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“How can SEE niche systems influence sustainable socio-technical transitions?” – the case of the European renovation sector

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Abstract

The construction sector contributes significantly to greenhouse gas emissions, with materials like cement accounting for 8% of global CO₂ emissions. To reduce its environmental impact, experts propose building renovations as a solution to lower emissions and enhance energy efficiency. However, high costs and bureaucratic hurdles often lead consumers to prefer new construction. To contribute to the sustainable transition of the renovation sector, this study proposes a novel approach which combines the Multilevel Perspective (MLP) and Sustainable Entrepreneurial Ecosystem (SEE) frameworks. It then explores how sustainable entrepreneurs in niche systems can drive change to destabilize incumbent regimes. The Transition Model Canvas (TMC) is utilised to guide the analysis of key elements, strategies, and resources in the renovation sector.

By integrating these frameworks, this study provides valuable insights into fostering sustainable transitions within the European renovation sector. By conducting interviews with pertinent actors across seven regions in Europe, the study identifies a diverse range of strategies employed to enhance entrepreneurial niches and disrupt incumbent regimes, thereby shaping and influencing sustainable transitions in the sector.

The findings underscore the significance of SEE's as potential avenues for driving sustainable transitions and highlight the pivotal role of fostering entrepreneurial agency. Policymakers and stakeholders can utilize these insights to support sustainable entrepreneurship and foster environmental improvements in the renovation sector.

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1. Introduction

The construction sector accounts for approximately 36% of the energy-related greenhouse gas emissions in Europe and the materials for construction such as cement account for approximately 8% of global CO₂ emissions (*Pioneering Technology Offers a Cleaner Future for Cement*, 2021); Miller and Moore, 2020). Other aspects of the sector such as design, maintenance, management, use and demolition also have significant negative impacts on the environment (Winston, 2008). To reduce the environmental impact of this sector, specialists propose renovating buildings as a solution to radically reduce global emissions (ACE, 2020; Guirdham, 2022; Zaransky, 2020). Renovation helps lowering the use of raw material, increasing energy efficiency and removing outdated materials created before ecological industry regulations (Interreg Europe, 2020; Jones, 2020; Kivimaa & Martiskainen, 2018; Zaransky, 2020).

Although renovation presents the environmental benefits mentioned above, consumers often opt for the construction of new buildings because of the elevated costs of renovation and the prolonged bureaucratic processes caused by protective regulations (Tobiasz et al., 2019; Zaransky, 2020). As a result, states such as Spain have a percentage of residential stock renovated as low as 0.13% compared to the Netherlands which has 8.6% share (*Share of New Dwellings in Residential Stock*, n.d.). This issue is especially evident in European historic city centres (Bandarin & Van Oers, 2012; Houpert, 2022; Tobiasz et al., 2019; Tomatis et al., 2022). Due to the regulations designed to preserve the historic values of the sites, many do not meet modern requirements of comfort and efficiency and are contributors to global warming ("The Value of Green Buildings," 2022; Jones, 2020; Houpert, 2022). Due to the taxing effect of construction on the environment, the sector is in need of a sustainable transition (Kivimaa & Martiskainen, 2018; Kamari, et al. 2017).

Sustainable transitions are fundamental changes in economic, social, cultural and technological conditions which create environmentally beneficial outcomes (Van Den Bergh et al., 2011). Amongst the various studies on sustainable transition, a useful framework utilised by scholars to understand this complex process is the Multilevel Perspective (MLP) (Geels, 2002). The MLP identifies and explains the complex dynamics of socio-technical transitions by helping draw the patterns and mechanisms that occur between three analytical levels: niche, incumbent and landscape (Geels, 2002). Depending on the dynamics between these levels and their strengths and weaknesses there can be various forms of transition pathways (Geels & Schot, 2007).

An important factor in the orientation and type of transition pathways is the level of development of the niche as it can affect its ability to destabilize the incumbent regime (Geels & Schot, 2007). The

conditions that ensue growth and development of the niche are however, not explained by the MLP framework (de Haan & Rotmans, 2018). This gap in the framework has been explored by scholars which have combined different theories or frameworks with the MLP, to investigate determinants such as niche activity and entrepreneurship and their contribution to sustainable transition processes (Geels, 2021; Huttunen, et al., 2021). For example, Geels, (2021) utilised four organisational and behavioural theories to identify the cognitive changes required for niche innovations to overcome lock-ins. However, within sustainable transition literature, there has been a limited exploration of sustainable transitions from the perspective of entrepreneurial niches. Moreover, the investigation into sustainable transitions within the renovation sector remains considerably inadequate.

In line with previous studies aimed to counteract the gap in the MLP framework and to further understand transitions in the renovations sector, this study proposes a combination of the MLP with the Sustainable Entrepreneurial Ecosystem framework (SEE) (Cohen, 2006; Theodoraki, Messeghem & Rice, 2018; van Rijnsoever, & Hekkert, 2020; Volkmann, Fichter, Klofsten, & Audretsch, 2021). The SEE is a framework that builds on existent entrepreneurial ecosystem (EE) literature and identifies elements such as networks of actors, institutions and policies that drive sustainability-oriented entrepreneurship (Theodoraki, Messeghem & Rice, 2018). The framework helps mapping the key elements that drive sustainable entrepreneurship which is vital for transitions because entrepreneurs can be agents of change (Hekkert et al., 2007; Pinkse & Groot, 2015).

In this study, the SEE framework is conceptualised as a form of niche due to the fact that sustainable entrepreneurs often function in protected spaces and cater to niche markets, which as one of the various outcomes, provide entrepreneurs with the tools to mobilize the necessary resources to develop the niche and destabilize incumbents' regimes (Pinkse & Groot, 2015). By incorporating both frameworks into a novel perspective, this study aims to address the elements within niche systems which contribute to the growth of the niche system and the destabilization of the incumbent. This leads to the following research question:

“How can SEE niche systems influence sustainable socio-technical transitions?” – the case of the European renovation sector

To answer the research question and to help bridge the two theoretical frameworks, this study made use of a guiding tool brought forward by van Rijnsoever & Leendertse (2020) defined as the Transition Model Canvas (TMC). This useful tool is used by practitioners and researchers to determine the actors, strategies and resources relevant to socio-technical transitions. In this research, it is utilized to outline and map the key elements, strategies and resources of the niche and incumbent systems of the renovation sector.

The theoretical section of this study provides the theoretical reasoning behind fitting SEE's as one of many forms of niches and outlines the method in which the TMC is applied as a guiding tool. Lastly, it provides an explanation of how sustainable entrepreneurs can contribute to sustainable transitions and the role of SEE's in aiding this process. To answer the research question and assess the novel framework, a qualitative analysis was performed of data gathered from interviews conducted with relevant actors in the renovation sector. The sample includes actors such as sustainable and traditional architects, contractors, installers of materials and technology, municipal governments and architectural research institutes (Kivimaa, & Martiskainen, 2018).

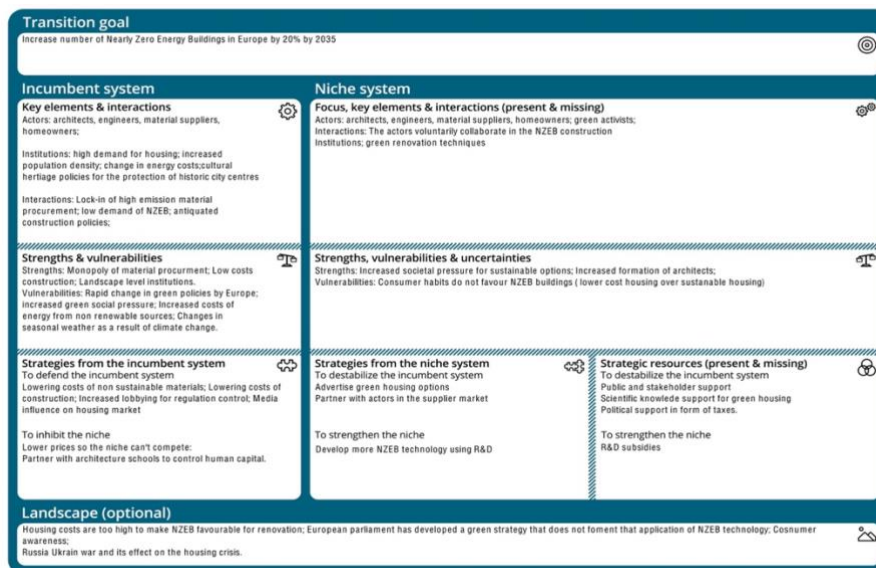
2. Theory

Understanding what occurs during a sustainable transition requires an analysis of the bigger picture with a grasp of the mechanisms that are nested within the processes (Smith, et al., 2010). For the purpose of this research, the most apt theory for understanding transitions in the renovations sector is a combination of the MLP with the SEE framework. In this section I explain how concepts from socio-technical systems and SEE overlap to help form the novel theoretical framework and answer the research question. I first discuss the MLP theory and the socio-technical barriers that are relevant to the renovation sector. I then briefly discuss SEE's, and identify from the literature elements of the theory and how these aid transition processes. The concepts and frameworks identified in this section will be used to interpret the findings of this study.

2.1 Socio-Technical Transitions

MLP provides a theoretical framework to describe the complex reality of technological and sustainability transitions. The framework is divided in three levels nested in a hierarchical order which are defined as: micro (niche), meso (Socio-technical regimes) and macro (landscapes) (Geels & Schot, 2007). The theory proposes that within these levels, there exist incumbent and niche systems and the dynamics between them are influenced by the surrounding landscape. To further understand the dynamics of the two systems, I use the TMC as a guiding instrument to explain the MLP. The TMC is a tool utilized by scholars and practitioners to evaluate and accelerate socio-technical transitions (van Rijnsoever & Leendertse, 2020). A visual representation of the TMC can be found in figure 1 for comprehensibility purposes.

Figure 1: Visual representation of Transition Model Canvas



The structure of the TMC consists of related blocks designed to help map the key elements, interactions, strength, weaknesses and strategies of both socio-technical systems (van Rijnsoever & Leendertse,

2020). It begins by setting the goal of the transition and is followed by the identification of the key elements of the incumbent and niche systems and their interactions. Based on the elements and interactions, the canvas proceeds with the identification of the factors that provide or hinder each systems stability, the strategies used to defend or inhibit one another and the resources needed to sustain the niche. In this section, parts of this tool are utilized as a guiding principle to systematically trace the transition process, and to gain insight into the role that entrepreneurs play in the transition process.

2.1.1. Transition Goal

The first step is the identification of the transition goal. Sustainable transitions vary in scope as they can be related to changes in technological or sectoral shifts (van Rijnsoever & Leendertse, 2020). In the case of this study, the goal of the sustainability transition is to accomplish systemic changes in both the diffusion of innovative technologies and the emergence of novel systemic and architectural innovations (Kivimaa, & Martiskainen, 2018).

2.1.2. Incumbent system

Subsequently, it is essential to map the incumbent system. Incumbent systems are the central level of the MLP framework and refer to a set of stable interacting social, technical, and institutional elements that shape the development and diffusion of a particular technology or system. They describe the ways in which technological systems are embedded in, and influenced by, social, political, and economic structures, norms, and values, as well as the ways in which technological systems in turn shape these same elements (Geels, 2002). The incumbent system is also referred to as socio-technical regime or in simpler terms the status quo (Markard, & Truffer, 2008). In this research, the incumbent system is formed by the agents that maintain the status quo of the sector. More specifically actors that use traditional renovation techniques because the current regime favours their methods and technologies (Kamari et al., 2017).

2.1.3. Strategies from the Incumbent

To maintain the status quo, incumbent actors employ defensive strategies to maintain and strengthen the system as a response to new actors that pose a threat (van Rijnsoever & Leendertse, 2020). These strategies can be aimed at proactively constraining the niche whilst simultaneously fortifying the existent institutional structures (Farla et al., 2012; Wesseling et al., 2014). Examples vary from influencing banks and research institutes to disapprove investments into high-risk projects or swaying political activists through lobbying (Jacobsson, Bergek, 2004; Kamari et al., 2017). In addition to fortifying the system, the strategies employed by the incumbent contribute to the reinforcement of socio-technical barriers which limit changes to radical innovative improvements (Stolper et al., 2022).

Barriers are the hurdles that impede or slowdown the transitional change, as a result of the environment and the incumbent strategies (Geels, 2019; Stolper et al., 2022). They vary across sectors and industries but are an important constituent of transition theory as they can influence the prospects of radical innovations. Following the findings from sociotechnical literature various groups of barriers affecting incumbent and niche dynamics can be gathered. For example, lack of understanding or mistrust, financial constraints, regulatory barriers, behavioural and cultural factors, technical challenges and market barriers (Kieft, Harmsen & Hekkert, 2021; Long, Blok, & Coninx, 2019; Rohracher, 2001). By implementing strategies that reinforce socio-technical barriers, incumbents are able influence the likelihood of success or failure of niche systems (Geels, 2002).

2.1.4. Niche Systems

Niche systems are described as a technology, product, or organization that have found a specialized and often unique market or application, and have developed specific features, processes, or practices that allow it to effectively compete and succeed within that niche (Geels, 2002). A niche system is often a protected space where an innovation or technology can develop (Geels, 2002). As the system gains wider acceptance and usage, it attracts more resources and investments allowing it to further develop and improve its reach and to exert a more significant influence over the development and direction of the field or market (Geels et al., 2016).

2.1.5. Strategies from the Niche Systems

MLP research proposes that niche innovations emerge through the deployment of strategies directed at strengthening and destabilizing the incumbent regime (Geels, 2019; Markard, & Truffer, 2008). Actors within the niche acquire the necessary resources and navigate the socio-technical barriers they are faced with (Geels, 2019). Examples of such strategies are supporting innovation and innovative start-ups, removing entry barriers or creating visions (van Rijnsoever & Leendertse, 2020). Entrepreneurs play an important role in niche strategic management as they employ tactics directed at mobilizing resources, driving new market waves, advocating for change, instilling norms and lowering costs which are contributing strategies to the destabilization of the incumbent regime (Pinkse & Groot, 2015). What leads to successful entrepreneurial activity is a stable and favourable ecosystem which can be explained by the SEE framework (Theodoraki, et al., 2018).

2.3 Entrepreneurship Ecosystem and niche systems

SEEs are the networks of actors, institutions and policies that shape the environment for sustainable entrepreneurship (Tiba, et al., 2020; Theodoraki, et al., 2018). Entrepreneurship is the act of taking initiative to develop, organize, and transform new ideas into products or services which are often innovative or visionary (Pesch, et al., 2017). In the context of this research, sustainable entrepreneurship

in the renovation sector is defined as small architectural firms or individuals that strive to provide innovative sustainable solutions. Sustainable renovators are deemed to be niche entrepreneurs because of the characteristics of their business models, the current rigidity of the existent regime, the low number of actors and because their innovations do not often reach mainstream recognition (Luksha, 2008; Ross, 2002). They interact and collaborate with other actors to identify novel renovation innovations and take championing roles to promote sustainable renovation (Kivimaa, & Martiskainen, 2018). Sustainable architects are thus key drivers of sustainable renovation and play a vital role in the development and growth of the SEE.

The SEE framework used in this study builds on entrepreneurial ecosystem (EE) research which proposes that interconnected actors within a geographic region influence the formation and trajectory of the entrepreneurial activity and output of the region (Cohen, 2006; Tiba, et al., 2020; Theodoraki, et al., 2018). The EE framework has since been utilized to inform policy makers and professionals on how to measure and boost the entrepreneurial potential of regions. SEE scholars utilized the findings and elements of EE literature to understand and measure which components of EEs would be necessary and what role they could play in fostering an SEE to create social, environmental and economic value (Cohen, 2006; Tiba, et al., 2020; Theodoraki, et al., 2018). This framework was thus selected because of its usefulness in identifying factors that influence the share of sustainable entrepreneurship and due to its usefulness in determining the influence of entrepreneurs in the orientation of ecosystems (Tiba, et al., 2020; Theodoraki, et al., 2018).

Due to the visionary nature of entrepreneurs, they customarily aim at serving niche markets and function within the protective spaces provided by the system which helps the growth of the niche (Kansheba & Wald, 2020; Smith et al., 2016). An important portion of the growth of the niche can be attributed to proactive entrepreneurial actors creating coalitions of agents, mobilizing resources and conducting institutional entrepreneurship for the success of the niche (Birley, 1985; Jacobsson, Bergek, 2004; Pesch, et al., 2017; Pinkse & Groot, 2015). In turn the SEE framework in which entrepreneurs' function can provide the actors with resources to navigate socio-technical barriers or incumbent strategies (Brem, & Radziwon, 2017; Cohen, 2006).

SEE literature proposes that the ways in which the framework stimulates sustainable innovation, is shaped by the strength and the presence of the interaction and elements within it (Cohen, 2006; Tiba, et al., 2020; Theodoraki, et al., 2018). Some of which are, institutions, infrastructure, demand, culture, financial support, networks, or knowledge (Stam, 2016). These fundamental elements are in turn influenced by crucial attributes or conditions that dictate how for example, regional abundance of knowledge or the quality of infrastructure can have on the entrepreneurial output (Acs et al., 2017; Stam, 2016). Such conditions, dictate whether an entrepreneur can successfully gather and mobilize the

resources required for developing its innovation (Stam, 2016). A wide variety of condition exist within EE literature and have been further delved into by scholars such as Stam & Spigel, (2016). These crucial attributes which lead to the development of innovation, aid entrepreneurial actors by facilitating agency (Acs et al., 2017; Stam, 2016). The same agency that leads to the growth of the niche (Pesch, et al., 2017; Pinkse & Groot, 2015). The framework in which entrepreneurs operate and the SEE elements that compose it, are thus a form of niche, because they represent a type of protected environment in which radical innovators can grow and generate socio-technical change (Brem, & Radziwon, 2017; Luksha, 2008; Smith et al., 2016; Pesch, et al., 2017).

2.4 Integrating the frameworks

The conceptualisation of EEs as a niche system is not a novel approach, but the study of the relationship between the framework and transition process, specifically towards sustainability-oriented transitions, is an uncharted path (Brem, & Radziwon, 2017). This study does not propose that sustainable entrepreneurial niches are the only explanation for sustainability transition nor that agency is the sole driver. Transitions are not a straight forward process but follow different pathways which are influenced by a multitude of factors beyond incumbent and niche strategies (Geels & Schot, 2007).

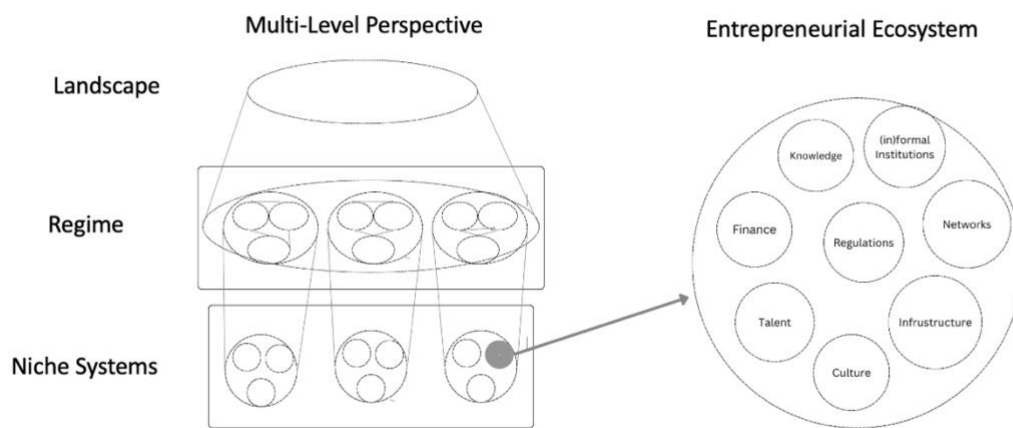
Transitions can require interactions between multiple systems and thus pinpointing this complex process requires a holistic approach. An attempt to simplify this transformation was done through the identification of four types of transition pathways: transformation, reconfiguration, technological substitution, and de-alignment and re- alignment (Geels & Schot, 2007). Between each pathway the role and characteristics of the landscape, incumbent or niche system all play important roles in guiding the transition process and can in their own way affect the transition process. As the focus of this study is the niche, I narrow down the focal point to one of these levels. What Geels & Schot (2007) propose is that the level of development and strength of the niche influences the type of transition that occurs (Geels & Schot, 2007). The more developed the niche is the more effect it can exert on the incumbent (Geels & Schot, 2007; Gibbs & O'Neill, 2014; Pigford et al., 2018).

Because in this study, SEE's have been conceptualized as a form of niche, it is thus possible that the better the quality of an SEE in providing the preconditions for agency and entrepreneurial output, the stronger the destabilizing effect on the incumbent system. This is however not an arbitrary conclusion as niche actors can also create reverse impacts and contribute to the downfall of the niche however this is beyond the scope of this research (Späth et al., 2016).

In previous sections, I argued how SEEs can provide the tools for entrepreneurial agency which contributes to the development of the niche and thus on its the ability to affect the transition process.

The expected addition of this framework to existent literature is a better understanding of which elements of entrepreneurial niches, such as a SEE are important for the shift in the status quo. As depicted in this section, the MLP framework and the SEE provide complementary overlaps which have helped illustrate the framework that will be used in this study (as exemplified in figure 1). The following section of this study, presents the methods for assessing this relationship.

Figure 2: Bridging the MLP and EE framework



3. Research Approach

3.1 Research Design

This research was designed to obtain a thick description of the relevant elements and interactions of the SEE framework and how they influenced socio-technical transitions. This approach aimed to ground a theoretical understanding of the contexts in the language, meanings, and perspectives of the people being questioned (Bryman, 2016). To achieve this goal, a qualitative research analysis was conducted, utilizing interviews with actors in the renovation sector to gain insights into the relationship between the niche ecosystem and socio-technical transitions from the viewpoints of actors within the niche and incumbent systems.

3.2 Sampling and Data Collection

The central entrepreneurial actor in the renovation sector are architects, serving as the starting point of this research. They were selected through the use of the social media platform LinkedIn or through their company websites (*LinkedIn*, n.d.). To enhance the sample size and enrich the research findings, snowball sampling was employed, allowing for the inclusion of additional participants based on relevant hunches and linkages (Biernacki & Waldorf, 1981). Following the same sampling methodology, other

relevant actors, such as contractors, engineers and architectural research institutes, were included in the study (Kivimaa & Martiskainen, 2018). These actors were chosen based on their significance in the creation and growth of SEE's and their availability during the research period (Kivimaa & Martiskainen, 2018).

This study collected data through 28 interviews, with the interviewees distributed across various European capitals and major cities as illustrated in table 1. Each interview was designated a code consisting of the initial letter representing the role, followed by the first three letters of the interviewee's SEE region, which can be observed in Appendix C. The selected cities for the study included Amsterdam, Barcelona, Berlin, Brussels, Milan, Rome, and Paris. These cities were chosen based on their similarity in fundamental characteristics, while exhibiting wide variations in terms of innovation and entrepreneurial outputs (Akande et al., 2019; Audretsch & Belitski, 2021). The use of larger cities as comparative samples is common in studies of this nature, considering the diversity and richness of their innovation ecosystems and their high rankings in renovation rates (Akande et al., 2019; *Share of New Dwellings in Residential Stock*, n.d.). Furthermore, these regions face similar challenges within the renovation sector, making the societal problem comparable across the selected samples (Houper, 2022; Urban Threats, 2021).

Table 1: Division of interviews by role and region

| Role | <i>Amsterdam</i> | <i>Barcelona</i> | <i>Berlin</i> | <i>Brussels</i> | <i>Milan</i> | <i>Paris</i> | <i>Rome</i> | <i>Total</i> |
|---|------------------|------------------|---------------|-----------------|--------------|--------------|-------------|--------------|
| <i>Architect</i> | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 12 |
| <i>Architect and Research Institute</i> | 1 | 2 | 1 | 2 | | 1 | 1 | 8 |
| <i>Project Manager</i> | 2 | | | | 1 | | | 3 |
| <i>Developer & Architect</i> | | | 1 | | | 1 | | 2 |
| <i>Contractor</i> | 1 | | | | 1 | | | 2 |
| <i>Engineer and Certification</i> | | | | | | | 1 | 1 |
| Total | 5 | 3 | 4 | 4 | 4 | 4 | 4 | 28 |

The study was carried out using semi-structured interviews to avoid limiting the interviewees and to allow for variation in their responses, ensuring that their answers reflected their genuine perspectives rather than being influenced by the interview context (Bryman, 2016). The interview guide is developed and based on insights from the SEE and MLP frameworks, and it can be found in Appendix A. The guide served as a tool to direct the interviews and focus the research on the identified concepts (Bryman, 2016). To facilitate the analysis process, the interviews were recorded with the participants' consent, and transcription software on Microsoft Teams software were used to transcribe the recordings.

During the interviews, participants were asked for their insights on the importance of SEE elements and their perceptions of the influence of these elements on the transition process. The interview guide

followed a two-step procedure. The first step involved identifying MLP barriers and assessing their relevance. The second step examined the elements of the SEE and evaluated their role and influence in the transition process.

3.3 Coding

The nature of this study incorporates different theoretical concepts and thus, it used the theory as starting point. A bottom-up approach was employed to obtain the actors, barriers, and strategy concepts. Throughout the coding process, new elements that emerged were incorporated into higher-level SEE concepts, establishing connections to the niche growth and incumbent destabilization strategies of the MLP frameworks.

For coding the barriers, SEE, and MLP concepts, a three-step approach was adopted in this study. Following data collection, two cycles of coding were conducted (Bryman, 2016). In the primary cycle, the information obtained from the interviews was openly coded (first-order coding), with data filtered based on key terms. This stage was followed by the second cycle of coding (second-order), which involved identifying recurring themes, topics, and terms across the interviews. After identifying these key elements, they were grouped into concepts (aggregate dimensions), which were integrated into the MLP and SEE frameworks to develop the novel framework, using the TMC as a conceptual guideline. The qualitative analysis software NVivo was utilized for the coding procedure (Lumivero, 2023).

3.4 Analysis process

The analysis process began by identifying the key elements and interactions that emerged from the data collection process. Across the sample, the agents that contributed to either maintaining the status quo or destabilizing it were gathered. In cases where the actors mentioned by the participants could belong to either category, they were included in both higher level concepts. The same process was then used to identify the incumbents and niche systems strengths and strategies which reinforce and/or negatively influence each other. This last phase of coding refers to the identification of the strategy and it is followed by the accumulation of these strategies into the SEE elements which are related to it.

To compensate for the validity and bias possibility of this type of research method, the study was conducted with semi-structured interviews (Bryman, 2016). This ensured that all respondents received the same treatment but had room to voice their personal opinions, while still minimizing the influence of the interviewer. Moreover, the interviewer summarized their findings to the respondents to seek corroboration regarding their interpretation of the responses (Aguinis & Solarino, 2019). This was a respondent validation technique that ensured the interviewer and coder did not affect the interpretation of the data obtained, but rather assured the intentions of the interviewees (Bryman, 2016).

For privacy protection, the sample was warned before the research took place that personal information would be kept anonymous. Lastly, for the sake of transparency and replicability, in addition to the findings of the research paper, this study provided an illustration of the coding process, accompanied by example quotes that serve to facilitate the comprehension of the findings which can be found in Appendix B.

4. Findings

This chapter provides the results of the qualitative analysis, which delves into the regional ecosystems while following the structure of the TMC. It provides an overview of the key elements, interactions, strengths, and strategies observed within incumbent systems. Subsequently, the focus shifts to the niche systems, examining them through a similar lens. An overview of the findings is illustrated in table 1. Throughout this chapter, the examination of the perceptions of regional actors regarding the various elements of an ecosystem and their roles in the transition process is presented. It provides insights into the dynamics and complexities of the ecosystems under study by combining the TMC framework, and the regional perspectives of the interviewees.

Table 2: TMC of the renovation sector

| | |
|---|--|
| Transition Goal Increasing the re-use of materials for buildings and implementing bio-based materials to contribute to sustainability in the renovation industry. | |
| Incumbent System | Niche System |
| Key elements and Interactions: Actors: Architects; Clients; Construction Companies; Engineers; Municipalities or local governments Project Managers; Universities; Prefabricated Material Suppliers; Insurance companies | Key elements and Interactions: Actors: Architects; Banks and Investors; Certification companies; Clients; Construction companies; Craftsmen; Engineers; Universities; Project Managers; Municipalities or local governments; |
| Strengths: Risk averse consumers; Awareness; High costs; Heritage laws; Protocols and regulations; Miscarried policies; Conservative ideology; Scepticism; Builders knowledge on sustainable practices; Disappearance of craftsmen; | Strengths: Passionate individuals Vulnerabilities: Lack of talent; Unprepared young architects |
| Strategies from the Incumbent system | Strategies from the niche system. |

| | | | |
|--|--|--|---|
| <p>To strengthen the incumbent:</p> <p>Competing for control of the supplier's market;</p> <p>Competing with other actors to limit other practitioners;</p> | <p>To destabilize the niche:</p> <p>Increasing the costs of labour;</p> <p>Artistic rights;</p> <p>Denying insurance;</p> <p>Limiting sign off rights on projects;</p> <p>Limiting access to resources;</p> <p>Pressuring the market;</p> | <p>To destabilize the incumbent</p> <p>Adapting to social trends;</p> <p>Changing customer perception;</p> <p>Citizen involvement;</p> <p>Expanding material repertoire;</p> <p>Lowering the costs of services;</p> <p>Using certifications to increase public demand;</p> <p>Raising public awareness;</p> | <p>To strengthen the Niche:</p> <p>Certification incentives;</p> <p>Creating architect unions;</p> <p>Digitalisation;</p> <p>Incentive schemes;</p> <p>Identifying leading sustainable architects;</p> <p>Multi-stakeholder projects;</p> <p>Pursuing new material ventures;</p> <p>Using social media to attract clientele;</p> <p>Using prizes for projects;</p> <p>Trainings by building council;</p> <p>Sustainable renovation policies;</p> <p>Sustainable architect's forum;</p> <p>Working with specialized architects;</p> |
|--|--|--|---|

4.1 Transition Goal

The transition goal portrayed in this study reflects the overall objectives that niche actors shared during the interviews. Across the seven regions, niche actors employed diverse activities and processes aimed at mitigating the use of environmentally detrimental construction materials, such as cement and PVC. A prevailing objective shared across the regions was the promotion of recycled materials and the adoption of bio-based alternatives as sustainable substitutes for conventional construction materials.

4.2 Incumbent System

The analysis of the incumbent system revealed 9 different incumbent actors. Of these actors, municipalities or local governments played an important role in preserving the incumbent system. Across six of the seven regions studied, this authoritative entity was identified, and its negative impact on the niche system was reported. Specifically, three distinct actors within the municipalities and local governments were observed: the archaeology committee, beauty committee and general policymakers. These entities create and enforce policies that impose limitations on sustainable renovators' activities, as seen in the case of Amsterdam where the Spatial Quality Committee establishes standards for urban development, public space, cultural heritage, prosperity, and preservation of historical buildings' aesthetic appeal which strictly prohibits any alterations to buildings that fall under the purview of its regulation (*Commissie Ruimtelijke Kwaliteit - Home*, n.d.) (AMS1).

The implications of these regulations on the renovation sector are significant due to the fact that while sustainable architects strive to find creative solutions that incorporate sustainability in their projects, they often encounter limitations in terms of parameters on modification, strict approval processes, and lengthy procedures (AMS1, CAMS1, AMIL2, ABAR1, AROM4, ARBRL2, APAR1). This discourages niche architects' ability to operate effectively. The regulatory framework imposed by the municipalities or local governments therefore acts as a passive barrier to progress and places constraints on the

transformative potential of the sector. Consequently, other actors such as niche architects are dependent on the limitations imposed by these authoritative bodies, hindering their ability to drive sustainable and innovative renovation practices.

Influence of Incumbent Architects

The incumbent system analysis highlights the role of architects as incumbent actors. For example, incumbent architects were identified as actively safeguarding their work through the use of artistic rights, consequently impeding future renovation efforts and posing challenges in navigating the regulations designed to protect existing structures. Artistic rights grants architects the right to oppose modifications to their work (*The Art Law Review - the Law Reviews*, n.d.). Protecting a building with artistic rights is thus similar to patenting or copyrighting a product which limits the future use of a given innovation. In Amsterdam, the interviewees found that architects used artistic rights as a strategic method to slowdown future renovation of buildings (AAMS1).

Moreover, incumbent architects were observed to disdain collaborations with fellow practitioners, thereby fostering an environment of competition. According to interviewees, this competitive atmosphere extends to engineers, and contractors, who actively seek to constrain each other's operations. Although interviewees did not provide explicit details about the strategies employed, one interviewee encapsulated the situation as a struggle for dominance, or as they describe it, "stepping on each other's toes." (CMIL1). Whilst they expressed the need to collaborate with other actors, the competition between them negatively influenced their ability to conduct a sustainable project that they were involved in.

In the context of Brussels and Berlin, instances emerged indicating a certain reluctance among architects in employing available talent within the region. Additionally, there have been instances where incumbent architects were identified as proponents of non-sustainable practices, perpetuating such approaches among the younger generation of professionals. It is worth noting that on the one hand architects in these regions wielded influence over the recruitment of talent and the dissemination of sustainable knowledge. However, in other regions, universities contributed to the lack of availability of skilled individuals (PMMIL4). In fact, one interviewee, PMMIL4, metaphorically referred to the academic world of architecture and renovation as a "fairy-tale realm," while underscoring the deficiency in practical knowledge among future prospects. Specifically, in Brussels and Milan, interviewees expressed concerns regarding the inadequate preparation of aspiring architects, resulting in challenges when seeking to hire prospective candidates capable of making meaningful contributions to sustainable renovation projects.

Interviewees expressed not only apprehension regarding the accessibility to proficient and practically skilled aspiring individuals but also raised concerns about the competencies of established actors. Specifically, these concerns centered around the capabilities of actors within construction companies such as builders (CAMS1, AMIL1, CMIL1, APAR1, AROM2). According to some interviewees, some of these actors do not possess the proficiency to implement novel innovations and can be resistant towards the ideas or projects put forth by niche architects. This difficulty can impair architects' ability to operate and innovate. This issue is also stressed by the disappearance of craftsmen which according to the interviewees hold expert knowledge on sustainable practices which is important for sustainable innovation in the sector (CAMS1, CMIL3, AROM4, APAR1).

Challenges in Accessing Skilled Individuals and Craftsmen

The disappearance of craftsmen is in the opinions of ABAR1 and APAR1 the result of strategies enacted by prefabricated material suppliers directed at controlling the market. These actors were observed increasing the costs of labour and pressuring the suppliers' market in an attempt to both strengthening their position in the market and limiting the one of the craftsmen. In contrast to craftsmen, these firms have limited flexibility in terms of the materials permissible for renovation purposes and the modifications that can be made to the prefabricated products they offer. APAR1 highlights that this phenomenon, can restrict opportunities for experimentation with diverse materials and techniques further emphasizing that the "savoir faire" possessed by craftsmen, in comparison to larger material suppliers, is better suited for fostering innovation.

Resistant Behaviours Reinforcing the Incumbent System

The analysis of the examined regions revealed the existence of resistant behaviours within the sector that further reinforce the incumbent regime. Several interviewees (AAMS1, AMIL2, ABER1, ABERL4, APAR1) highlighted these behavioural factors that favour the incumbent system, including risk-averse consumer behaviour, scepticism, and conservative ideology. Due to the high costs of sustainable renovation, interviewees found that clients tend to be risk averse and sceptical towards novel ideas and prefer to resort to the construction of new buildings. For example, ABERL4 stressed that after more than 20 years since admitting their innovation in the market, the most significant challenges they face are in terms of gaining client trust in their innovative products and managing the associated costs. The resistance to change behaviours observed within the sector, including risk-averse consumer behaviour and scepticism, pose challenges to niche architects striving to introduce innovative solutions. According to the interviewees, overcoming these barriers requires efforts to change consumer attitudes, foster trust in sustainable renovation practices, and promote the value and benefits of niche innovations.

Insights into the Incumbent System

In conclusion, the analysis of the incumbent system has shed light on various aspects that contribute to its persistence and hinder the advancement of sustainable and innovative practices. The findings highlighted that the incumbent system presents a mixed picture of strengths and strategies enacted by multiple incumbent actors. In light of these findings, the incumbent regimes present themselves as rather stable systems, with the actors within, each contributing to its endurance. The strengths of the incumbent systems mainly lie in its ability to constrain niche architects' ability to innovate. Moreover, some of the incumbent actors observed during the analysis, were found to be passive contributors to the incumbent regime fortifying the strengths that prevent niche growth and development. Passive incumbents constitute an array of agents which sustain the norms and behaviours of the existent regime, which fortifies its structure (McCormick & Kautto, 2013). The regulations imposed to maintain the integrity and historical value of existing structures and the reluctance to collaborate can hinder the ability to implement sustainable practices and innovative solutions. Moreover, the sub-par preparation of aspiring architects and the disappearance of craftsmen further highlight the need for improvements in knowledge dissemination and skills development. The following step of this study was to identify how the actors within the 7 niche ecosystems manage to overcome the strengths and strategies observed by the incumbent regime actors.

4.3 Niche System

The analysis of the niche systems across the 7 regions, determined 10 actor types and 20 activities and processes that are used to destabilize the incumbent system and strengthen the niche.

Influencing Culture and Demand

The results of the analysis propose that as anticipated in the theoretical approach section, niche architects play a vital role in the growth and development of the niche ecosystems. Various activities of this actor were intended to elevate the niche such as cultural, demand, financial and knowledge strategies. For instance, in order to navigate the demand within the market, niche architects were observed analysing social trends and strategically adjusting their activities to accommodate to social changes. This proactive approach entailed the development of appropriate products that aligned with current social media trends, effectively countering the offerings presented by incumbent architects and material suppliers (APAR1, ABAR1, ABER4, AROM2, CMIL1). In order to achieve this, architects were observed engaging in collaborations with project managers, including design managers and developers, within their projects. These collaborations encompassed conducting comprehensive

marketing analyses to establish benchmarks for sustainable material production and utilization (APAR1, ABAR1, ABER4).

Architects not only employed social media and marketing strategies to analyse market dynamics in response to incumbent products and services but also utilized these platforms as tools to actively shape and influence consumer behaviour. One architect, in particular, emphasized the use of social media platforms such as Instagram or Pinterest as means to exert influence on consumer psychology and behaviour (APAR1). According to APAR1, altering customer perceptions and attitudes towards architectural innovation constitutes a fundamental aspect of a niche architect's professional responsibilities. According to the interviewees a second efficient way of engaging customers is through the utilization of green building certifications as an additional avenue to promote sustainable practices and drive demand within the renovation sector.

Green building certifications influence demand by providing a recognition for sustainable buildings, improving building performance, meeting regulatory requirements, addressing tenant demands, and enhancing public perception (BRE Group, 2023; *LEED Certification for Existing Buildings and Spaces / U.S. Green Building Council*, n.d.). The niche strategies mentioned above thus aim to drive the transition towards sustainability by targeting and expanding customer segments which helps increase recognition of the products and services proposed by niche architects.

The strategies implemented by niche architects underline the significance of these actors in the advancement and establishment of niche ecosystems, aligning with the cultural and demand elements of SEEs'. The strategies implemented by architects exemplify their proactive engagement in navigating market demand and cultural trends. As entrepreneurial actors within the ecosystem, niche architects demonstrate their efforts to comprehend and address the prevailing norms, beliefs, and behaviours of actors within the ecosystem. This proactive approach proves essential for the success of sustainable entrepreneurs operating within the SEE, as it enables them to effectively respond to and meet the needs of the niche growth. This in turn reflects the complementary effect that cultural and demand elements of the SEE have on the transition process of the sector.

Financial and Institutional Strategies for Niche Growth

In some of the analysed regions, in order to foster the growth of the niche market, niche actors have also demonstrated the utilization of financial strategies. For example, some banks have introduced new frameworks and criteria for loans which favour the renovation sector (RBAR1, EROM1). The results of the framework changes are that today many mortgages or financial loans from banking institutions are linked to the assessment of the energy performance of buildings or real estate funds. According to

EROM1, banks are actively trying to increase sustainable renovation rates which has incentivised the transition process.

In addition to the aforementioned financial strategy, another notable strategy observed across various regions involves the implementation of regional rehabilitation incentive schemes and providing prizes for projects of a sustainable nature (ABAR1, ABER1, CMIL1, AROM2). These strategies entail the implementation of policies by municipalities or local governments, aiming to provide subsidies to consumers to alleviate the financial burden associated with building renovation. An illustrative case is exemplified by the "Superbonus 110%" incentive, which specifically targets interventions related to building renovation, energy requalification, and seismic risk reduction (Superbonus 110%, 2022) (CMIL1, AROM2). The introduction of such incentive schemes had two significant outcomes.

Firstly, the implementation of these incentive schemes led to a surge in renovation activities (CMIL1, AROM2). By offering financial benefits to property owners, the schemes have incentivized them to undertake renovation projects, thereby stimulating demand for construction materials, equipment, and services. This heightened demand, in turn, has the potential to create a ripple effect within the industry, fostering an environment of exploration and adoption of novel sustainable materials. Craftsmen and architects operating within niche ecosystems can capitalize on this opportunity, strategically pursuing new material ventures and expanding their repertoire of sustainable materials (AMIL1, APAR1).

Collaboration and interaction between architects and craftsmen have also played a role in material innovation within niche ecosystems (, AMIL1, RIMIL1, APAR1, PMAMS1). Niche architects, for instance, have actively sought ways to increase the utilization of reused materials or devised innovative approaches to reduce the costs associated with their implementation. According to insights provided by APAR1, engaging in collaborative ventures with craftsmen has resulted in the development of environmentally friendly materials, surpassing those offered by prefabricated companies. By doing so, these architects aim to stimulate customer demand for their innovative materials and promote their sustainable characteristics.

Thus, the regional rehabilitation incentive schemes, exemplified by the "Superbonus 110%" initiative, have proven to be instrumental in driving the revitalization of the renovation sector. They not only can fuel a surge in renovation activities but can also create opportunities for material innovation and the expansion of sustainable material alternatives. These initiatives highlight the interconnectedness of financial strategies, collaborative efforts, and the pursuit of sustainable materials in fostering growth of the niche.

In addition to the significance of regional rehabilitation incentive schemes, the importance of local governments and municipalities is highlighted by their attempts to promote sustainable renovation. By implementing regulations which target sustainable renovation, funds are directed towards the refurbishment of neighborhoods (ABAR1, RIBAR1, PMMIL1). In Milan, a notable best practice identified is the municipality's call for tenders, which invites various sustainable architects to propose innovative ideas and establish partnerships for rehabilitation projects (PMMIL1). This approach has led to the requalification of neighbourhoods and old buildings, with the integration of green roofs and/or walls serving as prominent examples (Rinverdiamo Milano – "Il Verde Su Tetti E Pareti" - CLEVER Cities Milano, 2020). Such initiatives demonstrate how local governments can foster sustainable development and reinforce the significance of collaborative efforts in transforming urban environments.

The initiatives observed within the niche system underline the interconnectedness of institutional and financial elements of an SEE in fostering growth and sustainability in the niche ecosystem. The implementation of financial frameworks and regional incentive schemes can play a significant role in stimulating renovation activities and driving material innovation. This, in turn, can facilitate collaboration between niche architects and craftsmen, resulting in the development of environmentally friendly materials. These initiatives demonstrate the collective impact of institutional and financial elements of the SEE framework in fostering growth and driving sustainable transitions within the renovation sector. Furthermore, the findings highlight the crucial role active participants such as local governments within the SEE, emphasizing the importance of collective efforts in effecting transformative change and promoting sustainable development.

Networks, Collaborations and Knowledge

Collaborative efforts within ecosystems play a role in fostering knowledge and strengthening the niche. In some of the regions under analysis, niche actors implemented collaborative strategies aimed at enhancing and disseminating knowledge on sustainable renovation, including the establishment of forums and unions for sustainable architects. These forums and unions have proven to be catalysts for two phenomena. Firstly, an example involves the collaboration between a municipality and a panel of sustainable architects, leading to the creation of a forum for sustainable architecture. This forum serves as an advisory body for the municipality, providing valuable insights and expertise on rehabilitation projects (CMIL1). Through this collaborative effort, sustainability-oriented policies and incentive schemes have been shaped to facilitate the requalification of buildings. Secondly, unions have aided the niche system by connecting sustainable architects and facilitating the exchange of knowledge and expertise within the niche. Particularly, young architects have benefited from the opportunity to learn from experienced practitioners through these collaborative platforms (DBRL1). This knowledge

transfer contributes to the professional development of emerging architects and strengthens the collective expertise within the niche.

In order to foster innovativeness within regions, various actors including niche architects, engineers, and construction companies have sought collaborations with universities to drive material and technique innovation in the field of renovation (AAMS1, CAMS, ARBRU3, RIMIL2 RIROM1, APAR2). In addition to internal studies such as materiality analysis, architects have engaged with students and professors from research institutes to explore ground-breaking innovations that could be incorporated into their projects. Furthermore, collaborations have emerged between certification companies and construction firms, driven by the recognition of limited knowledge among actors within construction companies, such as builders, regarding sustainable renovation practices. To address this gap, certification companies have implemented training programs that enhance the availability of knowledge and talent within the region (EROM1). Through these collaborative efforts among research institutes, architects, certification companies, and construction firms, the dissemination of sustainable practices is facilitated, promoting the wider adoption of sustainable approaches within the renovation sector.

Two elements of the SEE theory are observed from these findings. Firstly, the establishment of forums, unions, and collaborative platforms reflects the network element of the entrepreneurial ecosystem, where actors interact, exchange knowledge, and collectively work towards common goals. By creating these platforms, niche actors interact with each other sharing the knowledge and experience with expert talent which in turn enhances their collective expertise and contributes to the development of a supportive network within the niche ecosystem. This network and talent aspect enables collaboration, knowledge sharing, and resource mobilization among stakeholders, fostering an entrepreneurial ecosystem for sustainable renovation.

Secondly, the knowledge element of the entrepreneurial ecosystem is evident from the engagement with research institutes, training programs, and the incorporation of innovative practices. Niche actors, such as architects, municipalities, universities, and certification companies, actively seek collaborations with research institutes to drive material and technique innovation in the field of renovation. These collaborations in turn facilitate the transfer of knowledge, expertise, and technological advancements from academia to practice, fuelling innovation within the entrepreneurial ecosystem. Moreover, the implementation of training programs by certification companies is designed to enhance the knowledge and skills of actors within the ecosystem, addressing the limited understanding of sustainable renovation practices among construction companies within the niche.

Insights into the Niche System

In conclusion, the analysis of the niche ecosystems reveals evolving and dynamic niches that involve various actors working collaboratively or independently to foster growth and development. Overall, the analysis highlights the multifaceted nature of strategies employed by niche actors in driving the transition towards sustainable renovation. By addressing market demands, implementing financial incentives, and promoting collaboration and knowledge sharing, the niche ecosystems experience growth and foster sustainable practices in the renovation sector. Moreover, the analysis also shows the ripple effects that niche strategies have on the overall growth of the niche, as illustrated by the case of the rehabilitation incentive schemes enacted by municipalities and local governments or by the creation of unions and forums for sustainable architects. It is thus evident that according to the interviewees, transforming the sector toward sustainability and innovation requires fostering collaboration among actors, enhancing the skills and competencies of practitioners, and promoting a shift in consumer behaviour and attitudes.

Dynamics of Interaction between Incumbent and Niche Systems

Both incumbent and niche systems in this study are observed reacting to each other's strengths and weakness. Whilst on the one hand, the incumbent systems are dynamically stable and the strategies employed regard attempts to limit niche actors' activities, on the other hand, the niche systems present themselves as a work in progress, with niche actors within, working towards linking various elements in an attempt to stabilise and develop momentum.

The strategies observed in this study reveal the contrasting dynamics between the incumbent and niche systems in the renovation sector. The incumbent systems predominantly rely on policy, cultural, technological, and market strengths to maintain stability and dominance. These factors contribute to the resilience and endurance of the incumbent regime, limiting the disruptive potential of the niche system. Notably, the control exerted by the incumbent over the material market and the renovation procedures serves as a strategy to delay or limit the growth of sustainable materials, thereby hindering the progress of the niche.

In contrast, the niche system is still in its developmental stage and relies on various strategies to destabilize the incumbent regime. Niche actors actively seek to enhance the expertise and capabilities of key actors involved in the renovation process, such as builders within construction companies. The development of this expertise, or "savoir faire," is viewed as essential for the successful implementation of niche activities. Additionally, the niche system is observed to employ strategies aimed at gathering support and recognition for their products or services. These strategies are crucial for gaining traction and overcoming the challenges posed by the incumbent system. The findings therefore highlight the ongoing efforts on behalf of niche actors to establish a foothold and gain momentum within the

renovation sector. As the niche system continues to evolve, it is expected that additional strategies will be developed and refined to further strengthen the niche's position and disrupt the incumbent regime to reach the transition goal.

5. Conclusion

The central aim of this study was to answer the research question “*How can SEE niche systems influence sustainable socio-technical transitions?*”. It thus delved into the possible effects that sustainable entrepreneurial niches could have on socio-technical transition processes across seven regions in Europe.

The findings indicate that the actors, activities, and processes observed in the niche systems in this study support the notion that the renovation sector can be viewed as a constellation of interconnected elements. In this niche ecosystem, niche actors, particularly sustainable architects, assume an entrepreneurial role, employing strategies that align with the SEE framework to fortify the niche and disrupt the status quo. Drawing from the study's insights, it can be deduced that eight elements within the SEE theoretical framework, encompassing institutional, financial, cultural, demand, knowledge, network, and talent-related strategies, play pivotal roles in contributing to the transition process within the niche ecosystem. Therefore, the findings of this research provide support for the idea that SEE niche systems can play a significant role in influencing and contributing to socio-technical transitions towards sustainability.

The institutional, financial, cultural, demand, and knowledge elements of the SEE interact in synergy to promote collaboration, stimulate financial support, shape consumer behaviours, respond to market demands, and foster knowledge exchange and innovation. The SEE thus provides the tools to address agency for sustainability by empowering niche actors to be proactive change agents in shaping socio-technical transitions. Through entrepreneurial strategies, collaboration, knowledge sharing, and market responsiveness, niche actors drive the advancement of sustainable practices, contributing to a promising route towards sustainability in the renovation sector.

6. Discussion

This chapter provides a reflection on the theoretical contributions, policy implications and limitations of the present study. Initially, the focus is on discussing the theoretical and policy implications derived from the findings. Subsequently, a critical examination is presented, highlighting the limitations of the methods employed.

6.1 Theoretical Implications

This study provides a novel perspective to entrepreneurial niches within sustainable transitions literature. Existing literature, as observed in the theoretical section of this study, lacks a comprehensive explanation of the conditions that foster growth and development for entrepreneurial niches, leaving certain aspects unaddressed within the MLP framework (de Haan & Rotmans, 2018). Furthermore, it was highlighted that within existent literature, there is a lack of in-depth exploration into sustainability transitions of the renovation sector and its underlying drivers was present (Kivimaa & Martiskainen, 2018; Kamari, et al., 2017). In contrast, this research endeavours to bridge this gap by examining the transition process through the lens of the SEE framework, thereby shedding light on the pivotal role entrepreneurs can play in initiating and nurturing innovative sustainability-oriented practices within niches which can influence the incumbent regime. Consequently, this study augments the existing body of knowledge by enhancing our understanding of the key elements, processes and activities present in entrepreneurial niches that are instrumental in challenging the prevailing status quo.

Moreover, the theoretical section presented in this study posits that niche growth has been consistently linked in the literature to entrepreneurial activity, which has demonstrated its potential to drive niche growth (Jacobsson & Bergek, 2004; Pesch et al., 2017; Pinkse & Groot, 2015). Building upon this theoretical foundation, the findings of this research corroborate the hypothesis that the SEE framework, within which niche entrepreneurs operate, allows actors to navigate and influence socio-technical transitions and overcome some of the barriers associated with it. Consequently, these findings present a novel contribution to the existing literature, offering a distinct avenue to comprehend socio-technical transitions through the lens of entrepreneurial agency. In conjunction with previous research aimed at comprehending the contributing factors to sustainable transitions, this research presents entrepreneurial agency as one of many potential routes to sustainable transitions (Brem & Radziwon, 2017; Cohen, 2006). To gain a better understanding of the complex interplay between entrepreneurial agency and socio-technical transitions, future research should consider conducting in-depth case studies to understand the specific mechanisms through which niche entrepreneurs influence and shape these transitions in different contexts.

In addition, the integration of two theoretical frameworks has significantly enhanced our comprehension of the intricate dynamics between incumbent and niche systems. This study focused on robust and resilient incumbent systems, shedding light on the factors supporting their continuous presence. As a result, we gained valuable insights into how niche entrepreneurs respond to such stable incumbent systems and the strategies they employ to challenge and disrupt their dominance. The findings of this research align with Geels & Schot's propositions (2007) on the stability of incumbent and niche systems and their impact on the transition process. Notably, a considerable portion of niche

strategies revolved around influencing consumer behaviour and capturing customer segments from the well-established regime. By incorporating the SEE with the MLP framework, we gain a deeper understanding of the entrepreneurial processes and activities that facilitate transitioning from established regimes to niche-innovations. In essence, the integrated framework illuminates potential pathways for successful transitioning and disruptive innovation within the existing systems. Building on these findings, future research should attempt to map the evolution of the transition over time to better understand the long-term implications that SEE's can have on sustainable transitions.

Lastly, the study highlights the valuable contribution of utilizing the TMC as a tool for mapping sustainable transitions and integrating the SEE within the MLP framework. By acknowledging the challenges of comprehending the abstract nature of sustainable transitions, this research underscores the TMC's effectiveness in systematically categorizing and analysing the diverse actors, activities, and processes involved in the transition process. This positive finding encourages future research to further explore and refine the application of the TMC in understanding sustainable transitions, particularly in the context of the renovation sector. By undertaking comparative studies across different regions and cultures within the renovation domain, researchers can gain valuable insights into the contextual factors influencing sustainable transitions and devise tailored policy interventions. Moreover, future investigations can delve deeper into the integration of the SEE into the MLP framework, elucidating its impact on niche-innovations, entrepreneurship, and sustainable practices. Overall, the promising potential of the TMC in mapping sustainable transitions and its alignment with the SEE presents an opportunity for future research to drive transformative change towards sustainable practices within the renovation sector and contribute to a greener and more sustainable future.

6.2 Policy Implications

Promoting the sustainable transition of the renovation sector, based on the findings identified in this study, can be fostered through the implementation of three key policy integrations. Firstly, in line with the niche strategies which were in this study associated with the financial and institutional elements of the SEE identified in the findings, aligning regional rehabilitation projects with financial frameworks and incentive schemes can incentivize sustainable renovations and foster innovation in the material market. By offering financial benefits and subsidies to property owners engaging in sustainable renovation projects, the demand for eco-friendly materials and practices can be stimulated, providing opportunities for architects and craftsmen to explore and develop novel sustainable alternatives. Secondly, the knowledge and network elements related strategies identified in this study indicate that forming and incentivizing collaborations among expert sustainable architects, universities, and certification companies is crucial to disseminating local sustainable renovation knowledge. Collaborative platforms and forums can facilitate knowledge sharing, resource mobilization, and

collective efforts towards sustainable renovation goals, strengthening the expertise and capabilities of key actors in the renovation process. Lastly, based on the strategies associated with the demand and cultural elements of the SEE, promoting sustainable behaviour and choices among consumers through certifications and digital platforms can influence consumer perception positively. Recognition and certification for sustainable buildings, alongside leveraging social media to shape consumer behaviour, can create a demand for sustainable architectural solutions, driving the transition towards a more eco-friendly and innovative renovation industry.

6.3 Limitations

This qualitative study, comprising 28 interviews conducted across 7 regions in Europe, is subject to inherent limitations. Firstly, the sample size, although appropriate for qualitative research, may be considered relatively small for seven regions, thereby raising concerns regarding the generalizability of the findings beyond the specific regions under investigation. Consequently, the transferability of the study's results to other contexts and populations may be restricted. However, determining the optimal sample size to achieve theoretical saturation in qualitative research remains a topic of debate among scholars, lacking a unanimous standard (van Rinsoever, 2017). Given the interpretive nature of qualitative inquiry, the decision on sample size in this study was made at the researcher's discretion. Based on the quality and the quantity of observations, it was deemed that the sample size was sufficient to address the research question effectively.

Moreover, the selection of larger cities as units of analysis can be criticized as it may introduce a degree of selection bias, potentially omitting important perspectives or marginalizing specific socio-cultural, economic, or political contexts within Europe. However, by considering various regions, a more comprehensive and holistic understanding of sustainable transitions and the development of niche systems in the regions can be achieved. This broader approach enables the identification and exploration of diverse practices, initiatives, and strategies across different contexts, fostering a more inclusive and insightful assessment. The comprehensive picture obtained from the analysis of multiple regions provides valuable insights for stakeholders involved in sustainable transitions and the promotion of niche growth. By examining a range of contexts, stakeholders can identify and learn from best practices observed within niche systems. These best practices can then be adapted and applied to various socio-cultural, economic, and political contexts, thereby offering opportunities for stakeholders to enhance their understanding and make informed decisions regarding sustainable transitions.

Lastly, the qualitative nature of the study also entails subjectivity, as the findings are contingent upon the interpretations and biases of both the researchers and the participants. Consequently, alternative interpretations and perspectives may not have been captured adequately by the use of the interview

guide and the coding scheme which were implemented to minimize this risk. It is important to acknowledge these limitations to appropriately interpret the findings and to consider avenues for future research, such as expanding the sample size, diversifying the regions under investigation and employing mixed-method approaches.

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Appendix A

Interview Guide

Introduction

Firstly, thank you for your time, and for this opportunity to conduct an interview with you. I am a master student of Innovation Sciences at Utrecht University and this interview is going to be part of my final thesis research project. I am looking into the renovation sector and the relationship between the elements of sustainable entrepreneurial ecosystem (SEE) and sustainable transitions. A way to map entrepreneurship in a region is by looking at it as an entrepreneurial ecosystem, which consist of multiple interconnected actors that interact together to create value for a given innovation. These actors can be: entrepreneurs, policymakers, institutions, universities, banks, and consumers.

The scope of this interview is to understand which of these elements are relevant to the sector and how they influence sustainable transitions.

Before we begin, I will like to inform you that this interview will remain anonymous and that if at any time you wish to not answer a question you are welcome to refrain from doing so.

Confidentiality

1. Do you agree with this interview being recorded for transcribing purposes?

Introduction

1. In your personal opinion, how central is sustainability in your sector?
 1. What role does entrepreneurship play in transitioning to sustainable renovation?
 2. What role does culture have in the direction of the sector towards sustainability?
2. Could you give a short description of what you do?

Barriers

1. In your opinion, what are the barriers that influence the sustainable transition in this sector?
 - a. Which of these barriers are the hardest to overcome?
 - b. What is the cause of these barriers?
2. In your personal opinion, can entrepreneurship help overcome these barriers?

SEE Framework

1. In your personal opinion, what role do architects play in SEE systems?
 1. How does your role influence the SEE?
2. In your opinion who or what are the key actors in an SEE system?
 1. How do they influence the transition process in your sector?
 2. What does the relationship between these actors look like in relation to sustainable renovation in the sector?
3. In your experience, how does entrepreneurial activity develop in your sector?

1. What are the key determinants of successful entrepreneurial activity?

4. In your opinion, what factors foster innovation in the renovation sector?
 1. What are the key determinants of the success of an innovation in your sector?

5. Can you think of any event or multiple events that took place in your career where you implemented innovation in your sector?
 1. What triggered the emergence of this innovation?
 2. What factors influenced your ability to innovate?

Conclusion

1. Is there anything you would like to add regarding sustainable transitions in the renovation sector?

I want to thank you for taking time out of your day to complete this interview.

Appendix B

Incumbent System

Table 3 First and second-order codes of incumbent system strengths

| Higher order strength | First order strength | Quote example |
|-----------------------|-------------------------|---|
| Culture | Risk averse consumers | <i>"...most of the solutions you come up with are too radical or they are too expensive or it's not what they had in mind." – PMAMS1</i> |
| Demand | Awareness | <i>"There is nobody that knows what means 100 of Co2e or 2 or 1000 if it's big, if It's a lot, If It's not a lot." -ABARI</i> |
| | Client Preferences | <i>"I mean, if the client is not a believer or if the client don't want it, you cannot. You can pray as a as a religious, but I mean nothing will happen." – ABARI</i> |
| Financial | High Costs of materials | <i>"...they still have the...how you say that? the artistic right or something to the to the building so we have a wait with a project or used to have project which was really hard to deal with that." – AAMS1</i> |
| | Costs of maintenance | <i>" The major difficulty is maintenance, that is, what we have found is not so much doing it but maintaining it afterwards because it actually requires a commitment of money ." – PMILI</i> |
| | Labour costs | <i>"For medium and low, medium or local companies, it's more difficult to work with sustainability. Because I mean there are the direct labor cost and if it's they save money in some sense, they will apply but they don't have all the muscle to invest" – ABARI</i> |
| | Uncertainty | <i>"Like when you start a project you can say maybe this project would be 2,000,000 and then you start studying and at one point you discover.... then it goes to 3,000,000 and it goes to like 4,000,000 and the price is doubled"- APAR2</i> |
| Institutions | Heritage | <i>"...for which it is still necessary, even only for the interiors, to pass through an authorization from the architectural archaeological superintendence" -AROM2</i> |
| | Protocols | <i>"...there are agencies that try to innovate in terms of the material. But for them the limits are the law and they can't use their thing except if they have a special permit. But to have a special permit, it's very hard."-ABRU1</i> |
| | Miscarried Policies | <i>"...obviously the regional administration but in short, the administrations in general, see the case of the 110 which was a big incentive. Then let's not talk about how it was made, how it was organized, there would be a lot to say."- AROM2</i> |
| | Conservative ideology | <i>"Here in Germany, it's a big problem...the building sectors are very conservative one and they're really against any kind of innovation." – ABERI</i> |

| | | | |
|------------------|--|--|---|
| | Skepticism | | <i>“Then I was s****d, 110 because he didn't believe it, but now he's in a situation where, materials have become an unmanageable thing, understand? We have gone backwards fifty years.” – CMIL1</i> |
| Knowledge | Builders’ knowledge on sustainable practices | | <i>“And of course, when if you start about reusing old materials, a lot of contractors and come up with a lot of excuses not to do it because they don't know how to work with it or they think it's unsafe or whatever.” – AAMS1</i> |

Table 4: First and second-order codes of incumbent system strategies

| Higher order strategy | First order strategy | Quote example |
|-----------------------|--|--|
| Competition | Competing for control of the supplier market | <i>"...but then you have pressure from the big construction companies. This is for sure, they have their regular usage of material and they don't want new products to be introduced in the market, you know."</i> - APARI |
| | Competing with other actors to limit other practitioners | <i>"...architects, engineers and contractors... in reality they have created three factions where if they can, they hammer each other"</i> – CMILI |
| Financial | Increasing the costs of labour | <i>"...but this also depends on the price lists that they set, if they manage to get paid in the right way, it is also possible to carry on with a discourse of a sustainable nature."</i> – AROM2 |
| | Using resources to access financial frameworks, banking and taxonomy | <i>"...a multinational company, it's more easy to work with to sustainability, because they work with these kind of frameworks and banking and taxonomy and they have more rules. So they are quite more aligned"</i> – RIBARI |
| Institutional | Artistic rights | <i>"...they still have the...how you say that? the artistic right or something to the to the building so we have a wait with a project or used to have project which was really hard to deal with that."</i> – AAMSI |
| | Denying Insurance | <i>"if it's still a bit too experimental because they want to have insurance... if you can't verify that in a contract or written down a statement. Then it's a big big barrier you'll find."</i> – APARI |
| | Limiting sign off rights on projects | <i>"...but in reality, they are slowly making us disappear because we are specialized in a job that...cannot sign off for another one."</i> -CMILI |
| Knowledge | Unprepared architects | <i>"So, we have big, big professors like they don't care because they say I'm a starchitect. I don't know. I don't need some standard to be sustainable."</i> -RIBRLI |
| | Disappearance of craftsmen | <i>"...the last thing we don't, we didn't talk about is the what we call savoir fair in French. It's the knowledge of the, the, the Craftsman."</i> – APARI |
| Materials | Choking the market | <i>"And it's actually disappearing lot Uh. I mean, personally, I gave lecture about prefabrication, for example, which is getting bigger and bigger and bigger. And now we see elements of construction as a project."</i> – APARI |
| | Limiting access to resources | <i>"...completely built out of wood and he really was trying to make it sustainable, but in the end it was also a lot about building regulations that he had to do cover a lot with gypsum board and not sustainable stuff."</i> – ABERI |
| | Pressuring the market | <i>"...but then you have pressure from the big construction companies. This is for sure, they have their regular usage of material and they don't want new products to be introduced in the market, you know."</i> – APARI |

Niche System

Table 5: First and second-order codes of niche system strategies

| Higher order strategies | First order strategies | Quote example |
|-------------------------|---|--|
| Culture | Changing Customer Perception | <i>"I would say the psychology we say sometimes as an architect, you have to do a bit of pedagogy before starting the project." - APARI</i> |
| | Citizen Involvement | <i>"Therefore, the ability to involve citizens in the implementation of certain green installations helps to understand the sense of community, even within one's own home." - PMMILI</i> |
| | Raising Public Awareness | <i>"I think the we need to culture about data in sense of sustainability."- ABARI</i> |
| Demand | Adapt to Social Trends | <i>"...okay, so from a need that arose from a trend that started with changing the windows..." - CMILI</i> |
| | Adapting to Necessity | <i>"...we mainly look for (new) materials when we are in a situation where we need to solve problems..." – CMILI</i> |
| | Expanding material repertoire | <i>"...what is actually really interesting is that alternate like biobased materialization is getting more interesting..." - AAMS1</i> |
| | Making use of social media | <i>They are. They are looking into the magazines, onto the Instagram and Pinterest, et cetera...so you, you experiment stuff and it's, I mean it's a lot of psychology as well." – APARI</i> |
| | Using certifications to increase public demand; | <i>"...there are many certifications that make your building more commercial or maybe more popular..." - RIBARI</i> |
| Financial | Certification Schemes | <i>"If you choose one of these (certified) materials, it can give you or it score you points to get a lead to income." - RIBARI</i> |
| | Incentive Scheme | <i>"Thanks to the "110" [referring to a specific initiative or program], interventions were carried out on some buildings that otherwise would not have been done. In other words, there would have been no intervention at all. We would have had a public housing sector, especially in a dilapidated state, with a paradoxical situation."– CMILI</i> |
| | Lowering the costs of services | <i>"With this they try to make circular buildings and they are working aligned to LEVELS and they use LEVELS as a framework and it's also free [referring to the service]" – ABARI</i> |
| | Public Grants | <i>"...but for that we need the clients., we need grants and we need uh investment."- RIBERI</i> |
| Infrastructure | Digitalisation | <i>"A better project management and the adoption of digitalization tools for design processes, such as Building Information Modeling (BIM)..." - EROMI</i> |
| | Using certified companies | <i>"Maybe 6-7 years ago something...So it was made as a prototype, and now some companies are certified to use this product" -APARI</i> |

| | | |
|---------------------|---------------------------------------|---|
| | Working with local material suppliers | <i>"So we ordered the aluminum frames, but I guess now you consider a bit more like French made products or like local made products, even if it's a bit more expensive, I think what we didn't think about two years ago..." -APARI</i> |
| Institutions | National government policies | <i>"...another point...since I'm in Brussels, like in Belgium in general there's laws that promote the fact that usually you don't build new buildings, you just have to renovate stuff" - ARBRU3</i> |
| | Using Sectoral Forum | <i>"...with that, they're good developments in Holland with the climate tables where the sectors are divided in. In the whole society ...each sector has an own table. But the discussions afterwards are how to get the objectives and what are the objectives." - CAMSI</i> |
| Knowledge | Architectural firm led research | <i>"...or instead, for example, we have conducted research on materiality. We have done it, for example [in reference to internal research studies.]" - APAR2</i> |
| | Experimental projects | <i>"Especially there's a region called the 22[incomprehensible]... that many buildings are being done with for example hybrid buildings" - RIBARI</i> |
| | Innovating with Universities | <i>"Uh, start with young people. New creative ideas. We have a lot of knowledge and energy and combined with students with new ideas make it happen and uh people are watching us closely to see what the innovation is, to see if there's some business opportunities about it." - CAMSI</i> |
| | Training by certification companies | <i>"Certainly, today we have a goal of environmental sustainability. For those who are there, I am convinced that improving performance in both professional and personal careers." -EROMI</i> |
| Networking | Collaboration between entrepreneurs | <i>"Networking like allows entrepreneurs, to share their like knowledge and resources experiences. Which, like fosters the emergence of innovative like ideas and sustainable solutions like working together, is a big thing..."-RIPARI</i> |
| | Government architect relationships | <i>"I'm very close to two ministries that are involved with the change and openly where we have a resonance group for the sector building the building environment..."-CAMSI</i> |
| | Multi-stakholder projects | <i>"Yes, I have got partners and I've got some brands in which I work with uh, like uh wooden brands, flooring brands, construction partners and we are more aligned when we work."-ABARI</i> |
| | Networking to increase prestige | <i>"You always need to know people who know you or who know what you're doing"-DBRLI</i> |
| Talent | Creating architect Union | <i>"You can write all your searching for union architect and then they put it into a secretariat." -ABERLI</i> |
| | Working with specialised architects | <i>"So, architects, yes, architects, yes, we have looked for people who had already carried out such activities, designers who had perhaps had experiences abroad or had engaged in similar activities."-PMILI</i> |

Appendix C

Table 6: Overview of interviewees and assigned codes

| Region | Interviewee Code | Role |
|-----------|------------------|----------------------------------|
| Amsterdam | AAMS1 | Architect |
| | RIAMS1 | Research Institute |
| | CAMS1 | Contractor |
| | PMAMS1 | Project Manager |
| | PMAMS2 | Project Manager |
| Barcelona | ABAR1 | Architect |
| | RIBAR1 | Research Institute |
| | ABAR2 | Architect |
| Berlin | ABRL1 | Architect |
| | RIBRL1 | Architect and Research Institute |
| | DBRL1 | Developer |
| | PMBRL1 | Project Manager |
| Brussels | ABRU1 | Architect |
| | ABRU2 | Architect |
| | ARBRU3 | Architect and Research Institute |
| | ARBRU4 | Architect and Research Institute |
| Milan | AMIL1 | Architect |
| | RIMIL1 | Research Institute |
| | CMIL1 | Contractor |
| | PMIL1 | Project Manager |
| Rome | AROM1 | Architect |
| | RIROM1 | Research Institute |
| | EROM1 | Engineer and Certification |
| | AROM2 | Architect |
| Paris | APAR1 | Architect |
| | APAR2 | Architect |
| | RIPAR1 | Research Institute |
| | APAR3 | Architect |