Governance in niche development for a transition to a new mobility regime

Conference Item

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Introduction

Urban mobility is proving to be a difficult sustainability challenge. The UK's 2008 Climate Change Act seeks an 80% cut in CO2 emission by 2050 relative to the base year of 1990. This requires a 3% CO2 reduction per annum and a major reduction in CO2 from the transport sector by 2020. Between 1990 and 2012 the UK's end user greenhouse gas emissions dropped by 26%, but those from transport dropped by only 4% (DECC 2014). As a result transport's share of emissions rose from 18% of the total to over 23%. Rather than the required 3% CO2 reduction per annum, the transport sector is not even managing a 3% reduction *per decade*. Recent policy decisions to dismantle incentives for cleaner vehicles seem set to only worsen this poor performance (Harrabin 2015).

Shifting trips from the car to public transport systems forms an important part of many policy initiatives to address this and other transport issues. Considerable public money has been devoted to requisite infrastructure investments and ongoing fare subsidies. For example, the 25 km. Cambridge Guided Busway cost £180m to build and London's Crossrail megaproject is budgeted at £16billion. In London alone, subsidises to public transport fares are £3 billion per annum.

However, stimulating a shift from car trips to public transport represents a transition to a socio-technical transport regime similar to the one embedded in western countries some 100 years ago, and even that may be insufficient to address the scale and complexity of environmental issues highlighted above.   Instead, this paper argues that transitions to socio-technical mobility regimes that delivers sustainability compatible with the 21st century social-technical landscape are required .

Over the past 30 years there have been a number of niche experiments and developments that may contribute to such developments.   However these niche developments have had little if any influence upon the configuration of public transport regimes and have, found only limited applications. Thus drawing on transition management theory, this paper focuses on how niche proliferation can be achieved and requisite governance arrangements established.

Public transport regimes and transition management

This paper draws on the Multi Level Perspective (Geels 2002) and associated literature to analyse the nature of transition challenges affecting public transport regimes. The Multi Level Perspective (MLP) is based on a three level hierarchy, with each level differentiated by speed of change (see Figure 1). The Socio-Technical Landscape forms an exogenous context comprising of slow moving variables which reflect changes in society, economies, the natural environment and political systems. Socio-Technical Regimes lie at the heart of the MLP and are situated at the second level. Regimes are based on socio-technical configurations that meet societal demands for mobility, shelter, food and so forth. Niche environments form the third level of the MLP. Niches are protected spaces in which new socio-technical configurations are developed that may subsequently form the basis of new regimes. Here developments move faster than those in the regime and landscape. Transitions emerge as a result of interactions between the three levels. Indeed, Schot and Geels (2008) have set out several transition pathways. In this paper we focus on transitions stimulated by changes in landscape variables which trigger regime responses as well as the development of niches.

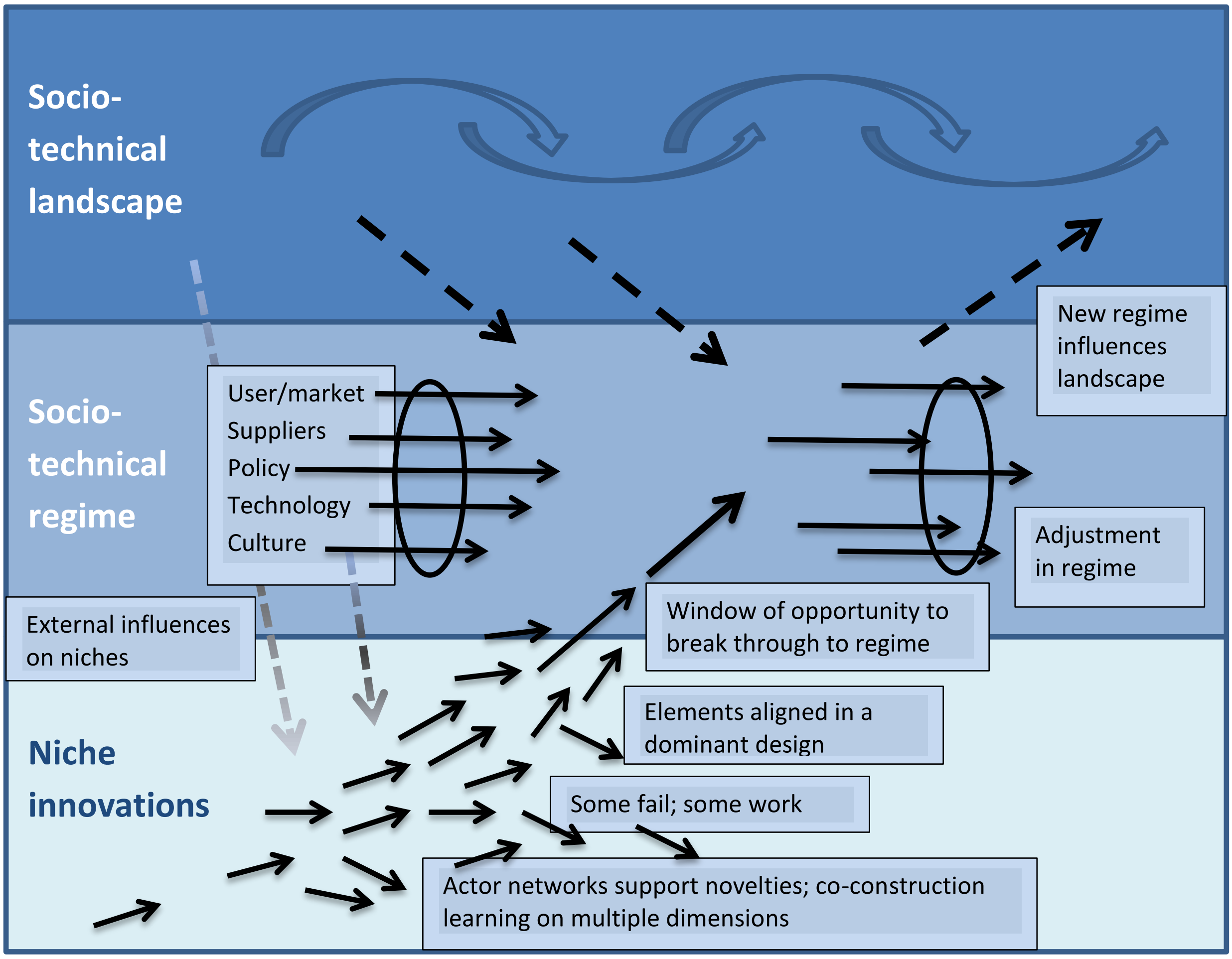

Figure 1: The multilevel perspective on innovation transition (based on Geels, 2002)

For public transport, the Landscape includes economic, social and physical factors that generate societal demands for mobility, which are met by public transport services in the socio-technical regime. Landscape developments, such as changes in employment patterns, leisure time and expected standards, shape travel demand and exert pressure on the regime to change in response. Niche innovations may also emerge as a result of landscape changes.

The public transport regime is based on a long-established socio-technical configuration that has essentially remained unaltered since the development of the horse bus in the 1820s. This configuration is well known. Big vehicles spread labour and capital costs over a large number of passengers. This leads to a particular service configuration, operating on corridors of high demand to set timetables. Tram and metro services have followed suit using the same configuration. There is thus a mobility regime that is distinctly separate from that of taxis and minicabs; the configuration of the latter are small vehicles operating door-to-door, on demand to the individual needs of users but at a much higher fare compared to large vehicle public transport systems.

For public transport services, the rules by which it is used by its customers have also remained essentially unchanged. Passengers access a service by going to a stop or station, wait until a vehicle arrives, which they then board. Traditionally bus and tram fares were paid on the vehicle, but increasingly fares are prepaid using smart/contactless card systems. At the end of the trip, the passenger alights at a stop or station on the route and continues to their final destination. One or more changes between routes may be needed to get to somewhere other than that served by the route they initially joined.

This is a very familiar socio-technical configuration, but it is perhaps remarkable that this configuration and how it is accessed has essentially remained unaltered for 200 years, even though the technology of public transport vehicles, fare collection and any associated track and infrastructure, have seen considerable technical developments (Daganzo, 2010).

This socio-technical configuration extends into the institutions of regulation and planning. Public transport services have tended to focus on commuting and business trips along corridors into and within big cities, with these functions also becoming the focus for state planning and regulation. For example, transport planning models were developed to accommodate journey to work commuting flows. In the UK, commuting season ticket fares are regulated, whereas off-peak and leisure fares are not. This regime focus exists whether public transport services are regulated and state-owned or are operated by the private sector. Regulatory and institutional bodies conceptualise public transport as being big vehicle, corridor, timetabled commuting services.

This ‘big vehicle/big infrastructure/dense corridor’ configuration is strongly engrained in public transport policy. Even when patterns of demand do not fit the model, passengers are expected to conform to this configuration and its rules of use. Hence the large vehicle configuration is retained for peri-urban and rural services, but operates at low frequencies to build up user numbers per vehicle run. The vehicles may be somewhat smaller (e.g. 25 seaters rather than 80 seater double decker buses), but the essential socio-technical configuration is retained.

Seeking transport sustainability within such a regime follows the characteristics of its configuration and involves interactions with factors at the landscape level. Thus transport for sustainable cities conceives urban forms that contain dense clusters that can support high-capacity, corridor-based public transport. This is seen as the ideal urban transport/land-use pattern to constrain car use – intended to get people to arrange their habitat, behaviours and lives around the service design requirements of a transport system. Planning controls are advocated to produce settlement patterns and conditions that will favour high-capacity, corridor-based public transport and discourage car use (Newman and Kenworthy, 1999). Such a policy approach is suggesting that the socio-technical landscape should be configured to facilitate the configuration of the regime.

Context and structures within a social-technical landscape always constrain individual behaviours, but there is an issue of the extent to which sustainability requires people to arrange their lives around the service design configuration of a particular transport regime. But even where this policy approach happens, transport's environmental impacts remain far from a sustainable level. In a comprehensive review urban design and related approaches, Banister (2005, Chapter 6) cites case studies of cities that have achieved a 10% cut in car use through utilising planning controls and public transport development. But a 10% cut in car use is nowhere near the factor 10 emission cuts the transport sector is failing to deliver.

A more fundamental issue is whether the reluctance of car users to travel by public transport is rooted in shortcomings in the basic configuration of the public transport regime. Although the product-level design of a public transport service can been improved, is the key problem the socio-technical regime configuration itself? It is not that buses can be made more comfortable, cheaper and with smart phone apps to tell you if they are running on time, but that the socio-technical mobility regime of the bus, fixed routes and timetables ill-fits the needs of the 21st century socio-technical landscape.

For at least the last 100 years, travel behaviour has been moving away from high demand corridor configurations. Travel behaviour is driven by deep-rooted economic and social factors in the social-technical landscape that have led to travel becoming increasingly dispersed in time, space and across functions. Transport planning focuses upon work journeys, which now constitute only 16% of all trips in the UK and business trips only 3% (National Travel Survey, 2014). Travel growth is now in leisure purposes (which have grown to 30% of all trips), shopping (20%) and highly dispersed personal business trips (20%). In space, the strongest growth is not along major city corridors, but in suburban, urban fringe ('peri-urban') and rural areas. The rise in car ownership and use has much to do with this dispersal of travel demand, but it is also a result of fundamental shifts in our economy and society. Enhancing the quality and cutting the cost of corridor 'big vehicle' timetabled services will only have a marginal impact on car use when 80% or more of travel is no longer along high density corridors or is at times when corridor services are infrequent or may not even be operating.

The fundamental problem is that travel behaviour continues to shift to a pattern of demand that is ill-suited to the nineteenth century system design for big vehicle corridor public transport systems. In an article written shortly before his death, Sir Peter Hall reviewed the need for a new form of public transport to effectively serve decentralised and dispersed travel demands, seeking what he called the 'Heineken' system (public transport that refreshes the parts other transport cannot reach), but could not find such a system (Hall, 2013). Crucially though, he restricted his consideration to existing regime configurations of big vehicle corridor public transport.

Is the key not getting people to return to travel patterns and a social-technical landscape of 100 (or more) years ago, but in a transition to a socio-technical transport mobility regime that delivers sustainability compatible with the 21st century social-technical landscape? Over the past 30 years there have been a number of niche experiments and developments that have sought to address this structural issue. However such niche developments have had little if any influence upon the configuration of the public transport regime and have, at best, found only limited applications. This raises questions about how niche proliferation can be shaped and what are the appropriate governance systems to manage this process.

Non-corridor public transport configurations

Non-corridor public transport socio-technical configurations have long existed in the form of taxis and minicabs (and their predecessors in the horse-drawn era). Hiring a small vehicle and driver for an individual journey means that it is expensive compared to the cost of travelling by a bus or tram, but has a stable market segment (Figure 2). However, taxi and minicabs have never had a core place in urban policy and their regulation is broadly in terms of licensing and safety. This is thus a distinctive regime that has its own network of user preferences, actors and culture.

Figure 2: Taxicabs picking up passengers at a London station

Quite aside from the taxi and minicab regime, there have been attempts at new models of public transport that can serve the shift in the socio-technical landscape towards dispersed travel demands. The term ‘Paratransit’, (originating in the USA) is frequently used to describe such systems. A long established niche market example are the USA airport shuttles, that take people from an airport to destinations in a particular area, dropping them off at a number of points or (for a higher fare) at a particular address.

This is one of a number of service models that paratransit uses. Enoch et al (2004) proposed a four – fold service model typology:

- **Interchange services** - feeder services into higher frequency bus and rail-based corridor services. The Chiltern taxibus in the UK and Netherlands Traintaxi are examples of this.
- **Network services** – which supplement conventional corridor services in a particular place or at certain times. An example is the Helsinki ‘Kutsuplus’, a 9 seater minibus that can be ordered to a pickup point at a certain time. There can be other passengers on board, picked up and dropped en-route. An algorithm calculates the most efficient route for drop off for everyone.
- **Destination-specific services** - these include the airport shuttles that operate to most major USA airports. Workplace vanpools are another example.
- **Substitute paratransit** effectively reinvents public transport by replacing conventional public transport rather than complementing it. One of the best known examples of this type is the Taxibus scheme in Rimouski, Quebec, which in 1993 saw the city authorities replace a stage bus network with a shared taxi operation for services to suburban areas (Trudel, 1998).

This typology indicates that a variety of paratransit niche roles have emerged. Some of these have been commercial, but many have been led by public policy concerns about shortcomings in conventional corridor-based public transport, particularly for disadvantaged groups in society.

However, a crucial weakness has been than many of these paratransit systems have been developed within the culture, structures and governance systems of the public transport regime. This has resulted in them tending to be expensive to operate and generate low revenue. They have thus struggled to establish a role within the existing institutional frameworks, although in some places with a high subsidy culture for public transport, there have been examples of where such systems have been sustained.

Paratransit could benefit substantially from recent advances in big data ICT systems (especially increased computing power at much lower costs) and potentially shift it from its specialist applications into mainstream. But it seems that existing paratransit schemes, with their culture still dominated by structures built around stage carriage services, have only gradually and marginally responded to this opportunity. By way of contrast, the minicab business has been quick to move into the digital world of booking apps, the internet and big data management systems, using this to significantly improve customer service and to automate and improve the efficiency of driver scheduling. This has both increased value and reduced costs. Indeed, the difference in cost to users between buses and minicabs is narrowing, and where two or three people travel together the cab is often cheaper.

This process is being taken even further by the, often controversial, invaders from the world of the digital economy. These are new entrants and not actors within the existing cab regime. This development is epitomised by the technology company Uber and its new model of an on demand car service (Boeckel et al 2012). This new business model is strongly commercially driven and is far from the cumbersome structures used by niche paratransit operators to date. Uber's lean model involves a user-friendly booking and payment app, crowdsourced owner-drivers, highly efficient scheduling and back-office software. Together, this package can outperform incumbent minicab operators on price and performance and leaves the old taxi model standing (if not redundant). The rapid appearance of this sector invader has invoked the politically powerful wrath of the taxi industry in cities around the world. A number of city authorities have supported the existing cab regime by constraining or banning Uber, and in at least one case have even jailed their executives (Groden, 2015).

But behind Uber is a global social-technical landscape mega-trend that will be hard to stop, even if it is held back a while in some places. Big data IT systems now allow passengers and service providers to communicate directly with each other and trip demands and available transport supply can be matched or brokered almost instantaneously. In many other sectors (music regarding downloads and tourism with customised websites being but two of many examples) there has been a readjustment between incumbent and new technology entrants. Local transport services are only just starting to be touched by the regime restructuring power of the digital revolution. In the long term, for some locations (particularly peri-urban and rural) and time periods (evenings and night-time) Uber-style systems are set to become the public transport of the digital age. However, incumbent stakeholders are putting up a firm resistance, with some city authorities using their regulatory powers to restrict or even ban Uber. In some cities, including Paris, there have been violent anti-Uber protests. These look set to be the opening skirmishes of a transport regime war.

Emergent configurations

Big data ICT systems are not only leading to the controversial reinvention of the minicab, but other innovation niches are opening up that contribute to potential new socio-technical configurations for local public transport. The development of autonomous (or driverless vehicles) has progressed rapidly in recent years. Driverless metro and peoplemover systems have operated successfully since the 1960s, but their technical and operating requirements have been relatively simple. Most operate in controlled environments like airports, theme parks or on segregated metros. However, the technology has developed to the point that a number of more advanced Personalised Rapid Transit (PRT) systems have been developed.

The service design for PRT is not to run along a corridor route, like buses and trains, but to operate individual journeys in small driverless vehicles across a network of narrow tracks. The small vehicle knows this network and uses a variety of sensors to travel safely along the tracks and to work with other vehicles on the system. The battery-electric vehicles (often called 'pods') wait for customers at local stops, and when one pod is occupied another automatically replaces it to await the next customer. Customers would get onto a pod and instruct it to go non-stop to a particular destination stop.

Figure 3: A four seater Heathrow 'pod' approaching one of the car park stations.

Such system configurations have been proposed since the 1970s, but it is only now that affordable IT capability is making them a realistic proposition. As might be expected, the first applications have been in sheltered niche situations. An established example is the Heathrow Airport 'pods' introduced in 2011 to replace a bus service to a car park. Instead of a big bus linking a number of stops along a fixed route before getting to the one nearest the users' car, the four-seat pod goes non-stop to the nearest station. Outside of sheltered niche contexts, PRT systems are only being applied gradually. Masdar Ecocity in the United Arab Emirates operates a PRT shuttle and in 2014, a small PRT system began operating in Suncheon Bay wetlands eco-park in South Korea. At the moment all these systems are little more than autonomous shuttles rather than prviding an area service configuration.

With advances in autonomous ('driverless') car technologies, the prospect is emerging of PRT systems that do not require segregated tracks, but will run on ordinary streets in mixed traffic. Since 2011 there have been public street trials of autonomous vehicles in the USA and in 2015 they became street legal in the UK. This suggests the opening of another, though longer-term, niche pathway towards a new socio-technical configuration for local public transport.

The transition to a new mobility regime

There are thus a series of niche innovations emerging around several mobility services that are well suited to the socio technical mobility landscape of the 21st century. These are coming into conflict with the entrenched actors and institutions of traditional public transport. Some of these public transport innovations may have initial compatibilities with the socio-technical regime, and the segmentation of the public transport market provides opportunities for different innovations to develop. Furthermore, the relationship with existing configurations in the present regime is yet to be established. It is likely that high capacity corridor systems will remain where demand is appropriately distributed, particularly to and within dense city centres. Railways, metros and light rail will form part of the future regime configuration, but such corridor public transport will be blended, in an as yet to be determined way, with the innovative individualised transit configurations. There may also be transitional designs, moving from manual to autonomous designs. For example, as presently structured, Uber may only be a transitional stage until autonomous vehicle technologies mature. There may not be (as at present) a dominant public transport configuration, but different types of paratransit may co-exist for different functions (as in the Enoch typology), but possibly later may coalesce around a dominant design configuration as markets expand and mature.

All this suggests that the niche innovation level is still at the stage of actor network learning around alternative configurations and their associated technologies. In terms of the MLP (Figure 1), the elements of new public transport mobility configurations are yet to be aligned.

This is in the context is the disjuncture that exists between the public transport socio-technical regime and the socio-technical landscape in which it operates. To a large extent that is a product of mass car use. The socio-technical landscape has been moulded by the dominant influence of car use (a non-corridor system), but public transport systems have stayed with a configuration formed in a past socio-technical landscape. Thus the public transport socio-technical regime is increasingly subject to both structural landscape pressures and competition from emergent niche innovations.

Niche proliferation: A case study of Milton Keynes

This situation of multiple niche experiments and early protected market applications in the context of an entrenched regime raises questions about how the transition process can be managed and the role of governance structures and systems in such processes. How can niche proliferation in urban mobility be shaped and what sort of governance can best enable and steer the shaping process?

Within transition theory, Strategic Niche Management has sought to provide an analytical framework around three processes that contribute to the successful development of a technological niche (Hoogma, Kemp Schot and Truffer, 2002). These processes are:

(1) The articulation of expectations and visions.

(2) The building of social networks.

(3) Learning processes at multiple dimensions: technical, market and user preferences, cultural and symbolic meaning, infrastructure and maintenance networks, industry and production networks, regulations and government policy, societal and environmental effects.

Later work, (particularly Grin et al., 2010), links transition theory and Strategic Niche Management The nature of the interaction between niches and regimes is also subject to further development, including research on how “bottom-up” activities in niches contribute to ‘transitional’ technologies breaking through into the mainstream (Genus and Cole, 2008), and about the nature of the protective and empowering measures required for initial technology niches to give way to market niches (Smith and Raven, 2012).

Niche proliferation within a specific geographical area is viewed as one way in which innovation transition processes can be nurtured and this is what is happening in Milton Keynes. Milton Keynes is an example of Grin's concept of bottom-up experiments providing learning and evidence for innovations to break into the mainstream. Located approximately 80 km. north of London, Milton Keynes was initially developed under the UK's New Town legislation and now has a population of about 260,000 (an increase of 43,000 in ten years) and 170,000 people are employed here. Milton Keynes has the UK's highest rate of job increase (18.2% between 2004 and 2013) and is expected to have a population of over 300,000 and a further 42,000 jobs by 2026.

Milton Keynes was designed in the late 1960s to have a transport/land use configuration that facilitates mass car use (Potter, 1997). This included a dispersal of land uses and a non-corridor grid pattern of roads. This urban design is extremely hostile to corridor public transport systems and consequently, bus services are poor and car and minicab use is high. This is the context in which Milton Keynes Council and its partners have cultivated niche proliferation around low carbon innovations. In the past six years there have developed several overlapping smart transport niches in different stages of development, as well as other energy, housing and smart grid niche initiatives. This is a purposeful strategy driven not by transport or environmental policy, but as part of a long-term economic development strategy that incorporates a lean partnership model of governance.

This series of niche initiatives has developed through programmes such as "*Future-Ready MK*" (Snelson, 2012) and *Low Carbon Living* (NHBC Foundation 2010). The Director of Strategy at Milton Keynes Council, Geoff Snelson, views running city-wide experimental spaces, as a way to "*establish an open innovation environment in which communities and businesses can devise their own services and solutions"* (Snelson, 2012). He has referred to Milton Keynes as developing an *"eco-system of solutions"*, recognising that some 'animals' in the ecosystem will do better than others, and some may entirely fail (Snelson, 2015). This approach maps closely to the evolutionary perspective of transition theory and the role of niche experiments. It approximates closely to the principles of Strategic Niche Management.

Niche Proliferation in Milton Keynes

A number of niche developments have been implemented in Milton Keynes, including work on smart grids, electric vehicles (including innovative electric buses), autonomous pods, home energy and energy from waste. Most represent projects that have sought to manage the transition from technology to early market niches and into mainstream. Appropriate niche protection and network building and learning have all featured strongly in these initiatives/experiments.

Starting in early 2009, the electric vehicle infrastructure project was one of the first that came to form part of the *Milton Keynes Low Carbon Living* programme. It was quite traditionally structured in that Milton Keynes Council and the Homes and Communities Agency (which at that time was responsible for new development lands in Milton Keynes) bid for a government grant under the Plugged in Places programme to install electric vehicle charging infrastructure ahead of anticipated demand. The original bid sought to include developmental activities with users and to build networks with key actors. Such niche actor engagement was outside the conception of the government programme, which was purely viewed as a basic infrastructure funding arrangement. However Milton Keynes Council did secure other resources for such engagement work, assisted by a growing network of niche supporters around the project. They included automotive actors (including Nissan), the electricity distribution company, the engineering consultancy Arup, local universities (the Open University and Cranfield University). Given the economic development motivations behind this initiative, there were also strong links to Milton Keynes Partnership, which was an economic development consortium and Invest Milton Keynes, tasked to attract new businesses and help existing businesses to grow. This work varied from hosting the UK launch of the Nissan Leaf electric car in 2010 (Figure 4) through to the Open University running a series of EV pioneer workshops for local employers.

Figure 4: The 2010 UK launch of the Nissan Leaf EV in Central Milton Keynes

The three year programme successfully installed a network of electric vehicle charging points, but the more significant contribution was that it acted as a focus for a developing network of actors who sought to articulate their expectations and visions of low carbon technologies and were seeking opportunities to support learning through innovative initiatives. One project that emerged out of this growing social network was the Milton Keynes electric bus project. The electric bus project was not led and managed by Milton Keynes Council, but by the engineering consultancy Arup. The project involved the council and was still developed under the facilitating umbrella of the Milton Keynes Low Carbon Living Programme with its network of actors from the private, public and community sectors.

For at least the last 25 years, battery electric buses have been operated by public authorities in many cities throughout the world. But, because of a limited range on an overnight charge, these are typically short city centre routes that require a larger fleet to permit additional downtime for recharging. For example, the electric buses operating the Coventry Park-and-Ride shuttle service requires two vehicles to operate the service, with a third electric bus on charge. This three for two replacement of diesel buses increases both the capital and operational costs, requiring substantial subsidies. The electric buses in central London involve a different approach (Transport News Brief, 2013), but the financial challenges are much the same. These electric buses enhance peak frequency, so they operate in the morning peak alongside the core diesel fleet, return to a depot to recharge ready for running in the evening peak and then go back to the depot again for an overnight charge. This pattern suits operating requirements, but such low utilisation means the high capital cost of purchasing the buses cannot be offset by sufficient reduced fuel costs. Again they require a large subsidy.

Electric buses may be in use, but in all cases they are heavily subsidised and have been unable to break out of their restricted niche into mainstream applications. Nottingham, a city of similar size to Milton Keynes, has an extensive network of electric buses, but they are the Council's own bus fleet used for their non-commercial operations which form 10% of the city's services. A major part of extra cost of the electric buses is funded from Nottingham's workplace parking levy (a charge on employers per employee car parking space). For example the recent purchase of 13 electric buses to use for a park and ride route is subsidised by £2.1m from the workplace parking levy (Nottingham Post, 2015) in addition to a £1.4m green bus grant from central government. Ordinary commercial bus operators, who run 90% of Nottingham's services, are uninfluenced by this niche and continue to use diesel buses. There is no influence on the bus operating regime.

The Milton Keynes trial has sought to overcome the financial structure that has consigned electric buses to a highly subsidised niche from which they have failed to influence the mainstream bus operating regime. As noted in Miles and Potter (2014), the Milton Keynes trial matched diesel bus operating costs and so led to a commercial operator leasing vehicles permitting a long (21km.) route to be electrified. The use of inductive charging helped to overcome the economic structural problem, but crucially the trial has used a risk-bearing enabling company to provide confidence for the commercial operator to invest in the electric buses. The result is that a commercially viable electric bus system has been demonstrated which matches diesel bus costs and does not require large state subsidies. The electrified route has been operating since early 2014 and has met the technical requirements set for it to. The inductive charging system means that a one-for-one replacement of diesel buses is achieved and the overall cost is no greater to the commercial operator. This sort of project is one that has the potential to impact on the regime, whereas expensive public subsidised projects have not.

Figure 5: A Milton Keynes electric bus approaching an inductive charging pad.

Although this project relates to a traditional corridor bus service, the technology of inductive charging and the finance model can equally be applied to non-corridor systems such as minicabs and paratransit. This is part of the Milton Keynes ecosystem of solutions that provide experience and learning to the network of participants be applied in new configurations. Having established viability on the electric bus project, new areas of application are planned by actors in the local niche network.

Figure 6: The first of the MK Pods, on display in the Transport Catapult offices in Milton Keynes

The shift in focus towards new transport service configurations is represented by the Milton Keynes (MK) 'Pathfinder' pods autonomous vehicle project (Transport Catapult, 2015). Unlike the Heathrow PRT system, these driverless two-seater pods do not need segregated tracks, but will run on cycleways and footpaths, mixing with cyclists and pedestrians. Trials will start in early 2016, on short distance links from the railway station to destinations in Central Milton Keynes.

It is notable that the pods are intended to be complementary to existing corridor public transport. They will be distributor/feeders between the rail station and business commercial district in central Milton Keynes. This function is presently performed by cabs and buses, but is a market they do not relish. For cab drivers, low fare short distance work is not appealing, particularly if they end up at the back of a queue at the station awaiting a more lucrative longer trip. Equally, for bus operators, full vehicles for only a couple of kilometres of a longer route is not a good operational profile. So it would appear that the pods are initially concentrated on a market of little value to incumbent operators. The technology is not yet able to move to challenge them as a system – but this initial niche could build up momentum and, with incremental developments, it provides a transition process.

These projects have developed a distinctive ethos around a dispersed form of governance. This is one not dominated by public control and financing, unlike in many other technology management structures. There is public finance involved, but role of the public sector is as network enabler and, consistent with Strategic Niche Management, acts as a broker of partnerships, expectations and visions. This links to the contention of Hill and Lynn (2005) of a shift from hierarchical government toward greater reliance on horizontal, hybridised, and associational forms of governance. This approach is reflected in the ethos MK:Smart, a large collaborative initiative, partly funded by the Higher Education Funding Council for England and led by The Open University. This will develop innovative solutions to support economic growth in Milton Keynes. Managers of MK:Smart (see mksmart.org/) describe their approach as one based on the concept of "living laboratories", providing open innovation environments in real-life settings in which user-driven innovation drives the co-creation process for new services, products and societal infrastructures .

This approach is supported through three complementary approaches:

- Provision of open assets (open data, open code);
- Citizen engagement activities, and
- A practice-oriented co-creative process.

MK:Smart has its own network of actors managing the projects within the overall programme. The transport workstream is around the concept of a big data information system (the MotionMap), which would facilitate users to co-create transport solutions.

Conclusions: A governance perspective on niche proliferation and transitions

Many niche experiments do not gain sufficient agency to effect transition to alternate socio-technical regimes. Niches often remain isolated but protected by public policy measures and have little influence on regimes. This is illustrated by the lack of influence of 25 years of electric bus projects on public transport regimes which are dominated by diesel buses. The governance approach used in Milton Keynes offers a different path that involves successfully moving experiments to the regime level and engaging with regime actors.

To some extent this governance approach has been developed in Milton Keynes because this relatively small city is unable to generate large sums of public money for innovative projects managed in a hierarchical top-down manner. Instead the council operates as a partnership broker. In this, the public sector's role is to develop networks and identify windows of opportunity that fit into a broad and flexible innovation approach. They may act as a conduit for applications to public funds, but this is only within the partnership broker model. As Hill and Lynn (2005) noted in their review of empirical practice in a USA context, this form of facilitative governance is within a system of constitutional authority that is necessarily hierarchical. However, such facilitating forms of governance are being used increasingly and seem to be particularly appropriate to the role of shaping innovation and transitions. Seen in this way, the role of the public sector is not to pick technologies and fund them, but to stimulate niche development and proliferation that support public policy objectives.

An important implication is that this model of facilitative governance demands very different sorts of skills, practices and understanding of governments such as city authorities. For example, innovations, rather than being seen as a threat to and clashing with traditional city roles of regulation, are broadly welcomed and facilitated. It is notable that, rather than resisting systems like Uber, in Milton Keynes Geoff Snelson (Snelson, 2015) commented positively on the role of new technology entrants to transport services, seeing them as key innovation providers, which may play a significant role in low carbon mobility initiatives.

Such new forms of governance relate to wider debates about the role of the public sector in modern economies. Indeed, this is an emerging subject of debate in literature concerned with the nature and role of modern state institutions in the public policy processes (e.g. Hill, 2013). Such concepts are reflected in developments from within the political arena which aim to 'reinvent' local government on the basis of a lean model. Much of this is driven by public finance issues and links into a wider debate, emerging from perceived challenges in the Eurozone and debates associated with the 'austerity' ethos sought from the public sector across Europe as a whole. Indeed, debates are opening up on wide ranging fundamental questions about the role of the state. In the UK, the Treasury is seeking the 'reinvention of public sector' (Peston, 2016) and this has started to be linked to innovation. Neville and Gainsbury (2015) see austerity economics as leading to cost cutting innovative approaches. However this seems little more than advocating a traditional right wing role for local authorities, reducing them to commissioners of outsourced services rather than having any proactive role.

The Milton Keynes experience suggests that there is a valuable public sector role in shaping the development of niches. This may challenge *how* local authorities currently operate but not reduce their scope. Indeed, local authorities may need to extent their scope to become effective innovation enablers. The public sector does not need to be sidelined or democratic accountability discounted as new governance practices and cultures are developed. There is a growing case for partnership models in which city authorities, rather than taxing high to fund public sector projects, adopt an innovation management role. This is likely to require entrepreneurial skills that may be quite different to those usually associated with city officers.   Nonetheless, these seem to be evolving in Milton Keynes and demonstrated in officers playing a key role in shaping niche proliferation in the search for innovative urban mobility solutions. It is perhaps only through such a governance approach that radical transport innovations can be managed to make the transition between niche and regime without incurring high protection measure costs (now increasingly unfeasible), disruptive regime wars (like that around Uber) or important innovations failing or being constrained to limited applications.

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He has worked with the Milton Keynes smart city programme including the Milton Keynes Electric Vehicle project, *MK:SMART,* writing on the MK electric bus and participating in the MK 2050 Vision project. He is a member of the Milton Keynes Low Carbon Living Steering Group. Stephen teaches on several Open University design, innovation and environment modules, most recently *Innovation: Designing for Change*.

Dr. Alan-Miguel Valdez is a Research Associate in the Department of Engineering and Innovation at the Open University. His recently awarded PhD applied the SNM framework to study electric vehicle interventions in Milton Keynes. Electric Vehicles, are early-market products with a mature technology but undefined value propositions. They thus require a different niche management approach to the one used to support pre-market stage technologies.

His current work further develops this early-market niche perspective within the smart transport work package of *MK:Smart*, a £16m smart city programme. *MK:Smart* brings together a consortium of private, civil, governmental and academic actors, supporting a study of the interaction of smart city technologies and smart communities as they engage into processes of value co-creation, capture and distribution.

Dr Matthew Cook FRGS is Senior Lecturer in Innovation and Sustainability at the Open University. By drawing upon several related literatures (e.g. cultural geography, science and technology studies), he seeks in-depth insights on the governance of innovation and sustainability. Much of his current work focuses on innovation in city regions, with particular reference to the development of smart grids and smart city initiatives. He leads the OU team contributing to the major smart grids programme *Project FALCON* and has also contributed to Open University design, innovation and environment modules, including *Innovation: Designing for Change*.

Dr Per-Anders Langendahl is an independent researcher and director of Langendal Consulting AB. His work is rooted in Innovation and Transition Studies to create novel insights that inform governance and change to promote more sustainable futures. He has collaborated with industrial actors to explore socio-technical change for sustainability, including corporate environmental strategies; environmental innovation journeys; and developing smart solutions for sustainable cities. As such, he is building bridges between academic research and innovation on the ground in public and industry sectors (e.g. city policy and energy).

His current work explores the intersection of smart solutions (e.g. energy, transport) and development of sustainable cities. This project is undertaken in collaboration with the Open University and industry professionals in the UK.