ILUCIDARE

Innovation Handbook

Supporting Evidence-Based Research

The quasi-evolutionary model for socio-technical change

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Table of Content

INTRODUCTION

The following is a summary of the evidence-based research conducted throughout the ILUCIDARE project. The purpose is to provide a more detailed record of the information, the backbone, that was used to develop the ILUCIDARE Innovation Handbook.

This document supports Chapter 3 of the Innovation Handbook, and focuses specifically on defining a model suitable for analysing heritage-led innovations. The research presented in this document is largely based on Vandesande (2017), and goes beyond the traditional focus of the innovation research field on technological end-uses and product performance, in order to identify the most suitable approach to analyse and activate heritage-led innovation.

Throughout different approaches to understand innovation, researchers and professionals have aimed to develop a coherent framework for analysing innovation processes. Already in an early phase, Freeman and Perez aimed to answer the question 'how can the thousands of inventions and innovations which are introduced every month and every year be reduced to some kind of pattern amendable to generalization and analysis?' (1988: 45).

In line with its long research tradition, various assessment, mapping and monitoring techniques and methods have been developed to assess and analyse innovation processes. Widely used approaches include expert based aggregated evaluations of technology, statistical techniques or ecological inspired equations to model and predict non-linear innovation trends (Leydesdorff and Van den Besselaar 1994). These analyses can range from simple tree-diagrams (Durand 1992) to complex techno-metric or morphological methods (Foray and Grübler 1990). Within these existing frameworks applied by policymakers and organisations, markets are often the locus of innovation in an open society or system (Vandesande 2017). However, keeping in mind that heritage assets are part of a sector where impacts are often intangible and difficult to capture in conventional terms, innovations cannot be analysed from a purely quantitative perspective.

1. ANALYSIS MODEL SUITABLE FOR HERITAGE-LED INNOVATIONS

Innovation and economics of change can be studied in a variety of ways, from and historical perspective to a Darwinian metaphysics framework. Herewith, the importance of a dynamic and long-term evolution process, behavioural characteristics, as well as stability and change in a systems regime is illustrated in the ILUCIDARE Innovation Handbook, Chapter 3: The innovation process explained.

In this specific research context, the optimal selection, replication and variation process have been widely discussed in evolutionary economics. Although early economists already incorporated evolutionary thoughts in their theory, only in the 1990s models such as directed variation, selection environment and co-evolution were explicitly used to develop an all-encompassing theory of innovation. This was a direct consequence of the 1980s critique that the market was not just a purely economic entity, but a socially constructed and selective environment which favours specific new technologies and services. However, despite these newly found models, evolutionary economics did not yet clarify how Lamarckian variation actually operates and how this is linked to the selection and retention process (Geels 2002). In addition, it was observed that the selection environment entails more than socially constructed markets and user preferences (Hard 1993). More specific, these observations came from the field of sociology.

Within sociology, ***sociotechnical theories*** focus on the formation and growth of technologies and services as 'configurations that work', fulfilling a function within society. Thereby, the pioneering sociotechnical research by Trist entailed a change in the traditional understanding of organisations. Following the reasoning of Emery (1978), Trist no longer differentiated a purely technical perspective from social entities but urged to relate the social and technical systems together (Trist 1978). During the 1990s qualitative shift occurred in which technology was no longer understood as linked to a local social system, but a global socio-cognitive system in itself (Stankiewicz 1992). Following Schumpeter, entrepreneurs were still given a key role, however, this was elaborated with an interest in the dynamics of more diverse actors outside the obvious firm and organization stakeholders. Influenced by actor-network theory, sociotechnical change is interpreted as a recomposition of social and technical elements in which shifting assemblies actors can provide stability (Callon et al. 1992, Mangematin and Callon 1995). Because the context in which the innovation takes place is not a priori defined, this approach is considered flexible. However, due to the lack of a methodological structure, researchers fall back on case studies and 'heroic storylines' (Geels 2002: 1263) of the innovation. Another research path in the field of sociology that has been dealing with evolutionary economics and innovation no such storyline can be followed, namely the ***quasi-evolutionary model*** developed by Van den Belt and Rip (1987), Schot (1992), Rip and Kemp (1998). The approach follows Nelson and Winter by focusing on the innovation process rather than the formation and growth of technologies and services and presents a specific interest as they no longer separate the variation and selection process, thus 'quasi-evolutionary'. Arguing that both processes are guided by existing regimes which are an outcome of former innovations, they introduce the concept of niches or local practices at the micro-level where new technologies and services are formed. They perceived this niche as a 'nexus' which can become institutionalized through labs or networks and which should be protected to increase the survival of the innovation while the existing regime changes (Van den Belt & Rip 1987). Over time, the innovation can be partially incorporated by the existing regime and even transform the sociotechnical landscape (Rip and Kemp 1998). Thereby, sociotechnical landscapes are derived from the punctuated equilibrium perspective developed by technology management scholars. In the tradition of long-wave theories, they argue that innovations are a long-term evolutionary process of relatively stable changes, punctuated or interrupted by periods of radical change (Anderson and Tushman 1990, Mokyr 1990b).

Both approaches accept that the overall pattern of innovation is coevolution. However, as their main focus entails firms and organisations, this coevolution process is mostly analysed on an empirical micro-level of demand and supply. Considering new technologies and services as the main topic of research, coevolution becomes a much more complex phenomenon whereby changes in one component in a system trigger changes in other components. Moreover, during the 1990s relatively little attention was given to empirical research and economic modelling of long-term and large-scale innovations. Within large technical systems research, a wider perspective is applied to understand how innovations emerge – but not their transformation (Summerton 1994). Further, in the field of business and management some empirical case studies with a long-term and multi-phase perspective on innovation have been developed, though largely focused on industry and product innovation (Abernathy and Utterback 1978, Utterback 1994).

2. QUASI-EVOLUTIONARY MODEL FOR SOCIO-TECHNICAL CHANGE

Following the 1990s developments in this research field, a closely related group of economists developed a quasi-evolutionary model for socio-technical change. They have been strongly influenced by former evolutionary approaches which they reinterpreted in a model that analyses emerging innovations and the transition to new regime systems (Loorbach 2007). The model, commonly referred to as multi-level perspective (MLP) was articulated particularly in The Netherlands by Schot (1992) and Geels (2002). Geels (2007) defines the quasi-evolutionary model or MLP as a middle-range theory that structures overall dynamic patterns in socio-technical change. This implies that the MLP deals with concrete phenomena within socio-technical transitions rather than abstract entities like a system and aims to specify relationships between empirical research and well-founded concepts into analytical models rather than proposing elaborate frameworks with numerous theories. Within this research it is interesting to note that the MLP or quasi-evolutionary model for socio-technical change can be applied through elaborate single case studies by identifying reoccurring patterns (Geels and Schot 2007: 414). Following, elements in the MLP models will be highlighted, albeit selectively, to provide a structure that demonstrates how new technologies and services can drive innovation of an existing regime through the persistent creation of new niches.

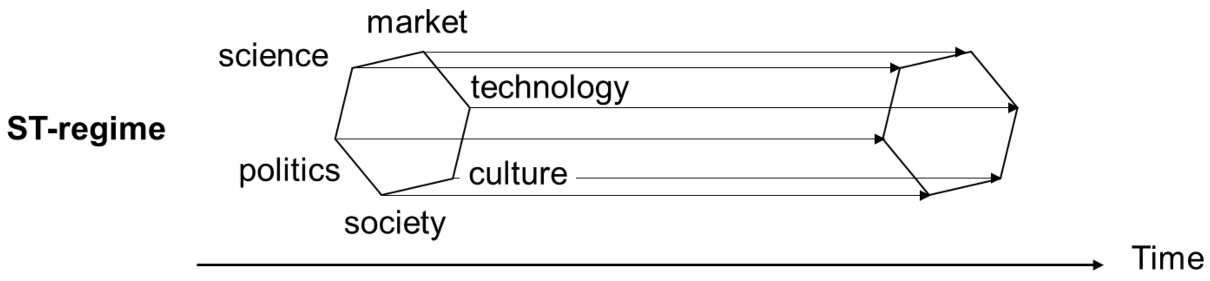
2.1 Analytical levels

The analytical model applies well-founded concepts from evolutionary economics, sociotechnical and quasi-evolutionary approaches, as well as structuration theory which deals with the effect of existing lock-in mechanisms and regimes on systems (Geels 2004). The MLP interprets socio-technical transitions as non-linear, dynamic processes that result from the interaction between 3 analytical levels: regimes, landscape and niches.

Regime

As correctly stated by Schot and Geels (2007), the technical regime is often underestimated in the work of Nelson and Winter (1982). Although their concept of cognitive routines found resonance in organisational learning research, the theory of a regime which defines the knowledge environment where problem-solving activities take place was mostly picked up by other evolutionary economists who interpreted it among others as a 'technological paradigm' (Dosi 1982) or 'techno-economic paradigm' (Freeman & Perez 1988). They understood the regime as 'the rule-set or grammar embedded in a complex of engineering practices, production process technologies, product characteristics, skills and procedures, ways of handling relevant artefacts and persons, ways of defining problems; all of them embedded in institutions and infrastructures' (Rip and Kemp 1998: 338). Regimes are coordinated by innovators and 'researchers with different beliefs attempt to sway each other with respect to these routines' (Garud and Rappa 1994: 347, quoted in Geels and Schot 2007). During the 1990s, influenced by multi-actor theory within sociotechnical research, this widely embedded hard and soft knowledge base was redefined as a sociotechnical (ST) regime. Thereby, innovation trajectories are not solely influenced by technical innovators, but also users, policy makers, civil society and other social groups.

Image 1: regime based on the sub-regimes of Freeman and Louça (2001), Vandesande (2017)

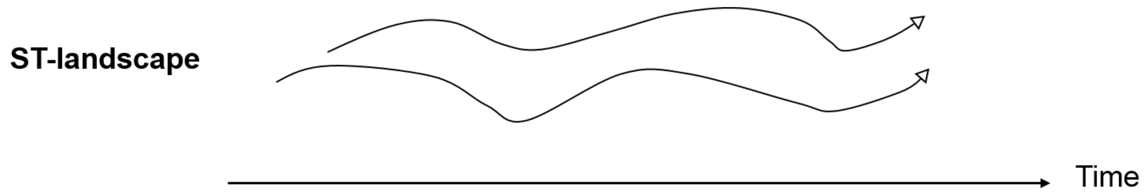


Within the MLP model, regimes establish stability within systems. Whereas existing regimes intrinsically entail lock-in mechanisms, innovation can only take place through small adjustments. These consecutive incremental innovations accumulating into stable trajectories, thus a stable dynamic. As previously noted, in evolutionary economic terms the regimes therefore acts as a selection and retention mechanism or 'deep structure' (Geels 2002). Moreover, these stable innovation trajectories do not only occur through technology, but also through services and dynamics in political, scientific, market and cultural dimensions. Thereby, every dimension has its own dynamics, coordinated by different 'sub-regimes' which also co-evolve with each other (Geels 2004). Within analysing a specific innovation case study, these sub-regimes can be determined according to different frameworks. For example, the PESTLE (political, economic, social, technological, legal and ecological factors) framework which are used to describe macro-environmental factors in strategic management. However, within this research, sociotechnical changes will be analysed according to the framework followed by Freeman and Louça (2001) who defined science, technology, economy, politics, and culture as 5 interacting sub-systems within their evolutionary approach. They state that their approach differentiates from other evolutionary economists as 'it attaches greater importance to science and general culture' and it does not attempt to assign primacy in causal relationships to any of the sub-systems at this level of the analysis (Freeman and Louça 2001: 124-125).

Landscape

The analytical landscape level can be situated in the context of the previously noted Kondratieff model and punctuated equilibrium perspective, but also has similarities with the 'longue durée' (Geels 2011). The latter was conceived by the Braudel when writing La Méditerranée (1966), in which he emphasized that history is a the long-term process and that events occur according a path that is rarely deviated from (Alvarez et al. 2011). Moreover, events and actions that take place within the analytical landscape level do not occur in a technical and material vacuum that sustains society. Within the MLP the this analytical level is similar to the regime as it is also denoted as landscape and a set of deep structural trends which contain a set of heterogeneous factors. However, in contrast to routines that define innovations within different social groups, the landscape entails an exogenous entity that introduces external factors to innovation trajectories. Changes within the landscape level occur at a slower pace, but have a radical effects within the innovation process. landscape changes can create a temporary window of opportunity for implementing innovations in the existing regimes (Geels 2002). From the section on sociotechnical transition trajectories, it will become clear that change can be initiated by actors and users who no longer adhere to the rules and routines of the prevailing regime.

Image 2: landscape based on Geels 2002



Niche

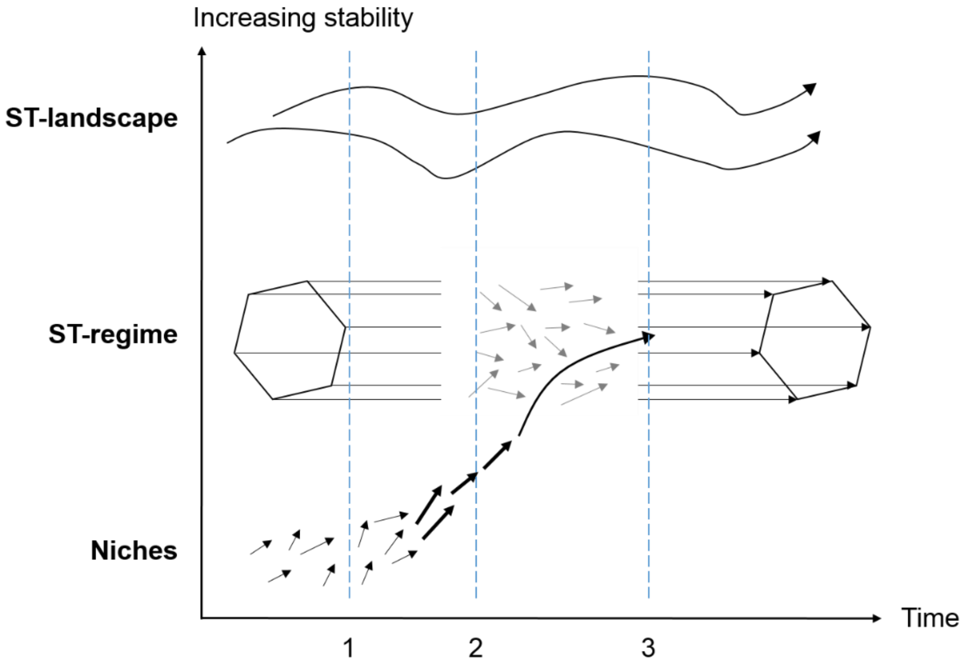
Niches or local practices at the micro-level where new technologies and services are formed, were already present in the original quasi-evolutionary model developed by Rip and Kemp (1998). Because of low early performance characteristics, innovations are often unable to fit within existing regimes. Niches are crucial for transitions as they provide spaces where the new technology and services can be further developed (Malerba and Orsenigo 1993). Therefore, niches should not be interpreted as fringe markets where the existing regime is inefficient and innovations can be introduced. In line with evolutionary niches in biology, they are protected spaces that provide locations for learning processes (Law & Callon 1988). Not every local sociotechnical experiment should however be referred as a niche, they only take place when a group of actors with shared views and routines hopes that their innovation becomes and aligned and used within the regime or even replace it. (Raven and Verbong 2007). In their literature review on innovation through niches, Kemp et al. (1998), Schot and Geels (2008) distinguish three core processes in niche development: (1) the articulation and adjustment of expectations or visions to attract interest and funding from external actors, (2) social network building to expand the innovation resource base, (3) learning and capacity building processes in different sub-regimes.

Image 3: Niches based on Geels 2002

2.2 Multi-Level Perspective

The foundation of MLP is that transition trajectories and consequent innovations are the result of interactions between the different analytical levels. Changes in the landscape level or internal regime tensions destabilise the existing regime, thus creating a windows of opportunity for innovations which have been developed in niches. The innovation reaches its stable configuration or 'dominant design' when the variety of new technology or service becomes more precise and widely accepted. Niches gain an internal momentum when networks become larger and related learning processes are aligned. In this process innovations can gradually stabilise into a new regime.

Image 4: MLP showing the different stage in the innovation process: 1) dynamically stable regime, 2) changes in the landscape level or internal regime tensions destabilise the existing regime and create a window of opportunity for a dominant niche, 3) stabilization into a new regime. Based on Geels (2002: 1263)



Herewith, the system approach towards innovation should be stressed. Every analytical level has its own heterogeneous rules and actors, which are more aligned and stable in the higher levels. Rather than a nested hierarchy, these levels relate to each other as 'derived concepts' whereby the regime is of primary interest and the niche and landscape levels are defined in relation to the regime (Geels 2005). As a result, transition trajectories are never a purely demand-pull or science-push, process (Shove and Walker 2007). Another important implication of the MLP's systems approach is circular causality. There is no single driver in the innovation process, but several dynamics in multiple dimensions which connect and strengthen or weaken each other (Geels 2011). Finally, the MLP introduces intervals and adaptations in the unfolding of socio-technical transitions that require a long-term perspective (Foray and Freeman 1993).

3. ONE MODEL VERSUS UNIQUE INNOVATIONS

As explained in detail in Chapter 2 of the ILUCIDARE Innovation Handbook, accepting that every innovation is unique implies a logical leap. But what does this imply for the MLP research methodology? Questions on the empirical soundness have been raised due to its complexity, broad unit of analysis, qualitative data usage and difficulty to pinpoint boundaries (Genus and Coles 2008). Although these arguments are recognised within the research process, their impact should be placed in a broader perspective. Keeping in mind the intrinsic link with open system thinking, the MLP is aimed more at networked systems research rather than solely rigorous quantitative data gathering analysis and replication. The empirical research of processes in complex, dynamic and networked systems implies dynamics like imprinting, path dependence, clustering and interaction, bifurcations, tipping points and thresholds, internal feedback loops and time delays (Vergne and Durand 2010). These mechanisms directly influence the innovation process and induce a very complex ontology for which no ready-made research approach is at hand, since 'most current scientific methods are not particularly well suited for research on change and development processes' (Poole et al. 2002: 4). This ontology-methodology balance does however not necessitate a radical compromise. Based on the examples indicated above, it can be stated that the MLP and its structural patterns hold for various innovation case studies. Thereby, the model has proven to be ***a highly qualitative research framework rooted in Darwinian metaphysics, actor-network theory, sociotechnical research and large technical systems research.*** Without reducing its research scope to the pitfall of formal theory, scientifically sound methods like comparative and nested case studies (Chong and Graham 2013), variation theory (Poole et al. 2002) and network analysis (Newman et al. 2006, Westaby 2012) can be applied. While the basic requirements of each innovation case study are – as in every scientific research – quality of data collection, critical interpretation of results and a well-founded conclusion, the MLP can be used and operationalised differently according to the type of innovation, focus of the researchers and the data collection methods. In short, 'the MLP should not be reduced to a mechanical procedure by forcing it into a variance theory straightjacket. The research of complex phenomena such as transitions cannot be reduced to the application of methodological procedures and will always contain elements of creative interpretation' (Geels 2011: 36).

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