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The role of cities in developing radical innovations: An analysis of niche-development in urban areas based on the Multi-Level Perspective

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Abstract

Thinking up new ideas and solutions might be hard; replacing old ones even more so. Ecological Modernization theory has helped significantly with the former, and now transition scholars are trying to resolve the latter. There is no longer a shortage of ideas on how to tackle issues of sustainability; however, these ideas are often translate into radical technologies that are incompatible with existing societal systems and cultures. These radical innovations need to be protected in form of niches, and brought into society as an increasing amount of people start to adopt and make sense of them. With its high concentration of heterogeneous actors, the city should – in theory – provide an ideal platform for niche development. This paper will discuss problems associated with niche development in urban areas, and offer a new way of conceptualizing cities by expanding on existing concepts of the multi-level perspective.

Keywords: transition studies, urban, sustainability, multi-level perspective, ecological modernization

List of Abbreviations

ECA – Ethnographic Content Analysis

EM – Ecological Modernization

ICLEI – International Council for Local Environmental Initiatives

MLP – Multi-Level Perspective

STRN – Sustainability Transitions Research Network

SZ – Switching Zone

UN – United Nations

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1.0 Introduction

The battle for sustainability will be won - or lost - in cities. This belief, echoed by academics and United Nation officials (UN News Center, 2012) alike, is a recognition that the city and municipality is fast becoming a setting in which global environmental issues ought to be addressed. At a glance, the increased focus on urban areas may seem a natural progression, given that a UN (United Nations Population Division, 2008) estimation placed half of the global population in cities; a figure expected to rise to 70 percent by the year 2050 (UN-Habitat, 2008). This shift is yet to be addressed in the form of enforced national and international governance (IEA, 2011), and in the absence of political pressure, the city might seem an unlikely champion of environmental action.

A core problem of sustainability is that our current socio-technical system, which is regarded as the culprit of our unsustainable modes of production and consumption, has become highly ingrained within society. This has occurred not just on a technical level, but also on social level, and this system is both shaping and being reproduced by our behavior. This has created a system that is highly locked-in, and any technology that challenges this stability will find it extremely difficult to influence, or even enter this existing 'incumbent' regime. This paper will explore the latter of these problems, and how radical, innovative technologies need to be developed in a sheltered environment, or 'niches', and to what extent the city can offer a platform for such development.

This paper will explore the concept of niche development within the growing field of transition studies, and its potential application to an urban context. Niche development describes a three-stage process, composed of shielding, nurturing, and empowering a niche, in order to integrate it into the mainstream. To this end, the paper will draw on the Multi-Level Perspective[1], a theory within transition studies, which conceptualizes socio-technical regimes as three distinct levels: niche, regime, and landscape. Within the discourse of potential sustainability trajectories for human society, Ecological Modernization (EM) has become the dominant framework with regard to countries – particularly industrial countries – need to adjust to the challenges of environmental issues. EM, at its core, is a theory founded on the notion that to overcome

[1] Geels (2011a) describes the MLP as a theory. Although it is debatable whether the MLP can be categorized as such, the terms 'perspective', 'concept', and 'theory' will be used interchangeably in reference to the MLP

problems related to sustainability, we need more, as opposed to less modernization. Given the focus on of Transition Studies on socio-technical regimes, the EM theory is largely the substrate of this field. Transition has emerged from EM, as a response to a number of shortcomings within this theory, most notably its reductionist assumptions of causality. In short, the objective of this field is to understand the social factors intertwined with large-scale, technological transitions.

Transition studies essentially tries to understand the inner workings of transitions. This is no simple task, and as Andrew Jordan (2010) puts it '… sustainability concerns nothing less than the future direction of human civilization. Is there anything more likely to generate discussion and dissent than this?'. Largely to blame are incumbent regimes, which are characterized by lock-ins and inertia It is for this reason that the importance of Transition studies is difficult to understate, as it attempts to grant us the knowledge and tools that will allow society to manage its own transitions (STRN, 2010).

In applying the MLP to urban areas, this paper will argue that niche development needs to enhance its focus on the 'nurturing' phase. After establishing a theoretical foundation, the paper will draw on a number of examples with transition literature that pertains to cities. The paper will conclude that to successfully nurture a niche in an urban context, requires a criteria for the selection of niches that is highly informed by the landscape-level, and that that 'landscape' rather being narrowly defined as a exogenous force that exerts pressure, it should be actively addressed, and influential, when nurturing niches. It will therefore dismiss the idea that a city can be conceptualized as a niche, since it fails to incorporate the diverse and malleable landscape that exists within cities.

1.1 Aim and purpose

Question 1. According to the MLP, how can the city be conceptualized to better understand the challenges of nurturing niches in an urban context?

Question 2. In the view of the MLP, who and what are the primary causal drivers of urban sustainability transitions, and how do they alter the ways cities can nurture radical innovations?

Aim:

Evaluate the extent to which the urban can be conceptualized as a niche or as a landscape, in order to create a theoretical foundation for subsequent analysis.

Highlight the various types of actors and drivers that play a crucial role in nurturing niches in urban sustainability transitions, and the extent to which they alter the process of niche development.

Purpose:

The purpose of this paper is to evaluate the extetnt to which the MLP can provide a useful perspective as to how niches can be nurtured in an urban setting. While the MLP has considerable breadth, there has been limited focus on the urban context of transitions (Hodson and Marvin, 2010). Additionally, real-world applications of niche development have had poor outcomes (Hoogma et al. 2002: 195), and this paper will suggest a new way to conceptualize cities, and that modest modifications can be made to the process of niche development, when applied to an urban context.

Furthermore, this paper will be written based on the assumption that the EM theory, after revisions, has managed to achieve a crucial milestone within the discourse on sustainability. In spite of there being no guarantee that the solutions envisioned by the EM theory are sufficient (York and Rosa, 2003), the theory has established common ground on which scholars, policy-makers, and environmentalists can agree. Transition scholars deem this convergence pivotal, as it establishes a guiding vision on which to grow transitions through the integration of innovative, radical technologies.

As mentioned in the introduction, the rationale behind the incorporation of an urban context into this paper is two-fold. First, cities are rapidly becoming hosts to the majority of the

world's population. Second, scholars in the field of urban sustainability transitions argue that cities are concentrated hubs of innovation (Bulkeley et al., 2010: 29). The objective of transition scholars is to both understand the dynamics of socio-technical transitions, and to ultimately advise on matters of policy in terms of how to instigate, manage, and accelerate transitions (STRN, 2010). Literature on this topic already exists, and scholars have made arguments regarding how the city should be conceptualized from perspective of the MLP. However, this paper will attempt to propose an alternate interpretation on how niches could be nurtured in an urban setting.

My personal interest in this topic stems from combination of interest. Firstly, I have always had a strong interest in technology, however what began as a strong interest in the 'next big thing' within the world of consumer technology, has gradually involved into an appreciation and fascination of society's technological progress. Secondly, this fascination has come to transform itself into an interest on where society is potentially headed; assuming this trend does not waver. One requirement for a sustained momentum is a sustainable society, which was eventually what grew my interest in environmental and ecological issues. The interest in urban areas was largely "catalyzed" by my nationality. Copenhagen recently won the Green Capital award, which prompted an interest in the city's ambitious Climate Plan 2025. However, early into my research I recognized that to conduct any research on the developments in Copenhagen, I would need to be more knowledgeable on matters related to urban sustainability transitions.

1.2 Delimitations

The purpose of delimiting a literature review, or any type of research for that matter, is to "[…]provide guidance for students on how to get started on their research project" (Bryman, 2012: 98). The following paper will be theoretical, and as such, certain delimitations have been established to prevent this paper to diverge from the research topic and questions. As a field originating in the Netherlands, the school of transition studies has an implicit focus on Western European nations, and therefore these following delimitations need to be highlighted.

Firstly, this paper will focus on urban contexts. It will refrain from discussing matters of international and national governance, and instead focus on the municipal governments and city networks. Literature will be selected on the basis that it either relates directly to cases of urban sustainability transitions, or if implicit relevance can be extracted. Second, the EM theory has

been criticized for its neo-liberal leanings (York and Rosa, 2003). This issue will be addressed in section on Risk Society, which highlights that the MLP pertains to a school of thought that conceptualizes an alternate path to ecological modernization, which stands in contrast to neo-liberal ideals. Thirdly, the paper will refrain from enter into the wider discourse on sustainable development, by having an explicit focus on cities in post-industrial nations. However, even with these delimitations, the topic is still too broad for a paper of this size. Therefore, the paper will be further delimited to Western European cities, due to their mixed composition of housing types and modes of transport (Næss and Vogel, 2012). Cases of cities within Western Europe will be used to support the theoretical claims made this this paper.

Finally, as a field of study, transition studies aims to extend beyond sustainability studies; an understandable ambition given that transitions do not occur exclusively within socio-technical regime. This paper will make no attempts to stray from sustainability transitions.

1.3 Definitions and key concepts

1. Ecological Modernization[2]

   "The only possible way out of the ecological crisis is by going further into the process of modernization" (Mol, 1995: 42)

2. Lock-ins

   "Established technologies that persist even when they are to some extent inferior to their new competitor" (Nill, 2009)

3. Multi-Level Perspective
   - Niche

     "[…] 'protected spaces' such as R&D laboratories, subsidized demonstration projects, or small market niches where users special demands and willing to support emerging innovations" (Geels, 2011a)
   - Socio-technical Regime[3]

     "The 'deep structure' that accounts for the stability of an existing socio-technical system. It refers to the semi-coherent set of rules that orient and coordinate the

[2] Ecological Modernization has diverged into two strands: strong and weak. The defining difference between these two is their primary focus: ecological or economistic, respectively. Further information on this divide is outlined by Peter Christoff (2006: 191).

[3] The 'socio-technical' regime will throughout this paper be referred to as 'regime'

activities of the social groups that reproduce the various existing of socio-technical systems" (ibid.).

- Socio-technical Landscape[4]
  "[Highlights not only] the technical and material backdrop that sustains society, but also includes demographical trends, political ideologies, societal values, and macro-economic patterns" (ibid.).

1.4 Limitations

The Ethnographic Content Analysis (ECA) method is highly reflexive and requires creativity on part of the user. This makes this method hard to replicate, especially when coupled with the creative interpretation Geels (2011a) refers to in terms of methods currently used by transition scholars. Given this starting point, and the nature of literature review in relying on secondary, written data, there is a risk that the researcher's interpretations may lead him or her astray. The ECA also highlights the importance of the researcher having a substantial knowledge of the research. Finally, in terms of the examples used to support the theoretical observations made in this field, there is a chance that the paper will lack depth and context, given that only a few cases were selected.

1.5 Disposition of thesis

To understand both the niche-development and the MLP, preliminary reading will be done on those subjects. In exploring niche-development, literature on both 'Strategic Niche Management' and 'Transition Management' will be covered, and subsequently outlined in the theoretical and conceptual framework. However, the paper will begin by outlining the method, which will be a literature review, drawing on Ethnographic Content Analysis to both collect and analyze the data.

The paper will proceed with an explanation of the background. This section will provide an overview of EM, transition studies, urban transitions, and risk society. The latter of these, 'Risk Society' has been included, granted its useful critique of EM theory, which has prompted a tangent within EM to consider more purposive responses to ecological and environmental issues. Scholars of transition studies largely adhere to this tangent. In discussion transition studies, the

[4] The 'socio-technical' landscape will throughout this paper be referred to as 'landscape'

social construction of environmental issues, and how our responses to issues are dictated by how we construct these problems.

The theoretical framework will cover the ontologies of the MLP, before covering the MLP itself. Alongside illustrations, the rationale behind the MLP will be elaborated upon, and how niches are conceptualized within the MLP. This section will conclude by covering the urban characteristics that will be discussed in the final section, and the problems with creating a universal definition of the 'urban'. The final section 'discussion' will be explained in the following data analysis sub-section.

2.0 Method

This study has been constructed as a literature review, in which the content of existing literature will be compared, interpreted, and synthesized to discover new meanings. It will conducted in two overlapping parts. The first part will be theoretical, focusing on the extent to which the urban can be conceptualized as either a niche or a landscape. The purpose of this is to analyze whether conceptualizing the urban as either will have significant implications for niche-development. To this end, the paper will explore the concept of niche-development within both 'Strategic Niche Management' and 'Transition Management'. This focus was chosen given that transition studies attempts to understand *purposive* transitions, which prompted an interest in the differing levels of agency possessed by various actors in the process of niche development. The purpose of this portion of the research was to identify the key actors, their distinct roles, and the interactions between actors that helped establish agency in the process of niche development. The second part of this research focused on how to translate this knowledge into an urban context, and by drawing on the characteristics of urban areas, to discover the causal agents and mechanisms in order to determine whether the city ought to be conceptualized as a landscape or niche.

Preliminary reading on the topic of Transition Studies, reveals the nascent state of this field, and even more so the MLP. In his paper, Geels (2011a) addresses a range of criticisms pertaining to the MLP. Geels notes that the purpose of the MLP is frame the discussion on transitions in order to elicit a certain type of questions that focus on patterns and mechanisms. He recognizes that the MLP is not a 'truth machine', but rather as a heuristic device to guide

researchers (ibid.). Based on this stance, and the embryonic nature of the MLP, assessing the concept deductively is likely premature, as it is currently in the process of producing itself inductively. However, this perspective has been sufficiently developed to be used as both an analytical tool and as an underpinning theory.

In a literature review, quantitative methods focus on subjecting hypotheses to empirical data, while in contrast, qualitative methods focus on existing literature to serve as '…context knowledge, which you use to see statements and observations in your research in their context' (Flick, 2009: 49). In an effort to provide new knowledge to a rapidly evolving field, Geels notes that the method used will require sufficient flexibility to make room for 'creative interpretation' (2011a).

To accommodate this creativity, this literature review has been *inspired* by Ethnographic Content Analysis (ECA)[5]. This method focuses on '… discovery, confirmation or extension of theoretical claims, and while not rejective of quantitative considerations, descriptive data is the main outcome' (Hansen, 2013). This method is essentially used to '… document and understand the communication of meaning, as well as to verity theoretical relationships' (Altheide, 1987). The ECA allows the researcher to interpret the underlying – latent – meanings of the data, rather than relying entirely on manifest data (ibid.). It is essentially a highly reflexive method that grant the researcher a cyclical tool to collect, interpret, and analyze data concurrently.

In short, the paper will draw on the MLP to construct a conceptual understanding of the city, in order to determine how the niche-development process could be understood in this context. In doing so, it draw on three examples found within the literature on urban sustainability transitions. It will evaluate the development of niches in each of these cases, using the three stages of niche-development, and frame this with a theoretical understanding of the MLP. It will do so with the aim to show the sequence of events and the type of interactions among actors that lead to a successful transition. This method will highlight the high concentration of heterogeneous actors as an urban characteristic, and the need for an extended understanding of the socio-technical landscape level within the MLP.

[5] An elaboration of the ECA can be found in the appendix, both in form of a flow chart (Fig. 4), and a comparison to Quantitative Content Analysis (Table. 1)

2.1 Unit of Analysis

The unit of analysis for this study is literature pertaining to the Multi-level Perspective, Ecological Modernization, and Urban Sustainability Transitions. This literature will be collected as both stand-alone articles from online publications, or as chapters in editorial books relevant to the subject matter. The literature will be selected on the basis on relevance in terms of topic, and from notable authors in these fields. The articles and books selected for this paper will be accessed through Google Scholar, and databases accessible through the Lund University library, and the databases accessible through Lubsearch.

As highlighted in the previous section, collection and analysis occurs concurrently as allowed by the ECA. Analysis and data collection for the initial part of the paper, in relation to the first research question, will focus primarily on actor interaction and levels of agency possessed by these actors. In contrast, the second part of the research paper will be guided by the findings of the first, in order to analyze empirical evidence used to by transition scholars to make their argument.

2.2 Sampling

The ECA permits the researcher to use theoretical and purposive sampling. These methods are both non-probability approaches (Bryman, 2012: 418). Purposive sampling, is described by Bryman as a method that '… is conducted with reference to the goals of the research, so that units of analysis are selected in terms of criteria that will allow the research questions to be answered' (Bryman, 2012: 418). This criteria will be set by literature on niche-development, literature on the MLP, which provides an understanding of the relationships between niches, regimes, and landscapes.

For the purpose of this paper, the sampling will be sub-divided into two types of purposive sampling; theoretical sampling and generic purposive sampling will be applied to the first and second research question respectively.

Theoretical sampling aims to 'discover categories and their properties and to suggest the interrelationships into a theory' (Bryman, 2012: 420). The criteria for selecting literature in this research was the MLP, urban sustainability, and EM. This approach is fits the first question, due its abstract nature, and reliance on latent, rather than manifest content.

This type of sampling helped highlight three significant elements in the niche process:

1. The critical and deciding role the nurturing process has in the overall process of niche development
2. The organic and highly uncontrollable nature of this phase
3. The high degree of variation among the nurturing stakeholders, when selecting whether to support a certain niche

Generic purposive sampling stands in contrast to theoretical sampling in that '… sampling is conducted purposively but not necessarily with regard to the generation of theory and theoretical categories and inferences' (Bryman, 2012: 422). This approach is suitable for the part of the research, given its more empirical nature. Bryman (2012: 422) notes that this approach, when selecting cases and contexts, a criteria will need to be established with regard to the cases that have been selected to address the research question. This type of sampling was used in the latter part of the research, to highlight the actors in the development of niches in an urban context, and their role in the selected cases.

2.3 Data Analysis

In the process of reading the literature, certain 'themes' emerged. Examples of these themes include: breadth and depth of actor involvement (municipal government, utility providers, civil society, corporate sector), level of agency of certain actors at certain times of the niche-development process, and urban characteristics that enhance the nurturing phase of niches. Understanding niche-development is pivotal, as niches are, for the most part, something we can control and protect. However, as will be discussed in the analysis, the most important phase of niche-development is the least controllable.

The analysis will evaluate the three phases of niche development to determine whether, and to what extent, the city can be categorized as a niche or a landscape. Once this has been determined, it will proceed to analyze transition literature that have focused on contemporary developments in the cities of Graz and Freiburg, and a historical case of the piped-water transition across cities in Holland. It will use the aforementioned themes to determine how niche development occurred in these cases. This analysis will highlight the shortcomings of the narrow understanding applied to the socio-technical landscape, and how this inhibits the niche-development process.

The discussion will not be divided to answer these research questions separately. The second question will be included in the analysis in form of examples, to strengthen the arguments made when addressing the first question.

3.0 Background

In this section, the underpinning theory of EM and its upsurge will be described, along with relevant critique relating to this theory. Diverging from the topic at hand, the following section will draw on a duality constructed by Maurie J. Cohen (1996), who in an effort to relate EM theory and Risk Society theory, has produced a useful framework that highlights the path transition scholars believe is more likely to bring us to a state of ecological modernization. Cohen's work is arguably outdated in many respects, but for the simple purpose of illustrating – to the reader – the diverging path in EM theory that transition scholars adhere to, it should provide some clarity. The section will continue with an overview of transition studies, coupled with an outline of the social construction of environmental issues – another dimension on which *some* EM proponents and transition scholars differ[6]. This section will end with a brief discussion on the difficulty of defining the 'urban', and the reasoning behind the choice to highlight a number of key characteristics instead.

3.1 The rise of Ecological Modernization

Ecological Modernization has risen to prominence over the past two decades. Its rise is however not a product of its theoretical merit, but rather its inherent appeal to the incumbent regime (Buttel, 2000). Christoff notes that the EM can be seen as a process of political accommodation of radical environmentalist critique (2006: p. 185). Unlike theories such as De-growth, and philosophical positions such as Deep Ecology, EM does not require human societies to radically alter its behavior, but rather redirect a higher proportion of its resources toward technologies and methods of production deemed more sustainable. It effectively tries to utilize the power of human ingenuity for the purpose of harmonizing economic advancement with environmental improvement (Cohen, 1997). In other words, where other schools of thought have promoted a message of less production and consumption, EM calls for more modernization and industrialization (Buttel, 2000). Specifically, they refer to this process as super-industrialization,

[6] Emphasis on the word 'some', as it would be incorrect to say there is no variation among EM proponents, as signified by the divide between 'strong' and 'weak' EM

yet argue that this development needs to be steered and constrained by political conditions (ibid.). It is important, however, to note that EM is not going to increase production and consumption in and of itself. In this instance, the term 'super-industrialization' may in fact discourage and confuse readers, and create unnecessary confusion given what the term insinuates. The logic behind the theory does not appear exclude the possibility (or rather, probability) that there will be a temporary reduction in production and efficiency while technological systems adopt greener sub-systems. However, EM does provide a vision of sustainability conducive with existing modes of thought. Due to this conduciveness with existing, and dominant schools of thought, EM has successfully integrated issues of sustainability into the political and economic agendas around the developed world (Bakari, 2014).

3.2 Criticism of Ecological Modernization

In spite of the relatively warm reception of this theory, it is not absent criticism. Ecological Modernization has been sub-divided into two categories: 'strong' and 'weak'. The 'strong' version focuses on the re-localization of consumption and production (Christoff, 1996: p. 495). This 'strong' form of Ecological Modernization essentially conceptualizes environmental and ecological problems as a new 'tragedy of the commons', in that it argues for a restriction of physical boundaries to promote competition. It believes that in addition to re-localization of production, new values need to be nurtured within this space to encompass human and environmental rights, social learning, and critical reflexivity (Blewitt, 2008: p. 47). On the contrary, the 'weak' variation of the theory, assumes the view that capitalism is capable of reforming and reorganizing itself to become sustainable (ibid.). This division in perspectives highlights not so much an ideological divide, but one based on degrees to which society ought to pursue purposive action, rather than relying 'organic' technology- and market-driven initiatives. Furthermore, critics have noted that proponents of Ecological Modernization expect that late modernization will have the necessary 'self-referential mechanisms' that will play a crucial role in its transformation (York and Rosa, 2003). The theory proceeds to make the ambitious assumption that, to a greater or lesser extent, economic growth is only restrained by human knowledge (Bakari, 2014). In a critique of modernity, however, Risk Society highlights some of the notable flaws within the Ecological Modernization theory, by arguing that the consequences

of environmental degradation will likely distract modern society from tackling environmental problems at their source.

3.3 Risk Society

Risk Society, a theory postulated by Ulrich Beck describes a new reality whereby Modernization and our industrial society has created a range of new risks that are in a category of their own. These risks are for the most part undetectable by our senses (Cohen, 1997), and characterized by dispersed risk and thus lack of accountability (Beck, 1992: 98), unpredictability, and immeasurability (Blewitt, 2014: 63). In the early stages of modernity, these trends were negligible due to the overriding priority of overcoming scarcity (Cohen, 1997). However, as technology has advanced, the level of risk has risen dramatically. Nuclear power, genetically modified organisms, toxic chemicals are all associated with high degrees of risk. Given the vested interests in these technologies, and that their side-effects are largely imperceptible, corporations and governments have actively tried to hide or downplay these adverse effects (ibid.). Beck (1992) argues that these side effects have reached a level, where they can now be viewed as one of the primary determinants of social stratification. In other words, people are stratified by the degree to which they are exposed to risks caused by Modernization. Aside from creating a new dimension by which we can define the less fortunate people in society, Risk Society proceeds to outline a trajectory that could potentially dispel any chance of Ecological Modernization.

In her paper, Cohen (1997) attempts to join the duality of EM and Risk Society into a combined framework. The following framework in Figure 1, depicts the different futures envisions by both Ecological Modernization and Risk Society.

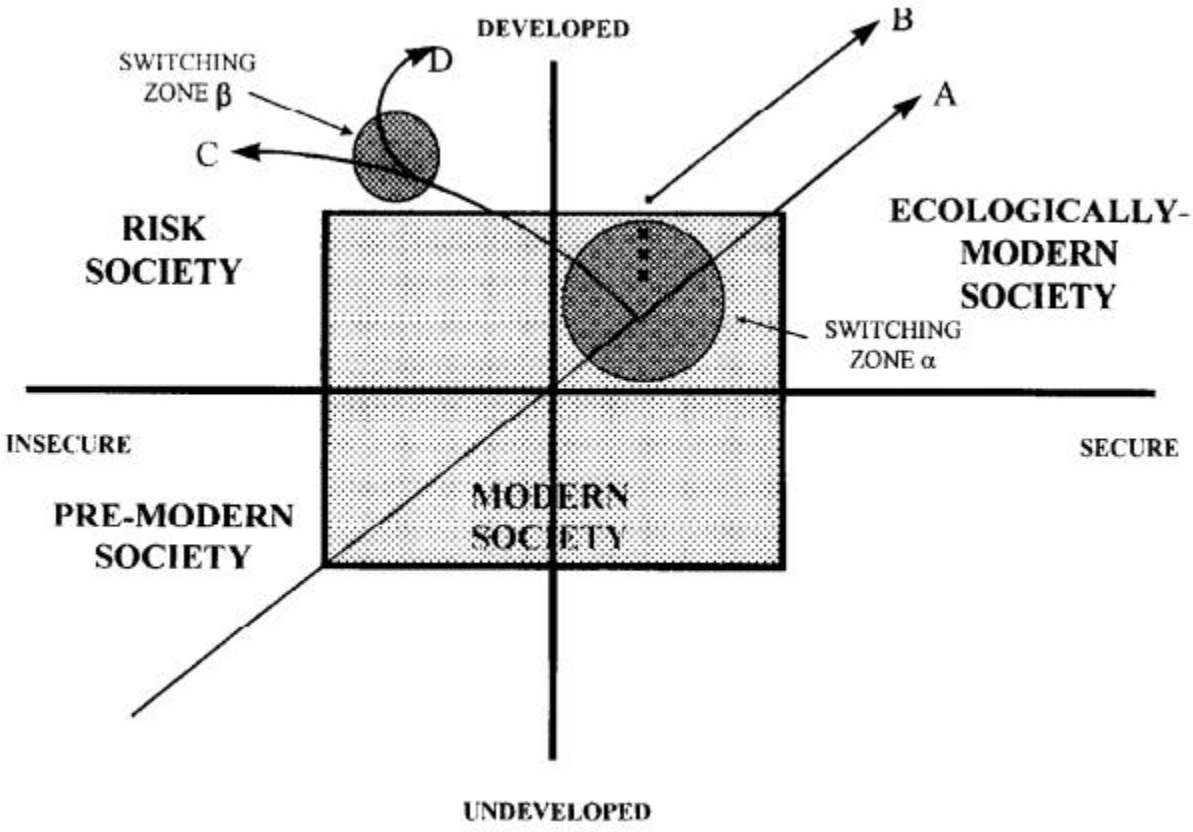

Figure 1. Technological environmental risk and development (Cohen, 1997)

The horizontal axis conceptualizes the degree of environmental and technological security, while the vertical axis portrays the typical development process seen in modern, industrialized countries, ranging from third world, pre-modern societies to advanced, post-industrial nations (ibid.). The central square represents the stage in which a society is considered modern (ibid.). The arrows denote paths in which society might develop, based on both external factors, and decisions made internally. Pathway A outlines an evolutionary process; one in which society will reach a threshold where marginal increases in material accumulation and economic growth hold less value than the preservation of the environment in which it would otherwise harm (ibid). This pathway largely relates to the aforementioned 'weak' type of EM, in which proponents assume that modern societies will have sufficient self-referential mechanisms that will, for example, internalize externalities due to a natural shift in values (Blewitt, 2014: 63). Cohen argues that this pathway is highly unlikely, and that its adherents fail to recognize that

EM is 'neither preconditioned nor inevitable' (1997). Pathway B, on the other hand, recognizes that to reach this stage, societies will have to '…substantially modify its institutional structures, develop new policy tools, and adapt its lifeways to accommodate environmental limits' (ibid.). This 'discontinuous leap' is represented by the dotted line leading up to pathway B, at which point society should, according to proponents of EM, be capable of advancing economically, whilst preserving a high level of technological- and environmental-security (ibid.). This leap can only be accomplished while society is within switching zone α (or SZ Alpha). SZ Alpha is a period of uncertainty, characterized by a complex process of social negotiations, in which alternatives are evaluated, and political, economic and cultural capabilities are assessed. According to the Risk Society theory, failure to complete this leap will lead society down a different trajectory.

Pathway C describes a scenario of increasing insecurity, resulting from the mismanagement of hazardous technology (ibid.). This path occurs from society's inability to make the necessary institutional adjustments to achieve Ecological Modernization. This type of society is marked by episodic events of environmental and technological crises. Beck notes that this type of society might be similar to the type that caused the issue, except with a "social preoccupation with the threats of technology" (ibid). In short, this scenario delineates a society fully preoccupied with adaptation measures and damage control, unable to devote time and resources to mitigating and addressing the root of the various problems. This portrayal is represented by switching zone β (or SZ Beta), which is marked by a state of perpetual, societal anxiety. These society are not confined to this zone indefinitely, however, as displayed by pathway D. This pathway will allow societies to recuperate and formulate restorative strategies, which recognize the fallibility of contemporary forms of scientific progress, and instead promote technologies that provide for social learning and institutional flexibility (ibid.). Unlike pathway B, pathway D is markedly more evolutionary, than discontinuous, involving the promotion of humanity over economic determinism and more stringent and accountable administrative structures that oversee technologies that have collective ramifications (ibid.)

The pathways to EM are highly dependent on the types of policy approaches that the society implements. Within EM there are three generic policy systems, which differ in terms of degrees of disruption to the system (Unruh, 2002). End of Pipe (EOP) is a policy approach which

attempts to internalize externalities. This policy approach is the least disruptive, as it merely seeks to compensate people and the environment from the adverse effects of disruption. Continuous policy approach, focuses on modifying components within technical systems, while maintaining the overall structure of the system (ibid.). Finally, there is the discontinuous approach, which aims to replace a system entirely. The EOP is viewed as a temporary, short-term solution, since it in the long-run it will be more expensive than its counter-parts. The continuous approach may be more effective at lowering inertia in a system, but it often fails to create optimal solutions. Discontinuous policies provide, in theory, the optimal solutions yet they are notoriously difficult to implement (ibid), as they are by definition, incompatible with existing systems in society. These policies should not be confused with the pathways, although they may share terminology. For example, pathway B, which is characterized by a discontinuous leap, is not necessarily achieved through discontinuous policies, these types of policies are simply more prevalent in this pathway. One notable difference, however, is that once you move beyond EOP solutions, social elements begin entering the equation, and influencing the degree of success (Geels, 2011a). In other words, Transition scholars deem the 'organic' pathway A to be a product of reductionist ideas with regard to how transitions occur.

3.4 Transition Studies

In basic terms, the 'need' for Transition Studies is apparent in Figure 1. Transition studies essentially investigates the social dynamics in SZ Alpha. In this zone, society's future direction is still uncertain (Cohen, 1997). Of the three pathways extending from this switching zone, only two can be deemed desirable. Differing on the degree to which purposive action is needed, pathways A and B describe two different paths to Ecological Modernization, while pathway C is a product of inaction or mismanagement. Both inaction and mismanagement can stem from the contestation and negotiations taking place in this switching zone (ibid.). Of these two pathways - A and B - Transition Studies adhere to the latter. Transition scholars recognize that management of transitions requires the involvement of the state. This belief is founded in the idea that private actors have limited incentives to address sustainability transitions, because the objective relates to a collective good (Geels, 2011a), which makes it subject to free rider problems and prisoner's dilemma (ibid). Echoing this, Elzen et al. (2011) argues that public authorities and civil society are crucial in framing economic conditions, such that externalities are internalized, and 'green'

niches can be nurtured. In other words, drastic reconfiguration of existing institutions and governmental oversight are required to ensure a sufficiently 'discontinuous' shift.

Transition scholars have joined to create the Sustainability Transitions Research Network. The purpose of this network is to combine the various different works on transitions to both deepen scientific understanding of transitions (STRN, 2010), and to give the field legitimacy to the point where it can become a leading resource for practitioners (ibid.).

The MLP (and Transition Studies as a discipline) diverges from EM by how it socially constructs environmental issues. Transition studies is an extension of EM, which focuses on understanding the processes in pathway B.

3.4.1 Social Construction of Environmental Issues

The construction of social issues is recognized as a prerequisite for purposive action to solve a particular problem. Transition scholars consider this process as pivotal in creating a shared vision on which to act. In terms of environmental issues, the belief is that issues are not created by some 'fixed, asocial, self-evident criteria' (Hannigan, 2006: 63). Instead, social issues are created by a number of actors, or 'claim-makers' (ibid.). The degree to which a society chooses to tackle a given problem, is determined by the success of these claim-makers. Environmental issues stand in contrast to social issues in terms of how they are derived. Where social issues are often treated as moral issues, environmental issues are based on factual evidence.

The social construction of environmental issues essentially involves highlighting a problem, and subsequently allowing it to undergo a highly contested process of integration into society. This process is largely one of rhetoric (Hannigan, 2006: 64-66), which involves creating grounds for the claim (basic facts that shape the discourse), warrants (justifications for demanding action), and conclusion (outlining what action needs to be taken). At this stage in the process, power is unevenly distributed towards those with the means to frame the dominant discourse for the masses, be it newspapers, politicians, or NGOs. The process itself, at a more technical level, focuses on animating, legitimating, and ultimately demonstrating the problem (ibid.).

In some places (and at certain levels of society) around the world, this discourse appears to have settled, and has progressed from questions on what to do, and instead asks how to do it, and what that entails. The problem has, in other words, been socially constructed, in large part due to the EM theory. Furthermore, the urban is one such level where tangible and often ambitious plans are enacted to address issues of sustainability.

3.5 Urban Transitions

Defining the 'urban' is no simple task. Weeks (2010) defines the urban as "… a place-based characteristic that incorporates elements of population density, social and economic organization, and the transformation of the natural environment into a built environment". He notes that the urban was previously defined as a high concentration of people, living predominantly nonagricultural lives. In a historic perspective, this might have held some merit, however, in today's world, where an ordinary office worker can be connected to his work almost anywhere on the planet this is no longer the case. The reverse is similarly apparent in the efforts to incorporate farming into urban life, be it through local initiatives in rooftop gardens, or vertical commercial farming. In other words, while people are increasingly migrating into ever-growing cities, numerous other characteristics that previously defined the urban-rural divide are fading.

There will therefore be no single definition of urban used in this paper. Instead, the paper will discuss the notion of the 'urban', as pertaining to a range of contemporary characteristics of Post-Industrial cities, which are deemed relevant to the topic of urban sustainability transitions. The characteristic of a sustainable urban area will be discussed in the section 4.4.

3.5.1 ICLEI

In parallel to the efforts of individual cities, a network of cities has been established to help share accumulate and share knowledge. The International Council for Local Environmental Initiatives is a network of local governments, and national, regional, and local government organizations that seek to achieve sustainable development. This association serves as a testament to the growing recognition that the urban context is a promising platform for tackling contemporary climate issues.

4.0 Theoretical and Conceptual Framework

The primary concept of this paper is the Multi-Level Perspective. The origin of this concept can be traced back to a chapter in the book 'Human choice and climate change: an international assessment' by Steve Rayner and Elizabeth L. Malone in 1998. In this book, Arie Rip and René Kemp were the first authors to use the concept. The rise of this concept can, however, be largely accredited to Frank W. Geels, a Professor of System Innovation and Sustainability at Manchester University, who has an extensive record of writing on the topic of the MLP. A notable contribution of his work has been to aggregate and synthesize literature on the MLP, and he will therefore be a key author referenced in the following sections.

4.1 Characteristics of urban areas

The urban setting has a plethora of unique characteristics that can both impede and support sustainability transitions. First, and perhaps most obvious, is the high density of people who both live and work in the city. These people are highly heterogeneous, and differ to varying degrees in terms of income level, education, profession, interests, means of transport, type of houses they inhabit, etc. Second, the urban setting is characterized by the fact that it is a *built* environment, with emphasis on the past tense. Not only is the urban something constructed entirely by human beings, exemplifying the high degree of power we have over our physical environment, it also restricts radical change, due to the fact that existing buildings, and especially infrastructure, take years, maybe even decades to replace.

With that said, perhaps the most notable characteristic of urban spaces is that they are spaces designed to be livable. In terms of identifying potential niches, this offers a number of different starting points. For example, while one of the most pressing issues with regard to automobile use is carbon dioxide emissions. In the context of spaces being livable, there are a number of different issues associated with car use, such as local pollution, both in terms of toxic particles *and* noise. Congestion, as well as available parking is another major problem with car use within cities. While these aspects of car use may not directly relate to the major issue of climate change, they do offer a platform for creative strategies to reduce the use of CO2-emitting automobiles altogether. In dealing with noise pollution, for example, electric cars produce substantially less noise than conventional automobiles.

Finally, on top of the previous characteristics, is the fact that the municipal-level of government is the lowest and most accessible form of government. This means that there is *potential* for close cooperation between the local government, business, and civil society to exist. The importance of this characteristic can be seen in Freiburg, in the second section of the discussion.

4.2 Ontologies of the MLP

Ontologies are defined as 'foundational assumptions about the nature of the (social world) and its causal relationships (Collins, 1994). Within (social) ontologies are causal mechanisms, agents, and assumptions. Understanding the ontology of a given approach or perspective is crucial, especially with multi-dimensional concepts such as socio-technical transitions. The MLP draws on two ontologies as basis for its analysis. In doing so, it draws on a meta-theoretical position known as 'inter-ontology crossover', in which differences between ontologies are recognized, but focuses primarily on their 'dynamic interplay' (Geels, 2010). This approach captures dynamic relations between 'agency and structure', 'change and stability', 'material interests and symbolic meanings', and 'rational strategy and institutional embeddedness' (ibid.). The ontologies that the MLP combines are 'Evolution theory' and 'Interpretivism'.

4.2.1 Evolution theory

Evolution theory view the causal agent as a population of heterogeneous agents; essentially a number of different actors with different interests and beliefs. In the context of socio-technical change, the 'agents' manifest themselves as firms, markets, and innovative entrepreneurs. An assumption made in this theory is that these agents (or actors), are subject to bounded rationality due to limitations of information processing. At this 'micro-level', the causal mechanisms within this ontology are variation, selection, and retention (ibid.). Variation refers to the naturally divergent paths followed by its agents such as firms in a competitive environment – however their search for a competitive advantage often does not stray far from their standard procedures and operations due to lock-in. Selection refers environment in which products succeed or fail, or 'market feedback' (ibid.). This can be conceptualized as another dimension of lock-in, whereby users are often weary of adopting technologies that are too radical, or too incompatible with their current lifestyles, unless they make notable changes or sacrifices. For

example, electric cars do not qualify as a direct substitute for gasoline powered cars, until they can be charged in the same amount of time as it takes to fill up a conventional car. Finally, retention refers to the calculated decision firms make on what routines need to be replaced, or retained. Retention is naturally a pivotal objective for firms, and the degree to which incumbent firms diverge from their existing routines and practices can be greatly affected by the presence of niches.

4.2.2 Interpretivism

Interpretivism is an ontology oriented around agency, and actors searching for meaning through interpretation (Geels, 2010). Understanding interpretation means understanding the factors that precede decisions, since actors first need to make sense of the world before they act. The causal mechanism in this ontology are conversations, debates, negotiations and learning processes (ibid.). These learning processes go beyond mere feedback processes, and are also products of both reflection and sense-making. This ontology relates to the concept of Structuration by Gidden (1984), which perceives structures as both rules and resources, arguing that actors creatively interpret rules, and in doing so continuously and in large numbers, effectively modify structures over time. These changes can be seen in incumbent regimes as they learn from the development of innovations targeted towards a problem, and the severity of said problem. Argyris (1976) argues that this learning process can come in two forms, single- or double-loop learning. The former, single-loop learning, refers to strategies adopted by firms who believe that solutions to a certain problem can be met within the current regime, and therefore focus on incremental innovations. The latter, double-loop learning, instead refers to the uprooting of existing beliefs to accommodate for a new reality (Geels, 2010). Lant and Mezias (1992) outlines this a three-step process of recognizing that existing believes need to change (unfreezing), adapting and learning to new conditions (double-loop learning), and stabilizing by creating new routines and practices (refreezing).

These learning processes are also products of interpretations, and interpretivism conceptualizes transitions as a product of the convergence of these interpretations. Achieving convergence is crucial; without it, aligning different stakeholders and actors around a specific objective is impossible. These stakeholders may interpret and rank these problems differently (Geels, 2010). In addressing this issue, Stirling argues that ‘Sustainability transitions should

[therefore] not be as technocratic challenges, but as deliberative social learning processes" (2007).

4.2.3 Inter-Ontology crossover

The ontologies of evolution theory and interpretivism share a number of similarities. They both perceive actors as creative and heterogeneous. The two ontologies also assume that actors are embedded in regimes, and both focus on processes and temporal factors, meaning that they offer explanations for both incremental and radical change (Geels, 2010). The purpose for this crossover is to explain the mechanisms of evolution theory in sociological terms. In so doing, variation becomes steered by expectations, visions, and beliefs, which provide 'cognitive substance' for search- and innovation-processes (ibid.). Selection is conceptualized as a multi-dimensional selection-environment, 'integrating markets and regulations', as well as 'social, cultural, and political requirements' (ibid.). Retention occurs in the socio-technical regime, and is understood in terms of structuration, in the sense that rules are followed with creative interpretation, leading to a process of institutionalization through negotiation and contestation (ibid.).

By combining these ontologies, the interactions within and between the levels of the MLP can be understood. Geels (2010) draws on behavioral learning within evolution theory, and cognitive learning within interpretivism to explain the reproduction and incremental adjustments within incumbent regimes. He further elaborates on the interaction between radical innovations and regimes, by conceptualizing them as 'variation' interaction with a 'selection' environment, which should not be seen as merely a market, but instead as a combination of markets, social, cultural, and political dimensions. These terms and concepts, and their relationships will be further elaborated upon in the upcoming section.

4.3 Multi-Level Perspective

Transitions are not easy to stimulate, let alone manage. The emergence of transitions can come from a wide variety of sources. By combining ideas from Evolutionary Economics, Science and Technology Studies (STS), Structuration Theory and Neo-Institutionalism, one creates a perspective which perceives transitions as "a non-linear process that results from the interplay of developments at three analytical levels" (Geels, 2011a). The product of this theory are three levels that are defined by their level of stability, in terms of their configuration of

heterogeneous elements. These three levels are niches, regimes, and landscapes, each becoming progressively more stable due to the number of actors at each level, and alignment between their elements. The MLP is a middle-range theory, which Merton (1968) defines as:

"Theories that lie between the minor but necessary working hypotheses that evolve in abundance during day-to-day research and the all-inclusive systematic efforts to develop a unified theory that will explain all the observed uniformities of social behavior, social organization and social change"

Geels (2011a) describes this theory as "a middle-range theory that conceptualizes overall dynamic patterns in socio-technical transitions". The niche level refers to the locus of radical innovation development, and can be conceptualized as 'protected spaces'. The regime refers to the level at which established institutions and socio-technical systems exist, following a set of practices and rules that stabilize their position in society (Geels, 2004). Finally, the landscape refers to the level where exogenous influences interact with the regime. Important to note, is that the regime is the level of primary focus in the MLP, and the 'niche' and 'landscape' levels are both defined in relation to the regime.

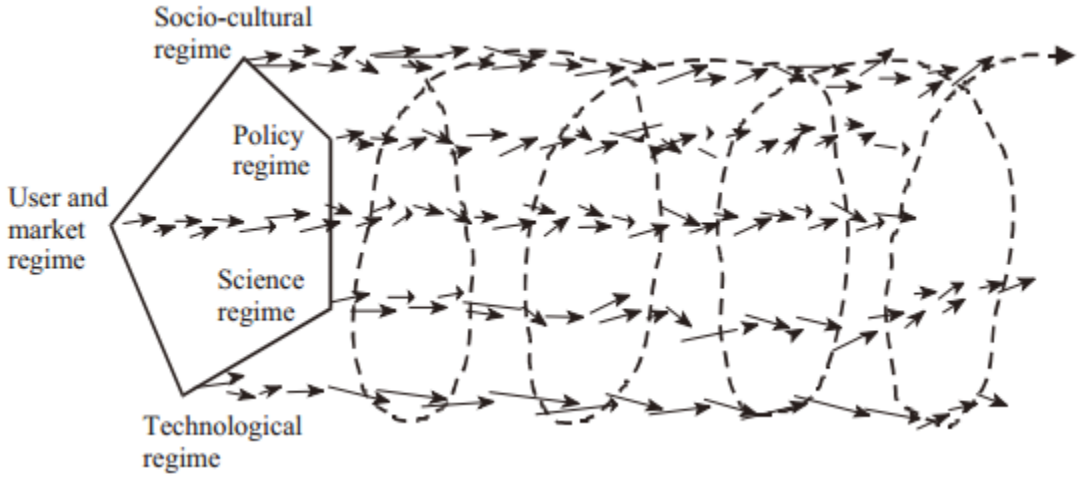

Figure 2. Alignment of ongoing processes in socio-technical regime (Geels, 2011a)

To visualize the dynamics of the regime, Geels (2011a) provides Fig. 2. 'The socio-technical regime forms the 'deep structure' that accounts for the stability of an existing socio-technical system' (Geels, 2004). Fig. 2 portrays how trajectories that stabilize socio-technical regimes are not only products of technological development, but are constructed from the co-evolution of science and technology with politics, markets, and user preferences (Geels, 2011a). Progress within socio-technical regimes necessitates the alignment of these sub-regimes. As described in the previous section, incumbent firms rarely stray far from their original product. Coupled with the requirement of alignment of other regimes, progress within the socio-technical regime, absent any external pressure, will invariably be incremental.

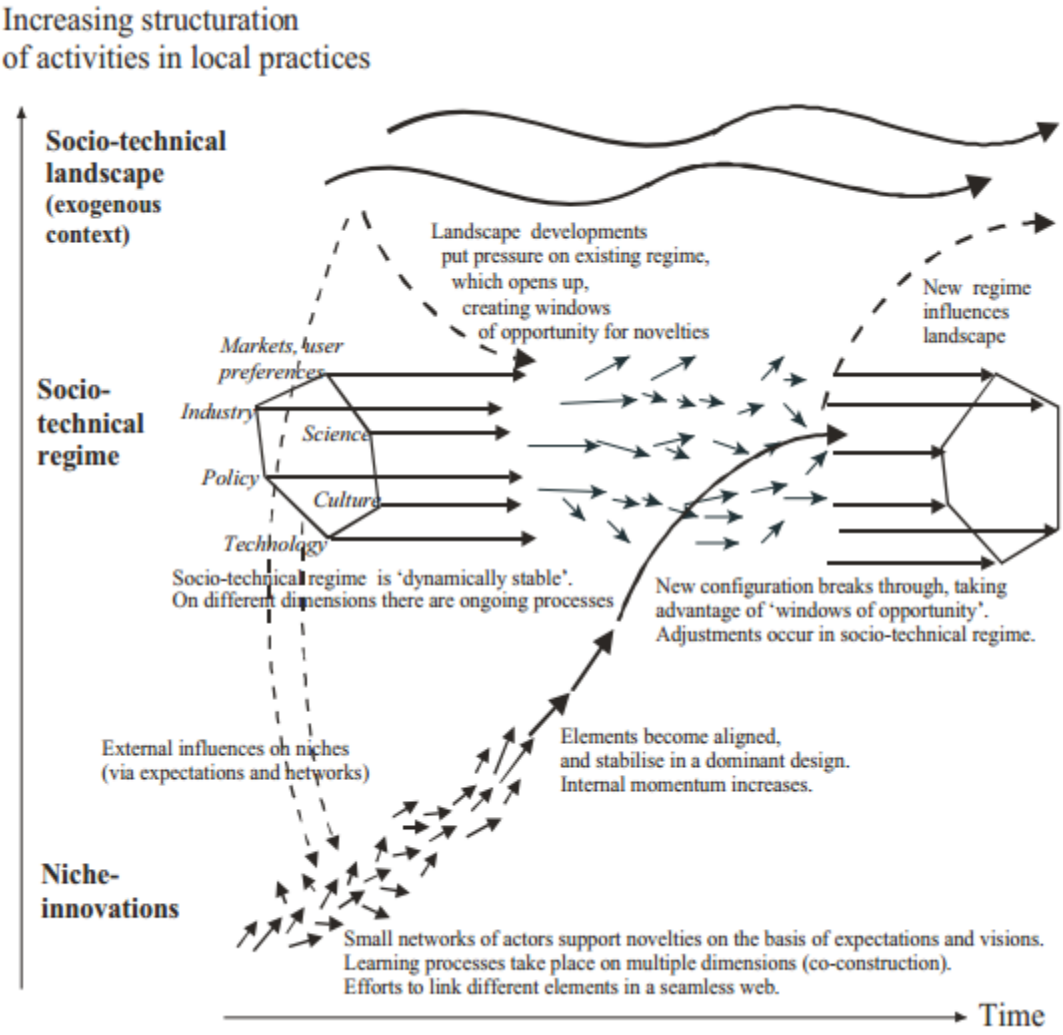

Figure 3. Multi-level perspective on transitions (Geels, 2011a)

Socio-technical regimes organize and stabilize themselves around semi-coherent rules, by organizing the various actors that interact within it. (ibid.) Examples of these rules include shared

beliefs, capabilities, and user practices. In the logic of the MLP, the regime cannot radically alter itself from within, and therefore require pressure from both the landscape- and niche-level.

Within the MLP, the niche-level is conceptualized as 'protected spaces'. Examples of these include R&D laboratories, subsidized demonstration projects, and markets where consumers have special demand (ibid.) The main objective of a niche is to provide 'safe haven' for an innovation, thus grant them both time and resources to integrate into the mainstream. The objective of the niche is to outgrow this stage. In contrast, niches in a more conventional sense have inherent value, particularly within sub-cultures of popular culture, where people actively try to preserve niches, rather than grow them into the mainstream. These niches struggle to gain ground for a number of reasons. On top of lock-in mechanisms within incumbent regimes acting as barriers to new entrants, radical innovations are, by definition, incompatible with the overall selection environment. However, since niches are recognized as key catalysts for systemic socio-technical change, efforts have been conducted to understand the processes underpinning successful niche-implementation. Two such attempts comes from Schot and Geels (2008), and Smith and Raven (2012), who each emphasize three processes of niche development:

- Schot and Geels (2008)
    1. Articulation of expectations and visions
    2. Social network-building
    3. Learning and articulation processes
- Smith and Raven (2012)
    1. Shielding
    2. Nurturing
    3. Empowering

Although both sets of authors point to three stages of niche development, the stages are not merely different conceptualizations of the same process. In a number of ways, Smith and Raven's (2012) work constitutes a more elaborate description of the process of niche development.

Shielding, for example, means to protect a niche from mainstream selection pressures. These pressures occur not just within the market, but also involves the pressure on niche-actors to select the correct radical innovation to support and develop. This 'correct' selection process is

based largely on the prospects of integrating the niche into the socio-technical regime. Shielding is either *passive* or *active.* Passive shielding is defined as '… generic spaces that pre-exist deliberate mobilization by advocates of specific innovations, who exploit the shielding opportunities they provide' (Smith and Raven, 2012). Active shielding is defined as '… spaces that are the result of deliberate and strategic creation by advocates of specific path-breaking innovations to shield regime selection pressures' (ibid.). Shielding occurs for numerous reasons, be it the inability of the innovation to compete, insufficient infrastructures, incompatible guiding principles in incumbent regimes. An initial stepping-stone to overcoming any of these issues is to articulate expectations and visions of a radical new technology. To successfully articulate expectations and visions, Schot and Geels (2008), point to three factors. High number of heterogeneous stakeholders (or members), the vision must be specific, and learning must take place on various dimensions, e.g. technical design, user preferences, symbolic meanings, policy instruments.

Once a radical innovation has been sufficiently shielded, it can be nurtured. This is defined as 'processes that support the development of path-breaking innovation' (ibid.). The literature on this stage is abundant, and too extensive to cover in this section. This stage, like shielding, is characterized by articulation, with a strong emphasis on an increasing plurality among its members, to provide new perspectives, as well as a stronger level of commitment by said members (Raven and Smith, 2012). At this stage the niche development becomes highly active, growing from a confined (or local) context to a "proto-regime", in which knowledge- and resource-flows start to become institutionalized among the members of the supporting network (ibid.).

Empowering a niche is the final stage in the process. Once empowered, the niche is essentially competitive in the current regime. However, competitiveness does not guarantee success, and the idea of empowering a niche comes in two sub-stages called 'fit and conform' and 'stretch and transform'. The former refers to the state in which a niche can compete in a virtually unchanged selection environment. This stage might refine the radical innovation, causing it to show less promising results (ibid.). However, the ability to sustain itself in the incumbent regime, can in itself be a justification for institutional reform, aimed to helping the innovation realize its potential. This is a precursor for the second sub-stage 'stretch and

transform', whereby the regime and the selection environment is pressured to transform itself to favor the radical innovation. This trend can become particularly powerful, if the niche can "piggyback" on parallel social movements within society. Within the MLP, pressure on existing regimes is most often applied by the landscape level, however, as described, niche developments can potentially gain sufficient momentum to exert their own type of pressure.

The socio-technical landscape level in the MLP addresses the wider context of regime change. The landscape level is composed of highly stable elements that sustain societies. These elements include technical, material elements, as well as 'demographical trends, political ideologies, societal values, and macro-economic elements (Geels, 2011a). The landscape level determines the degree to which a certain niche-innovation need to have developed, in order to apply pressure on a regime. In other words, if pressures from the landscape level are high, niches will be considered, even if they are under-developed. If on the other hand the landscape only exerts weak pressure, niches will need be mature, and likely exist in high numbers to pose a threat to the existing regime.

5.0 Discussion

In this discussion, characteristics of urban cities will be discussed in relation to the MLP. These will be relationships will then be connected to examples of cities within Western Europe, specifically Graz, Freiburg, and a number of cities in Holland. In the MLP, the niche and landscape are the levels that exert pressure and instigate change, and can therefore be considered the independent variables. The regime, on the other hand, is characterized by inertia and lock-ins, meaning that if the objective is to encourage change, one should address the levels that cause this change.

5.1 Niche development – what is controllable, and what is important?

In this section, the analysis will focus on the extent to which the city can be conceptualized as a niche and as a landscape. However, to gauge whether the city can (or should) be conceptualized as either, it is important to reiterate the purpose of transition studies. The field of transition studies aims to understand transitions, the extent to which purposive transitions can be achieved, and how such purposive transitions can be initiated, accelerated and managed. Given that the discipline recognizes the landscape as something nearly impossible to control, and

largely something policy-makers can only respond to, this analysis will be largely centered around the development of niches, and its three stages.

Niches are conceptualized as 'protected spaces', or in other words, environments within which radical innovations are sheltered from forces that would otherwise impede their development potential. Niches in the context of sustainability transition involves streamlining radical innovations to both maturity and mainstream integration. However, as noted by Hoogma et al. (2002: 195) previous prescriptions of niche management have struggled to achieve integration.

The objective of transition scholars is to encapsulate all notable factors that drive socio-technical transitions, and their broad perspective should therefore have some merit in the analysis of urban areas. The definition of niches as a 'protected space' implies a degree of conscious action. In other words, someone must be charged with the responsibility of 'protecting' the radical innovation. This relates to the social construction of *warrants* (Hannigan, 2006: 65). The success social construction of an issue, meaning that action to address the issue is taken, involves identifying the actors who will be responsible or entrusted to act. In an urban context, these potential actors include the municipal government, local businesses, civil society, and utility representatives and developers. The municipal government is often perceived as the actor most responsible for the city as a whole, and has therefore been selected as the primary actor. To evaluate the whether a city can be conceptualized as a niche, it should be able to fit the existing definition of a niche, and be susceptible to the niche-management strategies (shield, nurture, empower) described by Smith and Raven (2012).

In terms of controlling the process of niche development, both shielding and empowering require the involvement of specific actors. For example, research in basic science requires the involvement of universities, governments, and potentially businesses. These institutions are designed support and protect their internal processes, and should therefore be readily capable to shield novel products. The relatively small scale and low cost that 'shielding' requires should not pose a major problem. However, issues arise when questions regarding how specific the shielding ought to be, when selecting the potential number of radical innovations to shield. On the hand, empowering is in many ways the exact opposite of shielding in terms of resources required, and problems regarding what niches to select. Empowering often involves large

investments in infrastructure, and potentially constraining the efficiency of existing regimes during the transition period when old technologies are being actively discouraged in favor of the new. Once a radical innovation has reached the empowering stage, it will likely have outcompeted similar innovations in the nurturing stage, and will therefore be an obvious candidate to be 'empowered'.

The nurturing stage, on the other hand, differs from both of these stages as it heavily relies on an organic and unpredictable process of learning and sense-making. This stage is crucial, as it determines whether or not a radical innovation is adopted by groups of people within society. The nurturing phase essentially determines whether a radical innovation is retained or not.

5.2 Conceptualizing the city as a niche

To conceptualize the city as a 'protected space' means that cities need to embody the entire process of niche-development. In terms of shielding, the city should, in theory, be perfectly capable of providing a sufficiently sheltered environment. In the examples used below, the municipal government is a highly strategic actor. However, as mentioned, problems arise when the breadth of policies need to be determined. This relates to the notion of technology-neutral policies, which are essentially policies that promote low-carbon technologies, without specifying the exact type of technology (Azar & Sandén, 2011). The general logic behind this argument is to not interfere with the natural selection processes of the market, but to instead steer the market in desirable directions. One key characteristic of urban areas, however, is the fact that it is composed of a 'built' environment, and the built environment is characterized by inertia. The existence of this physical and rigid environment will inevitably make certain niches seem more compatible from the outset. This means that municipal government will feel inclined to select policies that are narrow, and thus a product of *active* shielding. However, these narrow policies are characterized by a low number of actors, of which a disproportionate number likely come from the incumbent regime, since the niche was selected based on its compatibility with the existing regime.

This paper will now draw on three separate examples, showing how the aforementioned concepts can be applied, and how they explain their respective transitions processes.

Graz

Graz in Austria is one example in which, in spite of including a high number of actors, the responsibility and momentum rested with a relatively low number of people (Späth & Rohracher, 2010). In the case of this city, the city administration was pressured to solve the city's problem of air pollution. Warranted by these pressures, the city adopted a top-down strategy, which incorporated elite members from the administration and local Technical University. While the city won numerous awards and made notable strides, the city lost its momentum almost entirely after just two key actors left the administration (ibid.).

During this period, however, the city was able to make lasting changes, which effectively limit the possibility that the city might revert to its prior state. These lasting changes consists of speeds limits to discourage motorized traffic, and making certain precincts exclusive for pedestrians and cyclists (ibid.) This can be interpreted as a form of stretching and transforming of the city in an effort to make the city incentivize greener behavior, by making it more conducive to bikers. One thing to note, is that in this case, the city was transformed to accommodate an existing, albeit green type of technology. This can be explained by Geels' (2010) evolutionary ontology, and the learning processes of interpretivism, in that there was absence of variation thus the itself technology did not require any form of nurturing. Therefore was no commitment required from the actors involved in its use. In other words, the actors involved did not have to make sense of this change to their new urban condition, instead they simply had to adapt.

In the case of Graz, it is it difficult to qualify the city itself as a niche. The exogenous pressure caused by air-pollution warranted the municipal government to search for solutions and implement restrictive policies. At no point did the municipal government broaden their search to include radical innovations; it merely encouraged the use of existing, greener alternatives. The city therefore did not engage in a process or either shielding or nurturing. If anything, the city given its narrow search for alternatives exhibited characteristics associated with an incumbent socio-technical regime.

Freiburg

In contrast to Graz, the Eco-friendly image of Freiburg as the 'solar city' was grown from the bottom-up. This city serves as an example of how impactful an actively engaged citizenry can shape the priorities of the city. The city of Freiburg has grown an informal local network on the back of a rejection of nuclear power (Späth & Rohracher, 2010), fostering a general culture of engagement with sustainable alternatives. This 'green' movement can be traced back to the 1970s, and has led to a general acceptance of green technologies and practices. In other words, the very act of rejection forced the city to articulate alternative visions to justify this rejection, a core part of the niche-development process (Schot and Geels, 2008). Much like Graz, the city focused on decreasing the use of motorized vehicles in the inner city, sectioning off parts of the city for pedestrians and bicycles, while offering cheaper bus fares for its citizens. The city has become a leading researcher and producer of solar technology, a highly significant development given that the city does not have a history of industry (Späth & Rohracher, 2010). The active involvement of the city's citizenry is largely a product of an urban feature: proximity of actors. Experts and the highly engaged general often interact, resulting in a well-informed public. These close-knit interactions have accelerated sense-making within the city, resulting in a production and re-production of guiding visions, another critical element of niche-nurturing (Schot and Geels, 2008). The proximity of these actors to the municipal-level of government has also been a crucial factor in the shielding and nurturing process. Given that a large number of the citizens within Freiburg have solar panels on their homes, they have come to self-identify as producers, and as such feel entitled to demand innovative solutions from their local government (Späth & Rohracher, 2010). The city of Freiburg exemplifies the power of a shared vision to oppose an existing regime, by actively trying to set standards that lie significantly above the national average. The city of Freiburg also hosts the ICLEI European Secretariat, demonstrating the city's strong commitment to share its knowledge.

Unlike Graz, Freiburg exhibits characteristics more akin to that of a niche. However, the municipal government was not so much an active agent, as it was a medium for its active citizenry to institutionalize and reinforce their culture and vision. Although Freiburg seems to embody numerous qualities associated with a niche, it is difficult to determine the extent to which city can be qualified as such, and whether its role extends beyond nurturing phase. Given

that socio-technical transitions often take several decades to finalize, a historical example of other socio-technical transitions will prove useful to determine whether Freiburg might be able to complete the final phase of niche-development.

Dutch piped-water system

The transition of the Dutch piped-water system dates back to the late 1877s. It involved a number of cities adopting the system for different reasons, and at different times. The municipal governments were wary to take the first step, due to the lack of knowledge in terms of how such a system could be successfully implemented and maintained.

In the case of adopting a piped-water system, the initial cost poses a bottleneck. At the time, the primary purpose this system served was to replace the need to collect water from wells, and this single function made the cost even more significant. However, urban areas, aside from being a space home to a high concentration of heterogeneous actors, its citizens also have a range of values that they rank differently. These values are both products of people leading their own, unique lives, as well as products of the urban setting itself. In other words, while people may not value the primary purpose of a given technology, they may value a secondary, or tertiary characteristic. Furthermore, the urban setting itself might alter how people rank certain values. In theoretical terms, this essentially translates into what Geels (2010) and others would refer to as a unique selection environment created by the urban setting.

In the case of Holland, certain groups of consumers within society wanted piped-water not simply for the convenience, but for the higher quality, comfort, prestige (Geels, 2011b: 19). Other groups, such as industry and utility providers, most notably fire and cleaning departments saw piped-water as an opportunity to lower their cost of operation (ibid: 20). Across Holland, cities began to adopt piped-water systems as a critical mass of consumers, producers, and utility departments began to demand its implementation. These specialized demands made certain parts of the cities willing to assume the higher initial cost, and nurture the novel technology. Once the infrastructure had been constructed, the added cost of expanding the network of pipes in other areas became more economically feasible for a large portion of the cities' populations.

This tiered growth was observed not just within cities, but also between cities. The reasons for adopting piped water-systems between similar were similarly diverse; where

Amsterdam adopted it due to a shortage of water, Maastricht adopted the system 34 years later to increase the city's prestige, in order to retain its middle-class (ibid: 19). The piped-water system ended up being adopted around Holland for different reasons and at different times, and core to the process was that the choice to adopt depended highly on the composition the cities, rather than a rational choice to replace an existing socio-technical regime with a superior one. Notable in the case of Maastricht and a number of other cities, was that the mainstream selection environment was changed internally as a product of external pressure; other cities were setting a new standard, thereby making the increasing the value of this new water distribution system. This change in the mainstream selection environment can be described as a shift in the landscape, whereby exogenous changes result in endogenous values (Geels, 2011).

In the Dutch case, the driver that ultimately resulted in universal adoption of a piped-water system was the network of cities. This network not only made the process cheaper by accumulating knowledge, but it also constructed a 'best practice' for water and sanitation systems, which gave the system a strategic value to municipal governments. Another way to phrase this, is that an effort of sense-making had now made the technology viable (Schot and Geels, 2008). In the case of Holland, the network played an enormous role in accumulating and distributing this knowledge.

5.3 Conceptualizing the city as a landscape

To conceptualize the city as a landscape means that the city is perceived source of exogenous pressure created by a shift in societal values, political ideologies, macro-economic elements, as well as technical and material elements (Geels, 2011a). On top of having a largely fixed, physical environment, cities often have their own composition of these elements. As mentioned, this physical environment can have significant on the policies a city might choose to adopt, as was the case in Graz, where the physical environment was merely re-purposed to support greener, yet conventional forms of transport. The narrow policies that are enacted as a result of the constraints of the physical environment, will likely have detrimental effects on the nurturing stage. However, at the same time, classifying a city, which adopts broad policies, is difficult. The inference with the term 'protected space' implies conscious, substantial action to protect a radical innovation from the mainstream selection environment. Broad policies, on the

other hand, not only means that each individual innovation will receive less protection, it also means that you are more likely to influence the city as a whole, or rather, the landscape.

In all three cases from the previous section, pressure came from a shift in values. In the case of Graz it came from an apparent need to solve the problem of air-pollution. In Freiburg, pressure came from the rapid growth of a social movement within the city, which pressured the government to act on its behalf. In the historic case of the Dutch piped-water transition, pressure initially came from actors who valued the system more than others, and were thus willing to pay more. In short, each of these cases were a product pressure from the wider urban society, but each for unique reasons.

The source of pressure in Graz can be understood as a physical pressure, triggering a social reaction. This may partly explain the loss of momentum, given that when the problem was resolved, the absence of air pollution no longer existed to sustain this social pressure. A similar explanation can be applied to Freiburg, where the pressure was built upon the rejection of something otherwise positive: energy. In rejecting nuclear power, alternatives had to be found, resulting in a process, which, from the very beginning, was one of sense-making and contestation.

The Dutch case showed that technological transitions come in waves; and in this case two waves occurred in two different dimensions. The first dimension was one of lowering cost and internal diffusion. The wave that occurred here, started with specialized demand that assumed the high initial cost, followed by a subsequent wave of broad demand, based on the comparatively lower cost of simply expanding on an already existing system. The costs were also lowered by a general increase in the stock of knowledge pertaining to this system, and subsequently spread through a trans-local network of cities. The second dimension took the shape of sense-making, new user practices, and increased expectations of city inhabitants. The piped-water system essentially changed the way people used water in the homes, cultivating a culture of cleanliness, sanitation, and comfort and convenience. As this culture became commonplace in cities that had adopted it, cities that were lagging faced increasing pressure from its inhabitants to follow suit.

6.0 Concluding remarks

The findings of this paper reinforce the sentiment that the battle for sustainability will be won – or lost – in cities. Cities around the world offer the level of tremendous variety needed to nurture radical innovations into existence. Even prior to writing this paper, this assumption was held. With the emergence of transition studies over the past decade, and strategies such as niche development, questions of 'what', regarding sustainable livelihoods and socio-economic configurations, are increasing being substituted by questions of 'how'.

As to whether the city can be conceptualized as a niche or a landscape, the latter seems more plausible. Although cities are seen as 'strategic actors', they can hardly be classified as autonomous, both external factors influence cities, and the general on-goings in a city are mostly something that needs to be reacted to and taken into account, rather than the city itself being the actor. As demonstrated by both Freiburg and the cities in Holland, municipal governments were only able (and willing) to act once spurred on by groups of actors within the city. On the other hand, the case of Holland did demonstrate how a network of cities can have a significant impact in terms of both lowering the cost (and risk) by accumulating knowledge from the learning experiences of multiple cities. In Holland this resulted in a warping of the landscape within other cities, in turn making them more susceptible to the implementation of this novel technology.

Conceptualizing the city as a landscape, will likely require modifications to the definition of the 'landscape'. As it stands, the landscape is narrowly defined as an exogenous force, which exerts pressure on socio-technical regimes to change. However, if this definition is extended to include the idea that the landscape itself can be understood, and thus responded to appropriately, the process of niche-development can potentially benefit. As stated in this paper, the nurturing phase of niche-development is the most crucial, but also the most uncontrollable, and a comprehensive understanding of the urban landscape that will be responsible for nurturing a niche, might greatly influence how radical innovations are initially selected for protection. This knowledge can potentially be useful if factored into the type of backcasting processes often utilized by policies concerned with sustainability.

Radical innovations succeed or fail based on whether they are retained by a society, and as seen in the case of Holland and Freiburg, the values held by the citizenry of urban areas, and how they chose to use the innovative technologies were decisive factors in adopting, and

integrating them into the incumbent regime. Furthermore, given that developments in Freiburg are still underway, and that the success of the piped-water system in Holland were largely a result of the inter-local network, future research on the effect of ICLEI in empowering the solar-niche, can be suggested. While it may be difficult to classify the city as a niche, one could perhaps classify the network of cities as one.

Further, as this paper has highlighted the importance of understanding the urban landscape, as a way to potentially predict the success of the nurturing phase of niches within cities, future research into how to identify these landscape characteristics would be of value.

Appendix

Figure 4. Flow Chart for Quality Document Analysis (Altheide & Schneider, 2013, p. 21)

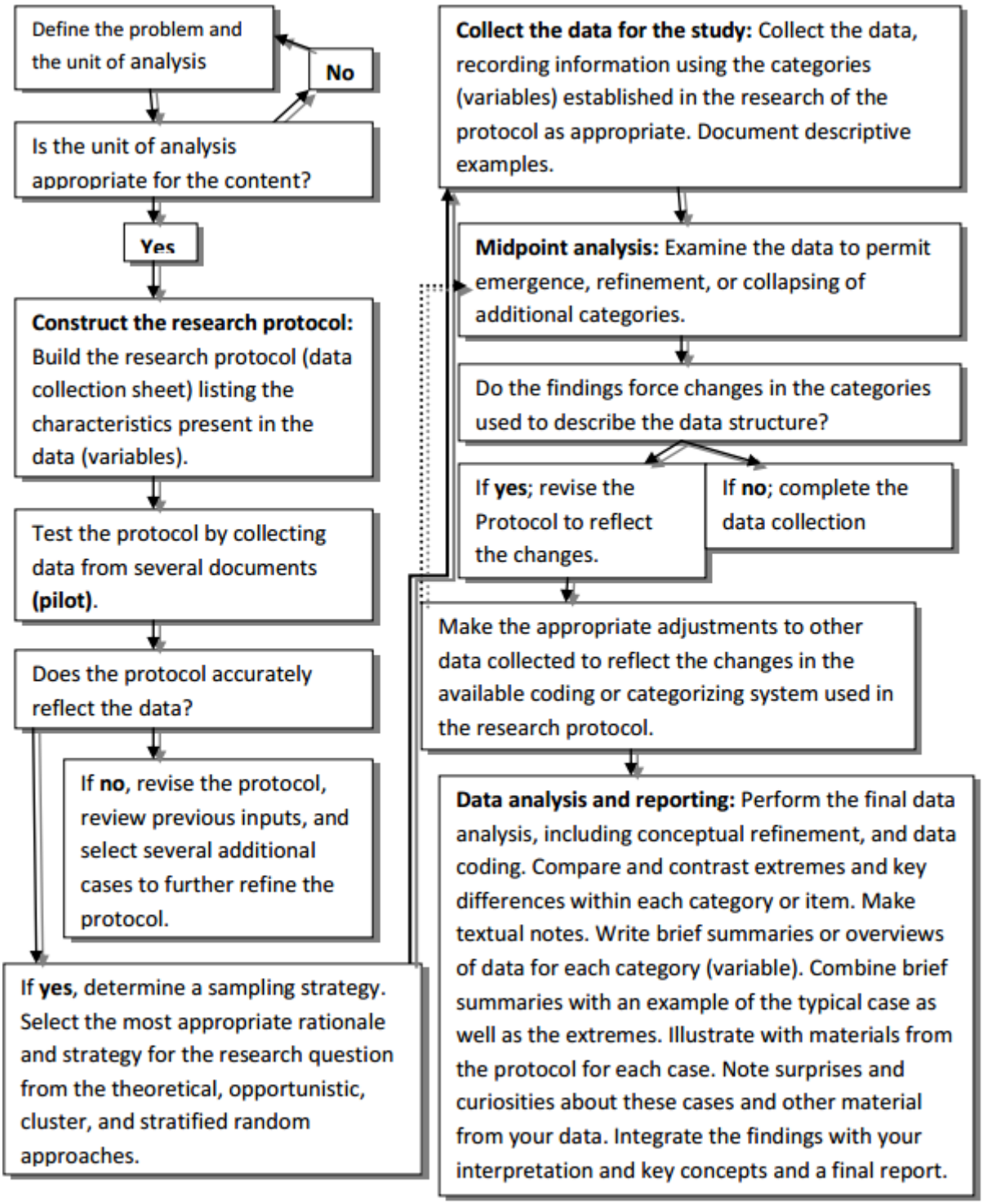

Table 1. Quantitative (QCA) and Ethnographic (ECA) Content Analysis (Altheide, 1987)

	QCA	ECA
Research Goal	Verification	Discovery; Verification
Reflexive Research design	Seldom	Always
Emphasis	Reliability	Validity
Progression from Data Co1lection, Analysis, Interpretation	Serial	Reflexive; Circular
Primary Researcher Involvement	Data Analysis and Interpretation	All Phases
Sample	Random or Stratified	Purposive and Theoretical
Pre-Structured Categories	All	Some
Training Required to Collect Data	Little	Substantial
Type of Data	Numbers	Numbers; Narrative
Data Entry Points	Once	Multiple
Narrative Description and Comments	Seldom	Always
Concepts Emerge During Research	Seldom	Always
Data Analysis	Statistical	Textual; Statistical
Data Presentation	Tables	Tables and Text

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