pathways and contexts. Yet despite an impressive breadth of focus on substantive areas as varied as transport, energy, water, waste and food systems (Hoogma et al., 2002; Verbong and Geels, 2007; van der Brugge and Rotmans, 2007; Geels, 2005; Green and Foster, 2005) frequently within a context of wider transitions to sustainability (Elzen et al., 2004) often with a focus on institutional and governance issues in relation to transitions (Voß et al., 2006) it remains less than clear as to the spatial scale that transitions approaches deal with.

Spatial scale frequently remains implicit or underdeveloped in the MLP and transitions approaches generally. The consequence of this is that we are often unclear about where transitions take place and, given the mutual shaping of system and social context, the spaces and places where transitions take place. That said, there is often at least an implicit emphasis on national scale transitions which requires understanding particular socio-technical national contexts and their historical, institutional and policy contexts and also the mechanisms, politics and processes through which attempts are made to steer transitions. Within the national view of transitions the role for sub-national scales (regions, cities, localities, etc.) is not always clear. Transitions approaches have been somewhat limited in focusing on spatial scales aside from the national level. In particular, transitions approaches have said little about cities and what the multi-level perspective on systemic transitions can contribute to understanding urban social-technical transitions. This is perhaps surprising given that it is estimated that more than half the world's population now lives in cities (United Nations, 2006), where cities are viewed as sites of intense economic activities and where it is claimed that the world's cities are responsible for significantly disproportionate amounts of greenhouse gas emissions (Stern Review, 2006).

The role of cities in transitions approaches is consequently uncertain, fragmented and often implicit (see Monaghan et al., 2009). This raises the issue of where cities 'fit' within the multi-level perspective and, in particular, where do cities sit within the landscape-regime-niche hierarchy? Indeed can they be encompassed by both regime and niche? That is to explore how innovative activities within cities interrelate with wider national and societal transitions:

- Initially then, do we conceive of cities as 'receiving' national transitions that are then 'implemented' in their own local context?
- If this is the case, can different configurations of social interests at the urban scale mediate national transitions – that is 'accelerate', 'reshape' or even 'disrupt' the implementation of national transitions in their local context?
- If cities can mediate national transitions can they then develop further capacity and capability to envision and enact their own locally developed transitions that are relatively distinct from national transitions?
- It is then even possible to conceive of cities developing transition initiatives at urban level that are 'taken up' by the national context and re-incorporated into new national transitions and

then cascaded downwards onto cities (see Hodson and Marvin, 2009b).

In view of the nestedness of regimes mentioned above – an urban transition can then conceivably form a variety of different types of relationships with national transitions. Central to this potential is the relative positioning of cities in terms of their position in urban hierarchies and governance capacity that means that cities have differential capacity to either be 'shaping of' or 'shaped by' national transitions.

Understanding the role of cities in a multi-level transitions perspective needs also to take seriously multi-level governance (see Bache and Flinders, 2004) and different scales of action. Agency at the level of the city cannot be reduced to understanding the variety and coalitions of actors (e.g. local authorities, mayors, universities, local economic actors, etc.) attributed to work at this scale. It also involves, and requires understanding of, the influence of actors at national and supranational scales of action who influence, both intentionally and through unintended consequences, action at a city-scale through the production of new state spaces (Brenner, 2004). To put it another way, there are multiple scales of governance action, with differing sets of power relations operating in the relationships between these scales of action and these power relations between different scales of action are variably constituted and organised in respect of different cities. Questioning critically these relationships between scales allows us to conceive of cities not merely as sites for receiving transition initiatives but also potentially as contexts for more purposive contexts for urban transition.

4. Understanding purposive urban transitions: a framework

Critically for us then the question is how do we address the relative neglect of cities in the MLP? Here we seek to address this critical gap by developing a framework for understanding the distinctiveness of purposive urban transitions.

A series of contemporary landscape pressures – including resource scarcity, responses to climate change, maintaining economic competitiveness, the struggle between public/private – whilst being exerted generically are being articulated more specifically in relation to cities, and in particular in relation to world cities (see Sassen, 2001; and also the collection by Brenner and Keil, 2006). This, of course, raises questions as to who is doing this and who is claiming to speak on behalf of these cities? As our series of propositions outlined above show, these pressures are becoming manifest in strategies of infrastructural transformation. What is particularly interesting here is that territorial priorities at the scale of the city – e.g. economic growth targets, carbon emissions reduction aspirations – are becoming strategically intertwined with the reconfiguration of socio-technical infrastructure systems which may, or more often, may not be organised at the scale of the city. That is to say that urban territorial social interests (municipal and local policymakers and officials in particular) may sit outside of socio-technical regimes but to achieve territorial priorities need to gain degrees of influence and control over regimes.

Consequently territorial governance priorities increasingly require degrees of control and influence over energy, water, waste and transport regimes. In terms of a purposive transition the issue this raises is the extent to which urban territorial governance priorities can effectively be coordinated and aligned with the priorities and social interests that constitute socio-technical regimes. With the notion of transition pathways in mind, the mutual constitution of urban territorial governance priorities and socio-technical regimes may vary across different cities. This is particularly so given (1) the different histories of the socio-technical organisation

of regimes and their relationships to cities and (2) the regulatory states and multi-level governance relationships, both 'internal' and 'external' to cities, which relationally constitute a view of, and a claim on, 'the city'. In respect of the former, there may or may not be or have been historically a strong role for the municipal state and metropolitan agencies in the organisation and provision of energy, water, waste and transport systems. There is the likelihood for a variable role both between cities and at different points in time. Relating to the latter, cities are enmeshed more or less strongly in multi-level governance relationships where, for example, cultures of centralisation (UK) or federalism (Germany) condition the nature of multi-level governance relationships.

The issue here is the degree to which there is 'separation' or alignment between territorial and regime priorities. To, use the language of the MLP, it is the extent to which the territorial priorities of an urban governance network – and the social interests that produce them – are able to actively manage socio-technical regime change. Linked to this is the need for an understanding of the existing organisation of socio-technical regimes and the degree of involvement of urban governance representatives within them; but also the necessity for understanding the potential for mutually reconstituting urban governance networks and socio-technical regimes. Yet, similar to the ways in which socio-technical regimes are constituted by complicated and often obdurate relationships, resources, regulations, artefacts and so on so too are urban governance networks.

In short, urban responses to these pressures will be variable. Cities and geographies will not only experience these challenges differently but also have historically organised infrastructure provision that may differ and a variable capacity at an urban scale to respond to the emerging pressures. Three issues are important here to understand whether an envisaged transition is predicated on a distinctly urban socio-technical regime, the degree of regime change required, the capability to enact such changes, and the ways in which there would be common understanding that it had been done. These are:

1. How the pressures are experienced and perceived in a particular city and by whom and how this translates in to a shared understanding of an urban socio-technical transition;
2. The current and historic organisation of infrastructure in relation to a city and the level of capacity and capability to develop and operationalise this shared understanding processually; and
3. The degree of learning that takes place within and about the urban transition.

4.1. Shared visions of urban transitions?

In thinking through what an urban transition would look like it is necessary to understand the extent to which there is a common and shared understanding amongst a wide range of social interests that produce territorial priorities and those of socio-technical regimes of energy, water, waste and transport infrastructures. 'Visions', which are a central part of prospective transitions management approaches (Kemp and Loorbach, 2005; Rotmans et al., 2001), offer the potential to both constitute and to present a shared understanding of territorial and regime interests. Visions of an urban transition may bring together both an understanding of the changes envisaged in a regime over time but in relation to territorial priorities. The production of visions is an important participatory process used to engage, inspire and mobilise a wide variety of different social actors but involves negotiation and struggle. In terms of urban infrastructure this may involve amongst others representatives of utilities, municipal government, regulators, developers, business, citizens, 'users' and so on. Visions and the goals they outline provide a reference point through which networks can be built,

gaining commitments to 'participate', orientating the actions of potential participants and constituencies, and in persuading potential participants of the desirability of transition (see Russell and Williams, 2002, pp. 60–1). Although visions are not fixed and will change over time with the variety of social interests who become involved, the key point is that there is an issue of whether visions are initially articulated around narrow coalitions of self-interest – be that from within existing socio-technical regimes or narrowly constituted urban governance coalitions – rather than in terms of a more broadly constituted sense of what a purposive urban transition would look like. There is, thus, a crucial issue of who, or which social interests, produce these early visions of the future and with what expectations?

This is important in view of the fact that neither urban territorial priorities nor socio-technical regimes are monolithic but are, as we have seen, constituted by multiple relationalities. Constructing a vision of an urban socio-technical transition encompasses multi-level governance arrangements and socio-technical systems that are often messy involving multiple actors and institutions across different scales. The construction of coalitions and development of a shared city vision is important but also potentially problematic given the multiple scales, priorities and social interests involved, the different motivations they have for involvement and the different financial, knowledge and relational resources they can mobilise. When addressing systemic transitions in urban infrastructures effectively it is necessary to involve representatives of a wide variety of relevant social interests. This may be more or less problematic particularly if regimes and systems of infrastructure provision are organised nationally or regionally and asks the question: to what extent are they able to be re-organised and control exerted over the process in relation to the achievement of territorial priorities?

Following from this, the issue of developing a shared vision of urban infrastructure transitions raises two critical questions about who it is that speaks on behalf of 'the city': (1) who should be involved? (2) And how far should this go? This is important for two reasons in particular. First in terms of the type of vision that is produced and the range of views that it embodies and second, it is important that there is engagement at an early stage in a process (see Wilsdon and Willis, 2004), of urban socio-technical transition so that there is ownership from and engagement with those whose participation, knowledge and expertise is necessary to translate the vision into practice at a later date. This is not unproblematic. Social interests will have different motivations for, expectations of, and ability to engage in such a process.

4.2. Translating visions: intermediary organisation

Visions of purposive urban transitions represent a transformative view of the relationship between cities and socio-technical regimes. Both urban governance networks and socio-technical regimes in and of themselves, by definition, are relatively stable and obdurate. With purposive urban socio-technical transitions, therefore, the aim is to mutually transform both urban governance regimes and socio-technical regimes. This is not straightforward! The production of a vision provides a framework and a direction of travel for a purposive urban socio-technical transition but it says little about how this will be done. A vision in that sense is a necessary but not sufficient condition of a purposive urban transition. What is required is a sense of how an 'effective' capacity can be coordinated to act on the vision and the process of manifesting that capacity in action, or in other words its capability.

We argue that an ad hoc and reactive alignment of social interests will not achieve the priorities encompassed in a vision. Coordinating capacity and mobilising capability requires the creation of 'new' intermediary organisational contexts. The creation

of intermediaries is necessary to constitute a space outside of the obduracy of both existing urban governance regimes and existing socio-technical regimes (Hodson, 2008), but that creates a context for the discussion of competing priorities and in doing so that brings social interests from each of them together.

The pressures to reconfigure socio-technical regimes at an urban scale are becoming manifest at a point in history when the governance of these systems is increasingly polycentric, at multiple levels or scales of governance and control is dispersed and distributed. It is within this context that 'new' forms of governance are emerging, being designed and experimented with to intervene in and seeking to reconfigure regimes at an urban scale. An increasingly central part of these new forms of governance are intermediary organisations which are set-up to intervene in a variety of ways in existing systems of producing and consuming resources.

Though intermediaries bare the same generic title they encompass a wide variety of different organisational priorities and motivations, funding streams and organisational capabilities which are predicated on the pursuit of different political priorities aligned with interventions. Though these organisations are frequently different in many respects, including the specificities of their function, they can be characterised in terms of three aspects of their mediating function. First, intermediaries mediate between production and consumption rather than focusing solely on production or consumption issues (see Van Lente et al., 2003). Second, they also mediate the different priorities and levels of different funders, 'stakeholders', policy interests' social interests, regulators. Third they also mediate not only between different priorities, in the production of a vision, but also in their 'application'.

Different intermediary organisations fulfil different roles in intervening and seeking to, in some way or another, reconfigure socio-technical regimes. Intermediary organisations can encompass a wide variety of organisations that includes government or semi-government energy agencies working at different scales of governance, Non Governmental Organisations, agencies sponsored by utilities, ESCOs and so on who perform functions such as the provision of energy advice and advice centres; consultancy activities; energy audits; project initiation, management and coordination; demonstrations; technology procurement; installation; promotion; advocacy; lobbying, dissemination and awareness raising; organising campaigns; education; training and courses; and network-building. In doing this different intermediary organisations function over timescales that can vary from a short-term project or initiative (e.g. 6 months) to something that is much more long-term and programmatic (e.g. 10 years and upwards). Intermediaries can be either project-focused or systemic in their orientation but what we characterise here are systemic intermediaries given their potential role in purposive urban transitions rather than the more limited role of project intermediaries. We are motivated to address one question in particular: How should we understand the role(s) of systemic intermediaries in urban socio-technical transitions?

4.3. Intermediaries: developing capacity and capability to act

It is important to ask what it is that we can understand about the mediating roles that systemic intermediaries play in intervening in purposive urban socio-technical transitions. It is particularly so in respect of the ways in which intermediaries' work at mediating different priorities and between these priorities and their 'application'. In short, whose interests and priorities shape interventions and how?

The issue we are concerned with is the critical role of systemic intermediaries in developing the organisational capacity necessary to attempt to reconfigure regimes at an urban level. It is crucial to understand the negotiation of whose priorities it is that shapes

these responses. What is the balance between social interests from 'outside' of a city, whether that is national government priorities, regulators, utilities, etc., and territorial priorities? These different social interests each bring not only different expectations of a transition but also forms of knowledge, expertise and understandings.

The organisational basis within which these social interests, their expectations and forms of knowledge is crucial to underpinning the development of active capacity and necessary capability to translate a vision into social and material action. In our previous work on intermediaries and through analysis on European intermediary practices (Hodson and Marvin, 2009b,c) we have identified seven issues that are particularly important in constituting capacity and capability.

There are two sets of issues that together critically constitute the organisational stability necessary for an intermediary to embed itself in a social context. First, in order to develop a longer-term systemic programme of activities to address the social vision it is necessary to secure sustained broad-based financial support. Such commitment reduces the risk of the priorities of the intermediary being dictated by the reactive chasing of funding with the associated targets, objectives and commitments. Second, longer-term funding provides the potential for underpinning security of employee positions. This stability means that resources are available so that staff can be incentivised, trained, feel rewarded in order to form the basis for an organisational commitment to the careers of employees.

Third, stability of organisational resources and commitment then provide the basis for a shared and collective organisational culture to develop and clarity around the different positions of multiple social interests. This requires intermediaries to be able to effectively 'plug in' to the networks of partners to enhance capacity but to be able to do so from a shared organisational view. This very dynamic set of circumstances means that intermediaries must develop as effective learning cultures and develop the ability to be able to adapt to changing pressures and new issues. In this respect, the development of shared organisational cultures is unlikely to be solely effective through project-based thinking but rather should be systemic, strategic and long-term.

Fourth, the adaptability and learning required by intermediaries means that they must constantly work at developing and re-developing the knowledge base which they have access to. In addressing long-term, systemic and strategic issues a wide variety of technical, policy and local forms of knowledge and social interests need to be constantly negotiated and effectively integrated. These are likely to include: developers, planners, utilities, regulators, companies, environmental and community groups, etc.

Fifth, negotiating and effectively integrating different knowledges requires the alignment of multiple sets of social interests and their priorities and the creation of communications forums to be able to do so. This requires that intermediaries cultivate a local presence and effective local networks through developing a proximity to local networks through face-to-face communications. Intermediaries also need to develop effective relationships and resources, beyond what may be the limits of local networks, and existing socio-technical regimes with national policymakers and potentially social interests at a supranational level as well.

Sixth, this requires that intermediaries think carefully about how they represent what they do to the variety of different partners they build relationships with. This is important in communicating credibility and building trust with a variety of partners, who in other aspects of their work and business may have competing priorities. Symbolic visibility in the local and national media is important as is symbolic exemplification through demonstration and showcasing. This is part of the positioning of the intermediary as distinctive, as 'first mover' and the people to turn to.

Finally, these previous six characteristics are all important in embedding the intermediary within a specific urban context and facilitating the development of the resources, relationships, forms of knowledge and communications and, thus, visibility, to be able to affect a credible influence. But the intermediary also needs to develop a shared organisational view as to how it would know if it was influential beyond the often narrow metrics of external funders. Through addressing these seven critical issues we have considered the necessary organisational context for how intermediaries can intervene in purposive urban socio-technical transitions actively and effectively. Inevitably these issues require further development through translation, practise and refinement. They also require an understanding of how we would know if interventions were 'effective' and 'successful'.

4.4. *Urban transitions: how would we know?*

Understanding urban socio-technical transitions through the lens of the interventions of intermediary organisations requires us to ask: how would we know if interventions had been 'effective' and 'successful'? There are two particular issues that need to be addressed here in constructing an initial analytical framework that can address this issue. First, the extent to which the aims, objectives and aspirations of the vision are achieved over time – an 'outcome' indicator of 'effectiveness' and 'successfulness'. Second, the extent to which these aims, objectives and aspirations are embedded in practice – a more processual and contextual view of effectiveness' and 'successfulness'.

Thinking about (in)effective and (un)successful outcomes acknowledges the importance of a focus on the intermediary organisation as an agent of change. In particular it requires addressing the degree of resonance or dissonance between the initial vision of urban socio-technical transition and its achievement over time, in respect of aims, objectives, timings, material and social change, etc. The extent of the similarities and/or gaps – between the aims and objectives proposed in the vision and their outcomes – informs an understanding of the degree of outcome success. Strong resonances between the objectives, application, timescales and budgets would inform a high degree of outcome success whilst gaps between the objectives outlined in the vision and their realisation would inform a high degree of unsuccessfulness in outcomes – obviously the achievement of some objectives indicating a degree of success somewhere in between.

The emphasis on outcome success allows us to retain a focus on the vision and its objectives in urban socio-technical transitions. It, however, tells us little about the processes through which the vision achieves or fails to achieve 'acceptance' amongst a wide variety of stakeholders and translation into materiality. Our starting point is again with the intermediary and with the objectives of a vision. Either implicitly or explicitly captured within visions is a sense of who intermediaries 'need' to engage to translate the vision. This may be broad-ranging or narrow in terms of the types of social interests – for example funders, planners, users, residents, technology suppliers, local authorities, national governments, etc. – intermediaries anticipate they will need to engage with. What is of particular interest is that having engaged with the different social interests in the process, intermediaries may still be confronted with difficult issues and problems. This might include, for example, controversies such as where a technology development is located, difficulties with funding streams, lack of political support and so on. How these issues are addressed and who subsequently becomes involved and with what expectations then becomes critical to the process. This is important as it broadens the constituency of the process of urban socio-technical transitions. A controversial location for technology development, for example, may involve technology developers engaging with local residents, funding diffi-

culties may require dialogue with different funding bodies, a lack of political support may involve discussions with political interests at different levels. Each of these social interests potentially brings different sets of expectations to the process of urban socio-technical transitions.

The intermediary coordination of these different social interests (or capacity) is the key signifier of process success and 'acceptance'. Coordination may occur between different social interests through a variety of methods and media. Addressing a controversial location for technology development may be through public meetings, via public information leaflets, through planning processes, etc. Likewise, a funding problem may be addressed through face-to-face meetings and bids for funding. A lack of political support could involve intermediaries trying to build relationships through lobbying politicians, through a media offensive, etc.

A 'totally successful' process would have a fully coordinated constituency at the 'end point' of an urban socio-technical transition. Those who intermediaries need to engage to realise the vision would have been successfully enrolled. Any issues, controversies or problems that arose would subsequently have been addressed through involvement the 'necessary' social interests and the 'relevant' resources and be coordinated – through various methods – with the initial objectives of the vision. A 'totally unsuccessful' process would have failed to engage with those needed to realise a vision. Any further issues, controversies or problems that arose would not have subsequently been addressed. The involvement of the 'necessary' social interests and the 'relevant' resources would not have been sought and there would, therefore be no coordination with the initial objectives of the vision.

Of course, the likelihood is that many intermediary interventions over time would be located on a continuum somewhere between the two points. The development of these ways of thinking about outcome and process success is not an end point in itself but provides the basis for understanding and thinking through intermediary interventions in urban socio-technical transitions and will be adapted and re-worked over time as they are applied to the context of different attempts at urban socio-technical transitions.

5. Conclusions

This paper asked two questions: Can cities shape socio-technical transitions? And how would we know if they were? We return to those questions here. Our interest in asking these questions was from our reflections on evidence that suggests that some of the world's most powerful cities are the focus of attempts to purposively reconfigure socio-technical regimes at the scale of the city. In the paper we engaged with the MLP on socio-technical transitions to address the ways in which it does and does not provide a conceptual framework to understand these trends and development. This enabled us to ask questions about how we understand questions of geography and difference between socio-technical regimes. This was particularly important in a context where increasingly urban territorial priorities appear to be informing attempts by urban political elites to gain degrees of control over the organisation and functioning of energy, water, waste and transport infrastructures – often where they have limited or no involvement in socio-technical regimes. We developed a framework for understanding a purposive urban energy transition, how shared understanding of this could be developed by various territorial and regime interests, the intermediary organisational context for how interventions to translate these visions would be constituted and how understandings of whether these interventions had been successful or not would be constituted.

In doing this we recognise that we are contributing to a nascent debate and that our framework provides a basis for intervention but is one that will be informed and adapted by future empiri-

cal investigation. Consequently, the paper has contributed to three issues.

First, our analysis highlights a key challenge for transitions researchers related to spatial contexts: where is the 'where' of transitions approaches? The interpretative flexibility of many transitions concepts is what in many ways makes transitions approaches resonate with such a wide variety of researchers and practitioner interests. Yet, when utilising these concepts in relation to particular problems, contexts or scales these terms need to be clarified. Central to this paper has been both the questioning of the extent to which key transition concepts are applicable to urban contexts and the attempt to empirically interrogate key transitions concepts in a particular urban context. In future much more of this conceptual-empirical engagement around urban transitions needs to be undertaken.

Second, conceptually this not only forces us to clarify where key conceptual units are but in doing so links where conceptual units, like regimes, are and how they may be re-scaled in transition from a national to an urban system of provision. This brings together both spatial with temporal issues. Methodologically, attempts to research the future are notoriously hazardous. How do you research 2020 or 2050? What we have contributed is an engagement with this problematic by developing a framework for researching the ways in which integrated *claims* on the future of the city (to 2025, 2050 and 2100) and the organisation of its socio-technical infrastructures, from the present, utilising historically produced resources. Much more of this contextually-sensitive research in various urban contexts is required as is a comparative understanding of the similarities and differences between urban contexts.

Finally, what we have been examining in this paper is the extent to which socio-technical systems and their transition can be governed and configured at an urban scale. We have demonstrated that there is a need for an effective coordination of capacity and capability to initiate and attempt to enact systemic transitions. This poses two further issues for research: the first of these relates to the translation over time of the visions of systemic socio-technical transitions and the necessity of undertaking ongoing research of attempts to enact transitions and the political processes and participation involved in doing so; the second of these is the issue of what happens in cities that do not have the resources and capacities to mobilise that world cities have. Further research should engage with transitions in cities outside of premium world cities and examine what transitions look like in ordinary cities and cities of the global south.

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